

IMPACT OF INDUCED EMS MUTAGENESIS ON SEED YIELD OF GROUNDNUT (*ARACHIS HYPOGAEAE.L*) GENOTYPES

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ABSTRACT

The aim of the study is to investigate the effect of induced Ethyl methanesulfonate (EMS) on seed yield of three groundnut genotypes under various EMS concentrations. The field work was carried out with three groundnut genotypes viz; (ICG2106, ICG5236, ICG76) collected from plant molecular lab, ICRIASAT, Hyderabad. The results showed that all three genotypes recorded lower seed yield under 0.3 percent EMS, 0.4 percent EMS, and 0.5 percent EMS over their control where as in M_2 generation the results showed that all three genotypes recorded higher seed yield under 0.3% EMS, 0.4% EMS, and 0.5% EMS over their control. ICG2106 was recorded higher seed yield at 0.3% EMS (37.90 gm per plant), 0.4% EMS (33.90 gm per plant) and 0.5% EMS (32.30 gm per plant) over its control plant (24.70) and compare to their other genotypes. It was observed the higher seed yield was at 0.3% EMS followed by 0.4% EMS and 0.5% EMS. It is revealed that when the concentration of EMS increased the seed yield of the groundnut is increased in M_2 generation. It is revealed that when the concentration of EMS increased the seed yield of the groundnut is decreased in M_1 generation and increased in M_2 generation. Hence highest increase of seed yield was observed by the variety ICG2106- 0.3% (37.90 gm) followed by ICG5236- 0.3% (30.30 gm) and ICG76- 0.3% (29.97gm) under three various EMS concentrations in M_2 generation.

Keywords: EMS, Groundnut mutants, M_1 generation, M_2 generation, Seed yield.

INTRODUCTION

In India, groundnut is a significant oil seed that ranks first in terms of acreage and second in terms of production, after soybean. With 18.36 million tonnes, china leads the second in terms of production. India comes in second with 10.24 million tonnes, Nigeria fourth with 4.61 lakh tonnes, the USA with 2.90 million tonnes, and Sudan with 2.36 million tonnes. These five countries accounted

for 34, 19, 9, 5 and 4 percent of the world's total production of 53.97 million tonnes in 2020-2021 first advance projections from the Government of India indicate that 2023-2024. Estimates for the groundnut crop in *Kharif* are 78.29 lakh tonnes, down from 85.62 lakh tonnes 2022-2023. With 36.76 lakh tonnes, Gujarat leads the states in groundnut output, followed by Rajasthan (18.95 lakh tonnes), Madhya Pradesh (9.61 lakh tonnes)

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(www.agri.telangana.gov.in). As per the Government of India's all-India *Rabi* crop coverage report, as of January 5, 2024, 4.88 lakh hectares of groundnut had been sown, compared to 5.68 lakh hectares the previous year. With 1.11 lakh hectares, Karnataka led the states in area coverage, followed by Odisha (1.00 lakh hectares) and Tamilnadu (0.72 lakh tonnes). www.agri.telangana.gov.in is the source. Groundnuts were planted on around 2,00,235 acres in Telangana as of January 31, 2024. With 1,03,698 acres planted to groundnuts, Nagarkurnool was the district with the largest amount, followed by Wanaparthy (20,286 acres), Nalgonda (17,386 acres), Vikarabad (13,144 acres), and Mahaboobnagar (10,482 acres) among the other districts. The marketing season 2023–2024 would see a rise in groundnut MSP of Rs. 527 to 6377 per quintal; up from Rs. 5850 per quintal in 2022–2023(www.agri.telangana.gov.in) groundnut oil is widely used in Vietnam, China, India, and Myanmar for culinary purposes. The production of improved cultivars through the advantageous application of grain legume mutation breeding has also been documented (Bell, 2008).

