Int.J.Curr.Microbiol.App.Sci (2018) *7*(11): 1408-1420

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 11 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.711.163

EMS Induced Variability for Physico-Quality Traits in Groundnut (*Arachis hypogaea* L.)

K. Gangadhara[1*], M.C. Dagla[2], A.L. Rathnakumar[1], T. Radhakrishnan[1] and H.K. Gor[1]

[1]ICAR-Directorate of Groundnut Research, Junagadh, Gujarat-362 001, India
[2]ICAR-Indian Institute of Maize Research, Ludhiana-141004, Punjab, India

**Corresponding author*

Keywords

Induced variability, Physico-Quality, Groundnut

Article Info

Accepted:
12 October 2018
Available Online:
10 November 2018

A B S T R A C T

An investigation was carried out to study the effects of various doses (0.2 to 0.6%) of EMS on physico-quality traits of groundnut (*Arachis hypogea* L) in M_4 families of the groundnut variety TPG 41. Among the different concentrations of EMS treated TPG 41 population, 0.2 % EMS was found to be effective in inducing variability for pod yield per plant, hundred kernel weight, shelling out turn and kernel length in M_4 families. Phenotypic correlation coefficients between different traits in M_4 showed significant and positive correlation between hundred pod and kernel weight, kernel length and width with pod yield per plant in all treatments. Shelling out turn was significantly and negatively correlated with kernel length. Of the total of 129 families, more than 20 families showed superior physical and yield attributes than TPG 41. The promising mutants identified in M_4 generation with respect to physical and quality traits need further confirmation through large scale evaluation.

Introduction

Groundnut is an important edible oilseed legume crop grown in mainly in arid and semi-arid tropics of the world. In India, it covers an area of 45 lakh hectares with a production of 67.7lakh tons and a productivity level of 1484 kg/ha (FAOSTAT, 2015).

In India, oil is the ultimate economic product of groundnut crop. Increased availability of cheaper oils for both food and confectionery purposes has resulted in the change in consumer preference and hence groundnut oil is relegated to the lower ranks (Govindraj *et al.,* 2016), hence the future of groundnut crop lies in its use as food and confectionery rather than exclusively as oil type.

Edible quality and export worthiness of groundnut is mainly determined by physical factors *viz*., larger seed size, consistency of seed mass and shape, integrity of seed testa, absence of immature seeds, integrity of the seed at the time of processing, and blanching efficiency (Dwivedi and Nigam, 2005). Seed size coupled with the nutritional quality can also determine the worth of groundnut for direct consumption. The nutritional quality is in turn decided by kernel chemical composition (protein, oil content, fatty acids) of kernels.

Quality of oil mainly depends on fatty acid composition and two unsaturated fatty acids, oleic and linoleic acids which together constitute 80% of the groundnut oil. The higher the O/L ratio, higher the oil stability (Holley and Hammons, 1968). However, variation for O/L ratio is very narrow (1 to 2.5) in cultivated types (Bishi *et al.,* 2015; Nawade *et al.,* 2016). The first high-oleate (80%) mutant line, F435 identified by Nordenas early as 1987. In released groundnut varieties of India, oleic acid content ranged from 38 to 60% oleic acid (Nawade *et al.,* 2016). Recently, Gangadhara and Nadaf (2016) developed high oleate (>70%) groundnut lines coupled with foliar disease (rust and LLS) resistance using high oleate mutant GM 4-3 through backcross breeding. Janila *et al.,* (2016) and Bera *et al.,* (2018) introgressed fatty acid desaturase mutant alleles from SunOleic 95R through marker assisted backcross breeding. However, to create additional variability for both physical and oil quality traits of groundnut mutation breeding was resorted using the popular groundnut variety TPG 41.

Materials and Methods

TPG 41 is a large seeded Spanish groundnut variety released for summer cultivation in India (Kale *et al.,* 2004). One thousand five hundred pure, healthy and dry seeds (moisture, 12%) of the groundnut variety TPG 41 was treated with five concentrations of Ethyl Methane Sulphonate (EMS) namely, 0.2%, 0.3%, 0.4%, 0.5% and 0.6% each with 300 seeds per treatment at ICAR-Directorate of Groundnut Research, Junagadh, Gujarat, India during Rabi-Summer-2015. Seeds of the M_1 generation were sown in *Kharif* 2015 in the field. Plants harvested in bulk gave rise to the M_2 population. About 138 individual plants were harvested from different doses of EMS treatments in M_2 generations (78 in 0.2%; 28 in 0.3%; 16 in 0.4 %; 10 in 0.5% and 6 in 0.6%) based on distinct morphological and pod features during *Rabi*-Summer, 2016. These plants were planted as progeny rows during *kharif*-2016. Of these 10 mutants could not germinate, hence 129 single plants could be harvested.

During *kharif*-2017, 129 mutant families were planted as M_4 generation along with parent control (TPG 41) and evaluated for physical and oil quality traits. In M_4 generation, physical traits *viz.,* hundred pod and kernel weight, shelling out turn (%), sound mature kernel (%), kernel length and width and pod yield per plant(g) were measured. The fatty acids profiling of 22 selected mutant lines along with TPG 41 were analysed using gas chromatography system (Thermo fisher, Trace GC 1100) equipped with flame ionization detector (FID). The fatty acid methyl esters were passed through capillary column (TR-wax) and esters of fatty acids were estimated (Misra and Mathur, 1998). The inlet, FID detector were set to 2400 C and oven at 1900 C whereas carrier gas (nitrogen) and fuel gas (hydrogen) were maintained at 30 mL per min. Total run time for each sample was 12 min and the peaks (Fig. 2) were identified by comparison to a FAME standard mix RM-3 (sigma-Aldrich, St. Louis, Mo). The data were averaged on M_4 lines belonging to each treatment and subjected to the statistical analyses. The distribution of different physical and yield related traits were plotted using Past Software (Fig. 3).

Results and Discussion

Variability for physical and productive traits induced by different doses of EMS

There were significant differences among M_4 families (Table 1) with respect to physical (shelling out turn (%), sound mature kernel (%) and kernel length) traits. Lower concentration of EMS (0.2%) could able to produce a range of pod yield per plant varying from 4.5 g to 19.1 g with an average value of 11.3g. At 0.5 % EMS, pod yield plant ranged from 6.4 g to 18.5g with an average value of 12.5g. Hundred pod weight was minimum (55g) in 0.2% EMS derived families and maximum (129g) in 0.3% EMS derived families (Fig. 1). Hundred kernel weight ranged from 33g to 45g with an average value of 39g in 0.5% EMS derived families, whereas in 0.2% EMS derived families, it ranged from 24 g to 46g with an average value of 38g. Shelling out turn was minimum (66%) in 0.5% EMS derived families and maximum (76%) in both 0.2% and 0.3% EMS derived families.

Sound mature kernel (%) ranged from 54% to 87% in 0.2% EMS derived families with mean value of 71%. Kernel width was minimum (7.2mm) in 0.2% derived EMS families and maximum (9.6mm) in 0.5% EMS derived families. Kernel length was minimum (11.7 mm) in 0.2% EMS derived families and maximum (17mm) in 0.3% and 0.5% EMS derived families. Thus it has been observed that, among the different doses of EMS derived TPG 41 families, 0.2% EMS was found to be effective in inducing variability for five important traits *viz.*, pod yield per plant, hundred kernel weight, shelling out turn and kernel length in M_4 generation.

Isolation of superior families for physical traits

As the market price and consumer preference are determined by shape and size of the pod and seed of groundnut, identification of high yielding genotypes coupled with attractive pod and kernel characteristics are very important. Various physical traits *viz.*, sound mature kernel (%), hundred kernel weight, kernels with elongated shape, tapering ends are useful for table purpose (Nigam *et al.*, 1989). Superior mutants isolated for physical and yield related traits are presented in Table 2. Mutants *viz.*, #94(129g), #121(121g), #118(120g) and #105(115g) showed higher hundred pod weight (g) compared to TPG 41 (96g).Two mutants namely #34 and #105 exhibited 46 g of hundred kernel weight compared to TPG 41(38 g). Higher shelling out turn indicated more kernel weight and preferable as shelling out turn is one of the important traits of trade. For sound mature kernel (%), four mutants #34(87%), #45(86%), #62(85%) and #130(83%) were found superior over TPG 41(69%).

Kernel length was longer in mutants *viz.*, #121, #118 and #94 (17mm each) than TPG 41 (13.8mm). Three mutants viz., #27(19 g), #124(18.5 g) and #20(18 g) exhibited higher pod yield per plant than TPG 41 (8 g). Recovery of productive mutants in groundnut for pod yield and related traits using different doses (0.3% to 0.5%) of EMS has been well documented in groundnut (Prasad, 1984; Gowda *et al.*, 1996; Mathur *et al.*, 2000). In groundnut using mutagenesis followed by hybridization and selection high yielding and large seeded varieties (TG1, TG17, TG 22, TG 39, Somnath, TPG 41) have been developed by Bhaba Atomic Research Center (BARC), Mumbai and SAUs (Patil, 1975; Patil 1977; Mouli *et al.*, 1989; Mouli *et al.*, 1990, Kale *et al.*, 2000, 2004).

Fatty acid profiling of selected EMS mutagenized mutants derived from TPG 41

Seed size coupled with the better fatty acid composition (High oleic acid and low linoleic acid content) is preferred for direct consumption as confectionery or table purpose due to enhanced shelf life and health benefits. High oleic acid content in groundnut is governed by two recessive alleles (Moore and Knauft, 1989; Gangadhara and Nadaf, 2016) but role of modifiers and additional epistatic interactions was also reported (Isleib *et al.*, 1996) in Virginia/Spanish types.