Induced mutagenesis occurs when agricultural plants are exposed to a mutagenic agent, such as radiation (neutrons, gamma rays, UV rays) or a chemical (EMS, SA, MMS), which then causes mutations in the DNA. Mutation breeding is an alternative to conventional plant breeding as a source of increasing variability and could confer specific improvement without significantly altering its acceptable phenotype (Menshah and Obadoni, 2007). The various studies with chemical mutagens have been extensively reviewed by several authors from 1960 only following the introduction of EMS (Ehrenberg, 1965). They reported that EMS has a higher mutagenic efficiency than radiations. Anbuselvam *et al.*, 2010, reported that chemical mutagenesis in groundnut breeding helped to produce mutant

lines. EMS has been successfully applied to a large number of plants to produce morphological diversity and promote the improvement of ideal traits (Lethin *et al.*, 2020). The efficiency of a mutagen in producing desired changes is just as important as the mutagen's mutagenic efficacy (number of mutations produced) when it comes to producing unwanted changes (sterility, fatality, damage, etc), (Girija and Dhanavel, 2009).

The mutation approach to crop enhancement was defended by (Gustafsson, 1947) as being superior to other strategies. In general, for plants propagated by seeds, their seeds are usually preferentially selected mutagenic material (Gottwald *et al.*, 2009). In recent years, there has been a lot of interest in the use of chemical and physical mutagens to induce mutagenesis. The amount present determines the rate of mutation. The range of mutations could be greatly influenced by the concentration. The length of time and the conditions under which the mutations occur determine how successful it is in raising the frequency of favorable mutations in a crop (Wang *et al.*, 2015).

MATERIAL AND METHODS

The field work was carried out with three groundnut genotypes viz., (ICG2106, ICG5236 and ICG76) collected from plant molecular lab, ICRISAT, Hyderabad. In M_1 generation ten seeds were used per treatment of three groundnut genotypes treated with 0.3 percent EMS, 0.4 percent EMS, and 0.5 percent EMS respectively. In M_2 generation thirty seeds were used per treatment of three groundnut genotypes treated with 0.3 percent EMS, 0.4 percent EMS, and 0.5 percent EMS respectively. The treated and untreated (control) seeds were sown in ten and thirty replications in CRBD method at experimental farm department of Genetics, Osmania University during *Kharif season and Rabi* season 2021-

2022. The recommended agronomic practices and plant protection measures were followed uniformly for all the treatments at appropriate stages during the entire crop growth period. Observations were recorded at harvest stage of the plants on quantitative traits viz; plant height (cm), number of branches, number of leaves, days to flower initiation, days to 50% of flowering, seeds per pod, number of pods per plant, pod weight (g/pl), number of seeds per plant, seed weight (g/pl) and the average performance was worked out M_1 and M_2 generation.

RESULTS AND DISCUSSION

The ANOVA results showed that all the quantitative traits under study observed highly significant values due to treatments except number of branches per plant and seeds per pod in M_1 generation (Table 1). It is revealed that for majority of traits, the mutants showed significant variation in the genotype ICG 2106. The ANOVA results showed that all the quantitative traits under study observed highly significant values due to treatments except Number of branches per plant, Seeds per pod, 50 percent flowering and Pod weight (gm) in M_1 generation (Table 2). It revealed that majority of traits showed significant variation in the genotype ICG 5236. The ANOVA results showed that all the quantitative traits under study observed highly significant due to treatments except seeds per pod and 50 per cent flowering in M_1 generation (Table 3). It was revealed that majority of traits showed significant variation in the genotype ICG 76. The similar variability was found in earlier studies of Yugandhar *et al.*, (2023) in groundnut.

The ANOVA results showed that all the quantitative traits under study observed highly significant due to treatments except seeds per pod in M_2 generation (Table 4). It was revealed that majority of traits, the mutants showed

significant variation in the genotype ICG 2106. The ANOVA results showed that all the quantitative traits under study observed highly significant due to treatments except seeds per pod in M_2 generation (Table 4). It was revealed that majority of traits, the mutants showed significant variation in the genotype ICG 5236. The ANOVA results showed that all the quantitative traits under study observed highly significant due to treatments except seeds per pod in M_2 generation (Table 4). It was revealed that majority of traits, the mutants showed significant variation in the genotype ICG 76.