Table.1 Trait variation for physical and yield related traits in M_4 generation

Trait	Treatmen	Minimu	Maximu	Mean	SD	SE
Pod yield per plant (g)	TPG 41	8.00	8.57	8.25	0.23	0.10
	0.2 %	4.50	19.15	11.33	2.50	0.29
	0.3 %	3.98	16.90	10.50	2.82	0.56
	0.4 %	5.62	15.12	10.20	2.66	0.71
	0.5 %	6.41	18.52	12.54	3.95	1.32
	0.6 %	5.75	15.21	10.39	3.53	1.44
Hundred pod weight (g)	TPG 41	94.60	97.44	96.50	1.21	0.54
	0.2 %	55.29	108.64	91.32	7.61	0.88
	0.3 %	89.06	129.21	97.59	7.57	1.51
	0.4 %	80.62	114.93	90.79	8.43	2.25
	0.5 %	84.76	120.52	102.5	12.0	4.00
	0.6 %	74.01	103.51	89.48	9.98	4.07
Hundred kernel weight (g)	TPG 41	38.14	40.12	38.82	0.93	0.42
	0.2 %	24.73	46.82	38.07	3.02	0.35
	0.3 %	35.81	45.45	39.35	2.02	0.40
	0.4 %	33.59	46.36	37.62	3.01	0.80
	0.5 %	33.60	45.93	39.72	3.67	1.22
	0.6 %	31.75	42.37	36.13	3.68	1.50
Shelling out turn (%T) Shelling Out turn (%)	TPG 41	71.00	72.84	72.14	0.76	0.34
	0.2 %	68.08	76.24	73.69	1.58	0.18
	0.3 %	67.19	76.64	74.02	1.84	0.37
	0.4 %	71.78	75.83	73.78	0.90	0.24
	0.5 %	66.90	75.22	72.77	2.48	0.83
	0.6 %	71.07	75.37	73.43	1.47	0.60
Sound Mature kernel (%)	TPG 41	68.00	69.70	69.08	0.65	0.29
	0.2 %	54.55	87.92	71.66	6.48	0.75
	0.3 %	64.80	79.78	73.03	4.04	0.81
	0.4 %	64.60	80.32	71.11	4.96	1.33
	0.5 %	62.63	74.37	68.46	4.24	1.41
	0.6 %	65.55	83.89	71.48	6.85	2.80
Kernel width (mm)	TPG 41	8.40	8.60	8.52	0.08	0.04
	0.2 %	7.20	9.10	8.35	0.34	0.04
	0.3 %	7.90	9.20	8.42	0.34	0.07
	0.4 %	7.80	8.80	8.26	0.33	0.09
	0.5 %	8.30	9.60	8.79	0.48	0.16
	0.6 %	8.40	8.60	8.45	0.08	0.03
Kernel length (mm)	TPG 41	13.70	14.30	13.88	0.25	0.11
	0.2 %	11.70	16.50	15.02	0.82	0.09
	0.3 %	14.30	17.10	15.17	0.69	0.14
	0.4 %	14.60	16.10	15.19	0.48	0.13
	0.5 %	14.60	17.10	15.78	0.90	0.30
	0.6 %	14.50	15.90	15.13	0.57	0.23

Table.2 Superior mutants for physical and yield traits in M_4 generation

Mutant	T	Pod yield per plant (g)	Mutant	T	Hundred pod weight (g)	Mutant	T	Hundred kernel weight (g)	Mutant	T	Shelling out turn (%)	Mutant	T	Sound mature kernel (%)	Mutant	T	Kernel length (mm)
27	T1	19.1	94	T2	129	34	T1	46.82	83		76.64	34	T1	87.92	121	T4	17.1
124	T4	18.5	121	T4	121	105	T3	46.36	12	T1	76.24	45	T1	86.41	118	T4	17.1
20	T1	18.0	118	T4	120	118	T4	45.93	11	T1	76.00	62	T1	85.31	94	T2	17.1
98	T2	16.9	105	T3	115	94	T2	45.45	100	T2	75.99	130	T5	83.89	78	T2	16.8
18	T1	16.7	45	T1	109	121	T4	44.72	71	T1	75.97	41	T1	80.95	17	T1	16.5
75	T1	16.6	117	T4	108	53	T1	44.06	105	T3	75.83	71	T1	80.68	29	T1	16.5
57	T1	16.2	83	T2	106	45	T1	43.24	51	T1	75.82	38	T1	80.56	57	T1	16.4
100	T2	16.2	124	T4	104	32	T1	42.82	23	T1	75.68	105	T3	80.32	50	T1	16.4
121	T4	16.0	130	T5	104	83	T2	42.43	98	T2	75.68	76	T1	79.78	116	T4	16.4
117	T4	15.9	40	T1	102	130	T5	42.37	6	T1	75.57	92	T2	79.78	14	T1	16.2
130	T5	15.2	18	T1	102	50	T1	41.61	127	T5	75.37	68	T1	79.67	3	T1	16.2
107	T3	15.1	116	T4	102	13	T1	41.29	80	T2	75.34	83	T2	79.17	77	T2	16.2
54	T1	15.0	29	T1	101	12	T1	41.26	18	T1	75.32	57	T1	79.10	27	T1	16.2
21	T1	14.5	49	T1	101	98	T2	41.22	82	T2	75.22	91	T2	78.77	102	T3	16.1
66	T1	14.5	81	T2	100	18	T1	41.12	123	T4	75.22	70	T1	78.21	35	T1	16.1
77	T2	14.3	87	T2	100	55	T1	41.11	13	T1	75.21	64	T1	78.09	76	T1	16.1
64	T1	14.1	82	T2	100	92	T2	40.98	2	T1	75.20	53	T1	77.98	113	T3	16.1
108	T3	14.0	98	T2	100	75	T1	40.92	88	T2	75.14	52	T1	77.97	130	T5	15.9
25	T1	13.6	12	T1	100	62	T1	40.89	57	T1	75.14	85	T2	77.90	45	T1	15.9
51	T1	13.6	39	T1	100	84	T2	40.88	34	T1	75.11	75	T1	77.51	79	T2	15.9
10	T1	13.5	16	T1	99	97	T2	40.87	10	T1	75.09	94	T2	77.49	64	T1	15.8
118	T4	13.5	51	T1	99	27	T1	40.85	31	T1	75.09	96	T2	77.17	8	T1	15.8
TPG 41		**8.25**			**96**			**38.8**			**72**			**69**			**13.8**

EMS 0.2 % (T_1) EMS 0.3 % (T_2) EMS 0.4 % (T_3)
EMS 0.5 % (T_4) EMS 0.6 % (T_5) Control (TPG 41)

Table.3 Fatty acid composition of selected mutants in M_4 generation of groundnut