The mean performance of plant height in our population shown in Table- 5, the highest plant height was recorded in ICG76 in control by 32.90 cm and lowest plant height was recorded in ICG 2016 at 0.5% EMS by 22.97 cm. The genotype ICG2106 recorded highest plant height with 32.83 cm by control. The lower plant height was recorded in induced EMS mutants in M_1 generation as compared with control and our results meet with Gunasekaran and Pavadai (2015) in groundnut. The trait number of branches per plant was recorded highest in ICG 76 at control by 9.10 and lowest number of branches was recorded in ICG5236 at 0.5% EMS by 5.00. The genotype ICG2106 recorded highest number of branches by 8.53 with control; this finding result is consistent with Raina *et al.*, (2022).

The character number of leaves per plant showed highest in ICG 2106 in control by 53.80 and lowest number of leaves was recorded in both genotypes ICG 2106 at 0.5% EMS by 31.87 and ICG 5236 at 0.5% EMS 31.87. The genotype ICG 2106 recorded highest number of leaves by 53.80 as compared to control. The results of present study indicated that in EMS is that when increase the dose concentration then decreases the number of leaves referred by Patel, (2020) in groundnut plant. The days to flower initiation was observed early in

Table 1. Analysis of variation for the quantitative traits in groundnut genotype-ICG2106 in M₁ generation

S.No	Source of Variations	DF	MSSQ										
			Characters										
			Pl. Ht (cm)	Bran/PI	Lea/PI	Flow. Ini	50% Flow.Ini	Seeds/Pod	Pods/pl	Pod. Wt(g/pl)	Seeds/pl	Seed.Wt (g/pl)	
1	Replications	9	91.067	18.641	506.219	72.364	39.711	0.275	198.085	107.204	620.543	70.653	
2	Treatments	3	11.625 **	0.140NS	33.991 **	9.368 **	2.815 **	0.003NS	17.997 **	7.331 **	181.814 **	4.098 **	
3	Error		17.407	1.804	81.926	12.087	4.641	0.025	41.564	14.428	114.100	6.887	
4	St E		1.319	0.425	2.862	1.099	0.681	0.050	2.039	1.201	3.378	0.830	
5	SD		1.866	0.601	4.048	1.555	0.963	0.071	2.883	1.699	4.777	1.174	
6	CV (%)		15.246	19.467	21.767	12.340	5.932	8.338	20.231	19.826	23.167	20.940	

*Significant at 0.05% and ** at 0.01 % level, respectively

Pl. Ht- Plant height (cm), No.of Br/PI- Number of branches per plant, No.of Lea/PI- Number of leaves per plant, Flow.ini-Days to flower initiation, 50% Flow.ini- days to 50% of flower initiation, No.of Seeds/Pod- Number of seeds per pod, No.of Pods/PI- Number of pods per plant, Pod.Wt (g/pl)- pod weight per plant (g), No.of seeds/PI- Number of seeds per plant, Seed.Wt (g/PI)- seed weight per plant (g).

Table 2. Analysis of variation for the quantitative traits in groundnut genotype-ICG5236 in M₁ generation

S.No.	Source of Variations	DF	MSSQ									
			Pl. Ht (cm)	Br/PI	Lea/PI	Flow.ini	50% Flow.Ini	Seeds/Pod	Pods/pl	Pod. Wt(g/p)	Seeds/pl	Seed.Wt(g/pl)
1	Replications	9	81.856	33.214	493.401	14.637	12.333	0.166	186.284	133.274	1,371.030	40.724
2	Treatments	3	6.883**	0.373NS	42.295**	9.056**	0.455 NS	0.025 NS	2.401**	0.675 NS	68.805**	4.628**
3	Error		16.179	2.379	82.972	7.808	2.949	0.027	26.976	8.351	83.099	6.744
4	St E		1.272	0.488	2.880	0.884	0.543	0.051	1.642	0.914	2.883	0.821
5	SD		1.799	0.690	4.074	1.250	0.768	0.073	2.323	1.292	4.077	1.161
6	CV (%)		14.482	22.412	22.208	10.146	4.973	8.603	17.034	15.937	21.344	21.293

Significant at 0.05% and ** at 0.01 % level, respectively.