Mutant	EMS Treatment	% (C16:0)	% (C16:1)	% (C18:0)	% (C18:1)	% (C18:2)	% (C18:3)	% (C20:0)	% (C20:1)	% (C22:0)	% (C22:1)	% (C24:0)
17	**0.2 %**	11.034	0.054	2.311	56.30	23.97	0.066	1.207	1.289	2.54	0.069	1.16
21	**0.2 %**	11.284	0.042	2.258	56.39	23.72	0.07	1.206	1.289	2.53	0.084	1.13
35	**0.2 %**	10.255	0.045	2.594	58.54	21.43	0.072	1.259	1.42	2.77	0.097	1.52
36	**0.2 %**	10.337	0.037	**3.123**	60.35	19.85	0.056	1.297	1.229	2.42	0.072	1.23
39	**0.2 %**	11.065	0.041	**3.112**	**61.26**	**18.62**	0.056	1.203	1.18	2.33	0.074	1.06
46	**0.2 %**	10.81	0.049	2.763	58.27	21.72	0.051	1.205	1.259	2.61	0.074	1.19
53	**0.2 %**	10.022	0.069	2.72	**61.54**	19.11	0.056	1.327	1.361	2.55	0.076	1.17
57	**0.2 %**	10.745	0.069	2.986	58.64	20.87	0.07	1.344	1.196	2.68	0.078	1.32
64	**0.2 %**	10.356	0.049	2.649	59.75	20.62	0.045	1.256	1.278	2.63	0.084	1.28
67	**0.2 %**	11.123	0.05	2.66	56.85	22.97	0.073	1.215	1.234	2.58	0.072	1.17
72	**0.2 %**	10.42	0.029	2.369	58.33	21.60	0.073	1.227	1.512	3.00	0.095	1.35
77	**0.3 %**	10.67	0.044	2.182	58.99	21.35	0.063	1.241	1.383	2.67	0.092	1.32
78	**0.3 %**	11.374	0.037	2.228	55.09	24.61	0.064	1.221	1.301	2.70	0.077	1.31
93	**0.3 %**	11.683	0.041	2.384	55.30	23.64	0.076	1.213	1.364	2.80	0.096	1.40
106	**0.4 %**	10.447	0.054	2.67	58.53	21.54	0.068	1.305	1.348	2.63	0.083	1.32
108	**0.4 %**	10.685	0.037	2.855	59.04	21.01	0.059	1.228	1.313	2.61	0.083	1.09
117	**0.5 %**	10.586	0.044	2.767	54.42	24.59	0.065	1.432	1.286	3.12	0.077	1.62
122	**0.5 %**	10.297	0.045	2.773	60.96	18.98	0.054	1.271	1.424	2.75	0.094	1.36
124	**0.5 %**	10.088	0.058	2.429	60.11	20.67	0.054	1.298	1.347	2.60	0.083	1.26
128	**0.6 %**	10.852	0.055	2.671	57.71	22.27	0.072	1.262	1.296	2.52	0.068	1.23
130	**0.6 %**	11.037	0.025	2.296	57.96	22.80	0.045	1.208	1.178	2.35	0.059	1.04
1	**TPG 41 (C)**	11.147	0.06	3.298	54.30	25.19	0.0553	1.433	0.9987	2.4257	0.053	1.04

C16:0-Palmitic Acid	**C16:1-Palmitoleic Acid**	**C18:0-Stearic Acid**	**C18:1-Oleic Acid**	**C18:2-Linoleic Acid**	**C18:3-Linolenic Acid**
C20:0-Arachidic Acid	**C20:1-Gadoleic Acid**	**C22:0-Behenic Acid**	**C22:1-Erucic Acid**	**C24:0-Lignoceric Acid**	

Table.4 Estimated oil quality parameters of selected mutants in M_4 generation of groundnut

Mutant	EMS Treatment	LCSFA	SFA	MUFA	PUFA	USFA	PUFA/SFA ratio	USFA/SFA ratio	(C18:1)/(C18:2) ratio
17	**0.2 %**	4.91	18.25	57.71	24.04	81.75	1.317	4.479	2.349
21	**0.2 %**	4.86	18.40	57.81	23.79	81.60	1.293	4.434	2.378
35	**0.2 %**	5.55	18.40	60.10	21.50	81.60	1.169	4.436	2.731
36	**0.2 %**	4.95	18.41	61.69	19.90	81.59	1.081	4.433	**3.041**
39	**0.2 %**	4.59	18.77	**62.55**	**18.68**	81.23	**0.995**	4.328	**3.290**
46	**0.2 %**	5.00	18.58	59.66	21.77	81.42	1.172	4.383	2.683
53	**0.2 %**	5.05	**17.80**	**63.05**	**19.16**	82.21	1.077	4.620	**3.221**
57	**0.2 %**	5.35	19.08	59.98	20.94	80.92	1.098	4.242	2.809
64	**0.2 %**	5.17	18.17	61.16	20.67	81.83	1.137	4.503	2.898
67	**0.2 %**	4.97	18.75	58.21	23.04	81.25	1.229	4.334	2.475
72	**0.2 %**	5.58	18.37	59.97	21.67	81.64	1.180	4.445	2.701
77	**0.3 %**	5.22	18.08	60.51	21.41	81.92	1.184	4.532	2.763
78	**0.3 %**	5.23	18.83	56.50	24.67	81.17	1.310	4.311	2.239
93	**0.3 %**	5.41	19.48	56.80	23.72	80.52	1.218	4.134	2.339
106	**0.4 %**	5.26	18.37	60.02	21.61	81.63	1.176	4.443	2.717
108	**0.4 %**	4.92	18.46	60.47	21.07	81.54	1.141	4.416	2.811
117	**0.5 %**	6.17	19.52	55.83	24.65	80.48	1.263	4.122	2.213
122	**0.5 %**	5.38	18.45	**62.52**	**19.04**	81.56	1.032	4.422	**3.211**
124	**0.5 %**	5.16	**17.68**	61.60	20.72	82.32	1.172	4.657	2.909
128	**0.6 %**	5.01	18.53	59.13	22.34	81.47	1.205	4.396	2.592
130	**0.6 %**	4.60	**17.93**	59.22	22.85	82.07	1.274	4.577	2.542
1	**TPG 41 (C)**	4.90	19.35	55.41	25.24	80.65	1.305	4.168	2.156

LCSFA-Long chain saturated fatty acids	**SFA- Saturated fatty acids**	**MUFA-Monounsaturated fatty acids**
PUFA- Polyunsaturated fatty acids	USFA- Unsaturated fatty acids	

Table.5 Phenotypic correlation coefficients for physical and yield traits

	Pod yield per plant (g)	Hundred pod weight (g)	Hundred Kernel weight (g)	Shelling Out turn (%)	Sound Mature kernel (%)	Kernel width (mm)	Kernel length (mm)
Pod yield per plant (g)	**1**						
Hundred pod weight (g)	.391** (T1)	1					
	.672* (T4)						
Hundred Kernel weight (g)		.813** (T1)					
	.949* (C)	.859** (T2)	1				
	.329** (T1)	.804** (T4)					
		.944** (T5)					
Shelling Out turn (%)		.311** (T1)	.365** (T1)	1			
	-	-.561** (T2)					
Sound Mature kernel (%)		.921* (C)	.537** (T1)				
		.431** (T1)	.575** (T2)				
	-	.400* (T2)	.748** (T3)	.262* (T1)	1		
		.590* (T3)	.974** (T5)				
		.752*(T4)					
		.852* (T5)					
Kernel width (mm)		.933* (C)	.279* (T1)				
	.822* (T5)	.310** (T1)	.442* (T2)		.820* (T5)	1	
		.501* (T2)	.792* (T4)	-			
		.737* (T5)	.813* (T5)				
Kernel length (mm)	.884* (C)	.449** (T1)	.916* (C)	-.952* (C)	.700* (T4)	.351** (T1)	
	.389** (T1)	.467* (T2)	.458** (T1)	-.628** (T2)	.928** (T5)		1
	.765** (T3)	.845* (T5)	.812** (T4)	-.691** (T3)			
			.922** (T5)				

EMS 0.2 % (T_1) EMS 0.3 % (T_2) EMS 0.4 % (T_3)
EMS 0.5 % (T_4) EMS 0.6 % (T_5) Control (TPG 41)

Fig.1 Box plots showing distribution of physical and yield related traits among different EMS treatments in M_4 generations of TPG 41