Pl. Ht- Plant height (cm), No.of Br/PI- Number of branches per plant, No.of Lea/PI- Number of leaves per plant, Flow.ini-Days to flower initiation, 50% Flow.ini- days to 50% of flower initiation, No. of Seeds/Pod- Number of seeds per pod, No.of Pods/PI- Number of pods per plant, Pod.Wt (g/PI)- pod weight per plant (g), No.of seeds/PI- Number of seeds per plant, Seed.Wt (g/PI)- seed weight per plant (g).

Table 3. Analysis of variation for the quantitative traits in groundnut genotype-ICG76 in M₁ generatio

S.No	Source of Variations	DF	MSSQ										
			Characters										
			Pl. Ht(cm)	Bran/PI	Lea/PI	Flow.ini	50% Flow.Ini	Seeds/Pod	Pods/pl	Pod. Wt (g/p)	Seeds/pl	Seed.Wt (g/pl)	
1	Replications	9	102.476	27.726	373.324	42.155	25.638	0.112	67.085	64.606	588.995	63.464	
2	Treatments	3	7.402 **	1.970 **	16.475 **	3.056**	0.162 NS	0.017 NS	16.360 **	30.283 **	341.546 **	14.888 **	
3	Error		15.745	2.486	84.617	10.185	2.787	0.029	10.536	12.686	70.070	10.768	
4	St E		1.255	0.499	2.909	1.009	0.528	0.054	1.026	1.126	2.647	1.038	
5	SD		1.775	0.705	4.114	1.427	0.747	0.077	1.452	1.593	3.744	1.468	
6	CV (%)		14.244	22.877	22.436	11.301	4.723	9.050	10.904	21.265	17.046	23.993	

*Significant at 0.05% and ** at 0.01 % level, respectively.

Pl. Ht- Plant height (cm), No. of Br/PI- Number of branches per plant, No. of Lea/PI- Number of leaves per plant, Flow ini- Days to flower initiation, 50% Flow.ini- days to 50% of flower initiation, No. of Seeds/Pod- Number of seeds per pod, No. of Pods/PI- Number of pods per plant, Pod.Wt (g/PI)- pod weight per plant (g), No. of seeds/PI- Number of seeds per plant, Seed.Wt (g/PI)- seed weight per plant (g).

Table 4. Analysis of variation for the quantitative traits in groundnut genotypes ICG2106, ICG5236 and ICG76 in M₂ generation

Source of variations	DF	MSSQ									
		Characters									
		Pl. Ht (cm)	Bran/pl	Lea/pl	Flow-Ini	50% of flow.ini	Seeds/Pod	Pods/pl	Pod. Wt(g/pl)	Seeds/pl	Seed.Wt(g/pl)
Replications	29	26.500	17.483	83.796	88.935	28.125	0.764	26.558	21.622	27.933	15.081
Treatments	11	179.255 **	146.849 **	1,711.458 **	107.991 **	207.080 **	0.014 NS	585.443 **	1,097.681 **	1,767.300 **	696.330 **
Error		0.607	0.538	1.275	0.550	0.481	0.008	0.845	0.741	0.724	0.797
St E		0.142	0.134	0.206	0.135	0.127	0.017	0.168	0.157	0.155	0.163
SD		0.201	0.189	0.292	0.191	0.179	0.024	0.237	0.222	0.220	0.231
CV (%)		2.270	5.522	1.823	3.458	2.408	4.665	2.723	1.857	1.516	3.127

*Significant at 0.05% and ** at 0.01 % level, respectively.