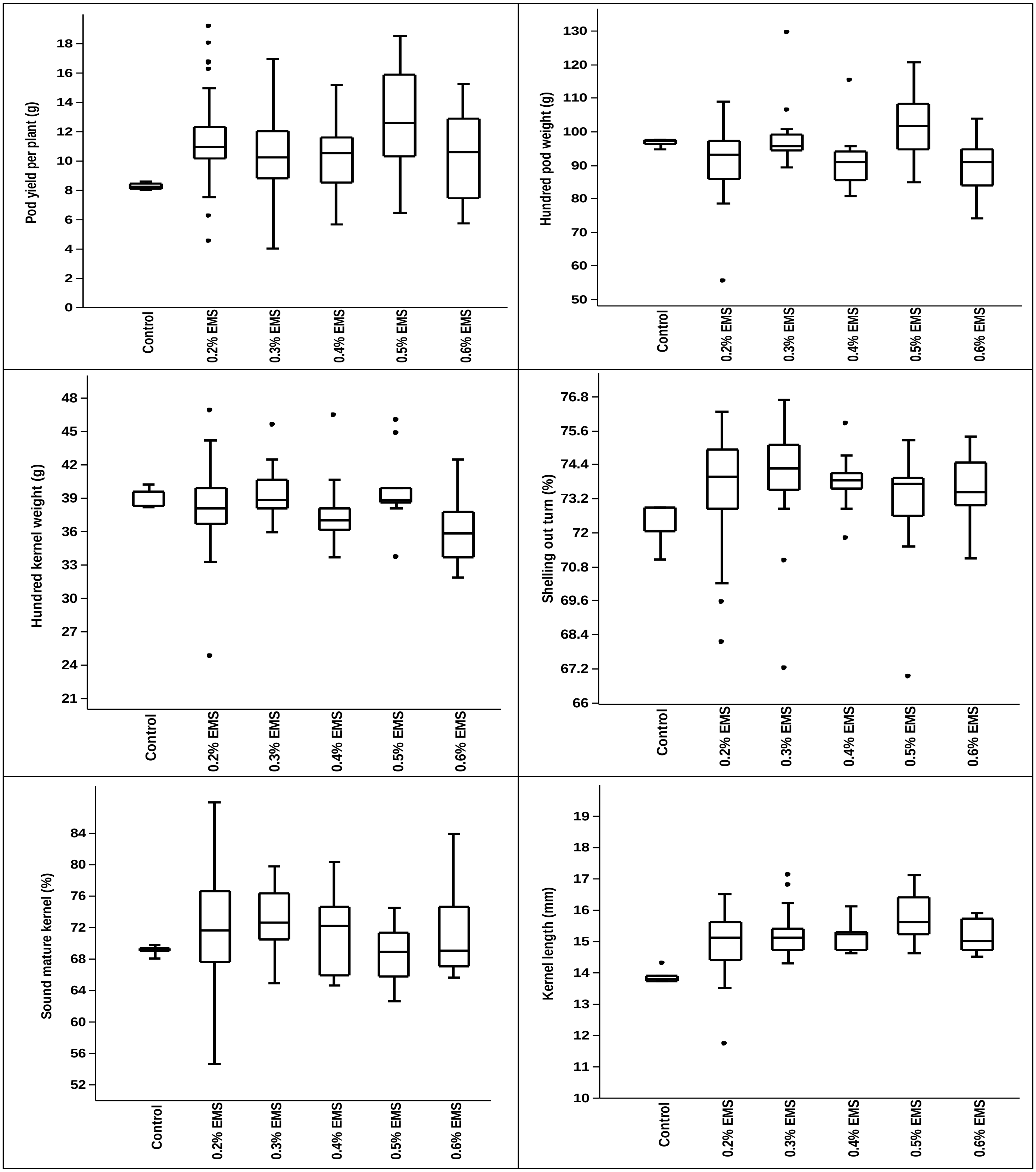


Fig.2 Chromatogram of fatty acid methyl esters separated in gas chromatography of fatty acid profiles of TPG 41 (control)

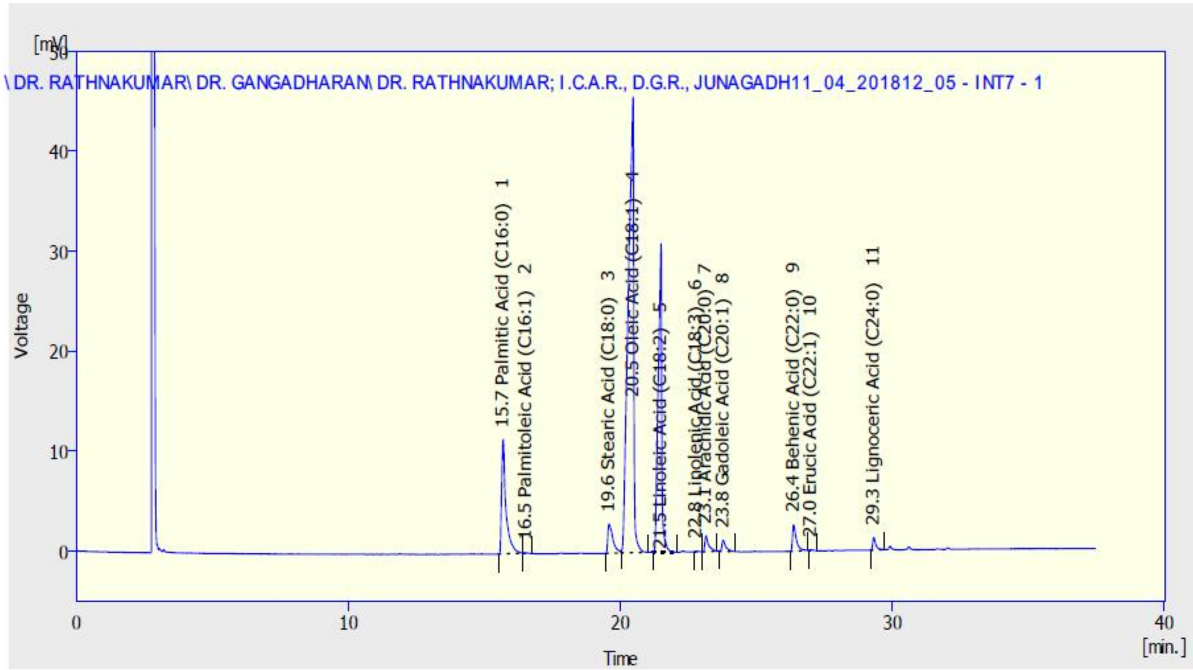
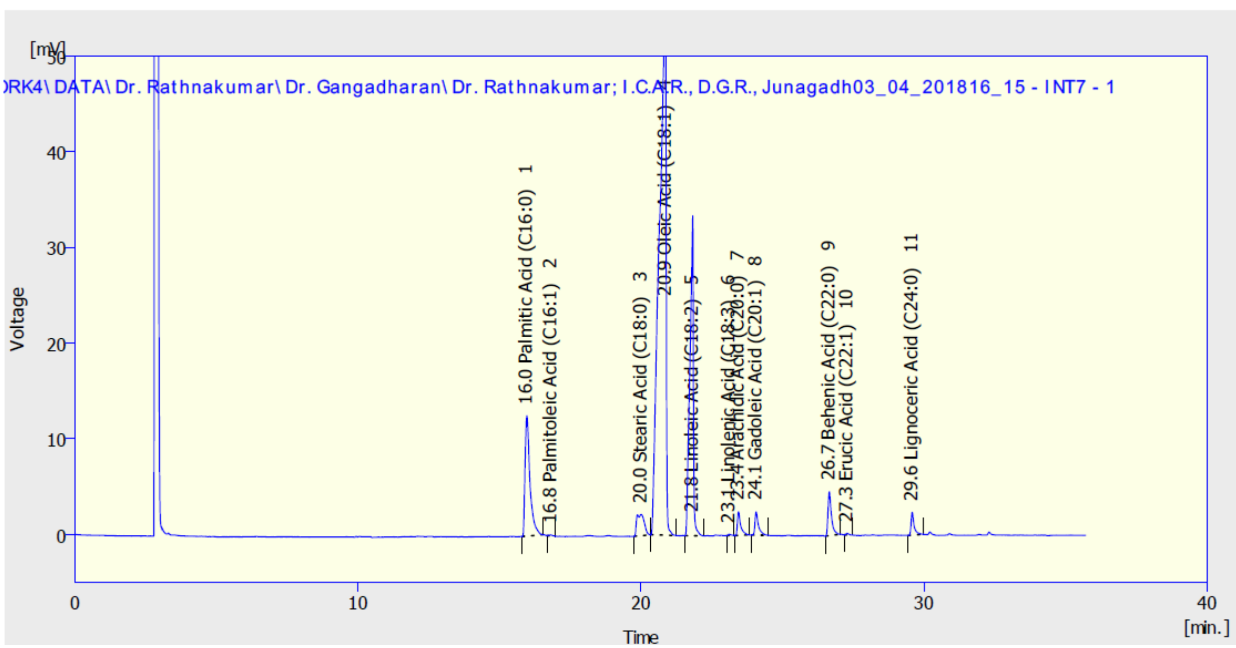


Fig.3 Chromatogram of fatty acid methyl esters separated in gas chromatography of fatty acid profiles of mutant Number 22 derived from EMS treatment



The fatty acid profiling of 22 mutants (Table 3), showed narrow range of oleic (54-61%) and linoleic acid (18-24%) content compared to TPG 41 (54% oleic acid, 25% linoleic acid) suggesting less role of EMS in inducing mutation for *Ol* locus. However, two mutants

#39 (61.26%) and #53 (61.54%) had slightly more oleic acid content compared TPG 41(54.3%). Linoleic (C18:2), a polyunsaturated fatty acid linked with oxidative rancidity of oils when heated at high temperatures (Isleib *et al.,* 2006) leading to formation of trans-fatty acids and causes cardiovascular diseases (Wang *et al.,* 2015). Three mutants #39 (18.62%), #122(18.98%) and #53(19.11%) exhibited low linoleic acid content than TPG 41(25.19%).

The trait high oleic to linoleic acid ratio (high O/L) in groundnut is favoured over low O/L as it confers health benefits (Garcia *et al.*, 2006) and oil stability. Groundnut with high oleate contents could maintain relatively more flavour after roasting as well as after longer periods of storage compared to low oleate types (Nepote *et al.*, 2006).

Regarding oil stability, high O/L ratios in groundnut extend shelf life by delaying the development of rancidity (O'Keefe *et al.*,1993). Four mutants #39(3.2), #53(3.2), #122 (3.2) and #36 (3.04) exhibited slightly improved higher O/L ratio compared to TPG 41(2.5) (Table 4).

Higher dietary intakes of major saturated fats are associated with an increased risk of coronary heart disease (Zong *et al.*, 2016) by increasing LDL cholesterol as well as total cholesterol. Two mutants #53(17.8%) and #124(17.68%) showed slightly lower saturated fatty acids than TPG 41 (19.35). Total monounsaturated fats was higher in mutants #53(63.05%) and #39(62.55%) compared to TPG 41 (55.41). Three mutants #39(18.68%), #122(19.04), #53(19.16) had lower polyunsaturated fats than TPG 41(25.24). In addition to these parameters few mutants also exhibited slightly higher polyunsaturated/unsaturated ratio and unsaturated/saturated fatty acid ratios (Table 5).

Relationship between physical and yield traits

Phenotypic correlation coefficients between the traits in M_4were calculated and presented in Table 5. The results showed that pod yield per plant was associated positively with hundred pod and kernel weight (Venkataravana *et al.,* 2000), kernel length and width in all treatments. Sound mature kernel (%) showed significant positive correlation with hundred pod and kernel weight as well as kernel length and width in all treatments. Shelling out turn (%) was found to be correlated negatively correlated with kernel length.

Mutagenesis by EMS treatment generated considerable variation for physical and productive traits. Of the total of 129 families, more than 20 families showed superior physical and yield attributes than TPG 41. It has been observed that the lower mutagenic dose (0.2%-0.3% EMS) had beneficial effect on physical and productive characters. The superior mutants identified in M_4 generation with respect to pod yield per plant, hundred kernel weight, kernel length, shelling out turn and O/L ratio could be used as donors in breeding programmes for development of confectionery type groundnuts. These mutants need to be evaluated for further confirmation in large scale evaluation.

References

Bera, S.K., Kamdar, J.H., Kasundra, S.V., Dash, P., Maurya, A.K., Jasani, M.D., Ajay, B.C., Manivannan, N., Vasanthi, R.P., Dobariya, K.L., Pandey, M.K., Janila, P., Radhakrishnan, T. and Varshney, R.K., 2018. Improving oil quality by altering levels of fatty acids through marker-assisted selection of ahfad2 alleles in peanut (*Arachis hypogaea* L.). *Euphytica.,* 214:162,

https://doi.org/10.1007/s10681-018-2241-0(0123456789().
Bishi, S.K., Lokesh Kumar., Mahatma, M.K., Khatediya, N., Chauhan, S.M. and Misra, J.B, 2015. Quality traits of Indian peanut cultivars and their utility as nutritional and functional food. *Food Chemistry*., 167:107–114.
Dwivedi, S.L. and Nigam, S.N., 2005. Confectionery groundnuts: Issues and opportunities to promote export and food uses in India. *J. Oilseeds Res*., 22: 1-4.
FAOSTAT, 2015, www.fao.org/faostat/en/# data/QC.
Gangadhara, K. and Nadaf H.L., 2016. Identification of high oleate peanut lines with foliar disease resistance. *Advances in Life Sciences*., 5(6): 2427-2431.
Gangadhara, K. and Nadaf, H.L., 2016. Inheritance of high oleic acid content in new sources of groundnut (*Arachis hypogaea* L). *Agric.Sci.Digest.*, 36(4):299-302.
Gangadhara, K., 2013, Genetic enhancement of oleic acid content in groundnut (*Arachis hypogaea* L.) *Ph. D. Thesis*, Univ. Agric. Sci. Dharwad (India).
Garcia, M.D.M., Garcia, C.M.A. and Hernan-dez, A.G., 2006. Importance of lipids in the nutritional treatment of inflammatory diseases. *Nutr. Hosp*., 21: 28–41.
Govindaraj, N., Suryaprakash, S., Sivaramane, N. and Murali, P., 2016. Changes in edible oil preference and present-day consumption status of households: A case of Tamil Nadu state. *India*, *J. Oilseeds Res*., 33(3): 178-184.
Gowda M. V. C., Nadaf, H. L.and Sheshagiri R., 1996. The role of mutations in intraspecific differentiation of groundnut (*Arachis hypogaea* L.). *Euphytica*., 90(1):105–113
Holley, K. T. and Hammons, R. O., 1968. Strains and seasonal effects on peanut characteristics. *Ga. Agr. Exp. Sta. Res. Bull*., 32: 1-27.
Isleib, T. G., Wilson, R.F. and Novitzky, W.P., 2006. Partial dominance, pleiotropism and epistasis in the inheritance of the high oleate trait in peanut. *Crop Sci*., 46: 1331-1335.
Isleib, T.G., Young, C. T. and Knauft, D. A., 1996. Fatty acid genotypes of five *virginia*-type cultivars. *Crop Sci.*, 36: 556–558.
Janila, P., Pandey, M.K., Shasidhara, Y., Murali V., Sriswathi, M., Kheraa, P., Manohara, S.S., Nagesha, P., Vishwakarma, M.K., GP Mishra, Radhakrishnan T., Manivannan N., Dobariya, KL, Vasanthi, R.P. and Varshney, R.K., 2016. Molecular breeding for introgression of fatty acid desaturase mutant alleles (ahFAD2A and ahFAD2B) enhances oil quality in high and low oil containing peanut genotypes. *Plant Science*, 242:203-213.
Kale, D.M., Badigannavar A.M. and Murthy G.S.S., 2000, Development of new large pod Trombay groundnut (*Arachis hypogaea*) selections. *Ind. J. Agric. Sci.*, 70:365-369.
Kale, D.M., Murthy G.S.S. and Badigannavar, A.M. 2004. TPG 41 – A large seeded groundnut variety released in India. *Intern.ArachisNewslett*24:21-22
Mathur, R.K., Manivel, P., Samdur, M.Y, Gor, H.K, and Chikani, B.M, 2000. Creation of genetic variability through mutation breeding in groundnut. DAE-BRNS Symposium, Mumbai
Misra, J.B. and Mathur, R.S., 1998. A simple and economic procedure for transmethylation of fatty acids of groundnut oil for analysis by GLC. *Int Arachis Newsletter*.18:40–42.
Moore, K.M. and Knauft, D.A., 1989. The Inheritance of high oleic acid in peanut. *J. Heredity*., 80(3): 252-253.

Mouli, C., Kale, D.M. and Patil, S.H., 1989b. Somnath: A high yielding Virginia runner variety of groundnut. *Groundnut News*, 1:5.

Mouli, C., Kale, D.M. and Patil, S.H., 1990. TG-19A: Alarge seeded Spanish groundnut. Groundnut New., 2:3.

Nawade, B., Tejas C. Bosamia, Radhakrishnan Thankappan, Arulthambi L. Rathnakumar, Abhay Kumar Jentilal R. Dobaria, Rahul Kundu and Mishra, G.P., 2016. Insights into the Indian Peanut Genotypes for ahFAD2 Gene Polymorphism Regulating Its Oleic and Linoleic Acid Fluxes. *Front Plant Sci*., 7: 1271.

Nigam, S.N., Dwivedi, S.L., Reddy, L.J. and Vasudeva Rao, M.J., 1989. An update on groundnut breeding activities at ICRISAT centre with particular reference to breeding and selection for improved quality. *Proceedings of the Third Regional Groundnut Workshop, held during 13-18 March 1988, Lilongwe, Malwi*, *pp*.115-25.

Norden, A.J., Gorbet, D.W., Knauft, D.A. and Young. C.T., 1987. Variability in oil quality among peanut genotypes in the Florida breeding program. *Peanut Sci.*, 14: 7-11.

Patil, S.H. and Mouli, C., 1984. Preferential segregation of two allelic mutants for small leaf character in groundnut. *Theoretical and Applied Genetics.*, 67:327-332.

Patil, S.H., 1975. A new groundnut variety for export. *Nuclear India*, 13:7-8

Venkataravana, P., Sheriff, R.A., Kulkarni, R.S., Shankaranarayana, V. and Fathima P.S. 2000. Correlation and path analysis in groundnut (*Arachis hypogaea* L.). *Mysore Journal of Agricultural Science.*, 34(4): 321 325.

Wang, D.D., Li, Y., Chiuve, S.E., Hu, F.B. and Willett, W.C. 2015. Improvements in US diet helped reduce disease burden and lower premature deaths, 1999–2012; overall diet remains poor. *Health Aff*. 34: 1916–22

Zong, G., Li, Y., Wanders, A.J., Alssema, M., Zock, P.L., Willett, W.C., Hu, F.B. and Sun, Q., 2016. Intake of individual saturated fatty acids and risk of coronary heart disease in US men and women: two prospective longitudinal cohort studies. *BMJ*.., 355: i5796

How to cite this article:

Gangadhara, K., M.C. Dagla, A.L. Rathnakumar, T. Radhakrishnan and Gor, H.K. 2018. EMS Induced Variability for Physico-Quality Traits in Groundnut (*Arachis hypogaea* L.). *Int.J.Curr.Microbiol.App.Sci.* 7(11): 1408-1420. doi: https://doi.org/10.20546/ijcmas.2018.711.163