Pl. Ht- Plant height (cm), Bran/pl- Number of branches per plant, Lea/pl- Number of leaves per plant, Flow-Ini- Days to flower initiation, 50% of flow.ini- days to 50% of flower initiation, Seeds/Pod- Number of seeds per pod, Pods/Pl- Number of pods per plant, Pod.Wt (g/Pl)- Pod weight per plant (g), Seeds/Pl- Number of seeds per plant, Seed.Wt (g/Pl)- seed weight per plant (g).

Table 5. Mean performance of quantitative characters of groundnut mutants of three groundnuts (ICG2106, ICG5236 and ICG 76) in M₁ generation.

Genotypes	Characters	Pl.ht(cm)	Bran/pl	Lea/pl	Flo.ini	50%.flow	Seeds/Pod	Pods/pl	Pod.Wt(g/pl)	Seeds/Pl	Seed.Wt(g/pl)
ICG2106	Control	32.83	8.53	53.80	23.87	33.43	1.93	39.40	22.18	55.10	15.45
	0.3% EMS	28.20	8.41	44.23	25.90	35.70	1.90	30.00	21.70	52.33	12.16
	0.4% EMS	26.20	7.80	41.60	27.10	37.23	1.87	28.70	20.50	51.50	11.53
ICG5236	0.5% EMS	22.97	6.80	31.87	32.37	38.90	1.87	27.30	16.84	46.70	10.99
	Control	28.90	8.70	48.90	24.20	32.63	1.93	31.10	21.50	52.60	14.06
	0.3% EMS	27.30	8.30	44.53	25.50	33.73	1.90	30.10	20.70	50.40	12.77
ICG76	0.4% EMS	25.77	7.30	40.90	27.30	35.37	1.87	29.40	19.90	47.20	11.32
	0.5% EMS	23.17	5.00	31.87	29.83	36.40	1.87	27.03	17.60	46.80	10.64
	Control	32.90	9.10	48.85	24.47	33.10	1.93	33.21	21.40	56.13	15.97
ICG76	0.3% EMS	28.13	8.40	45.70	25.70	35.03	1.90	31.86	20.70	54.80	14.25
	0.4% EMS	25.93	7.40	43.20	26.70	36.13	1.87	28.90	19.20	51.50	13.53
	0.5% EMS	23.20	6.40	40.50	31.67	37.10	1.87	27.57	15.03	50.20	10.95

Pl. Ht- Plant height (cm), No.of Bran/Pl- Branches per plant (number), No.of Lea/Pl- Leaves per plant (number), Flow.ini- flower initiation (days), 50% Flow.ini- 50% of flower initiation (days), No.of Seeds/Pod- Seeds per pod (number), No.of Pods/Pl- Pods per plant (number), Pod.Wt (g/Pl)- Pod weight (g/pl), No.of seeds/Pl- Seeds per plant (number), Seed.Wt (g/Pl)- Seed weight (g/pl).

Table 6. Mean performance of yield and yield contributing characters of mutants of three groundnuts (ICG2106, ICG5236 and ICG 76) in M₂ generation.

Genotypes	Characters	Pl.ht(cm)	Bran/pl	Lea/pl	Flo.ini	50% offlow	Seeds/Pod	Pods/pl	Pod.Wt(g/pl)	Seeds/PI	Seed.Wt(g/pl)
ICG2106	Control	31.00	10.00	50.95	24.71	33.10	1.94	29.13	38.70	47.40	24.70
	0.3% EMS	37.10	15.60	71.40	19.50	26.10	2.00	42.10	56.70	70.37	37.90
	0.4% EMS	35.40	14.30	64.20	20.50	27.50	1.97	38.10	51.90	64.00	33.90
ICG5236	0.5% EMS	34.30	13.20	61.70	21.50	28.50	1.95	35.20	48.40	58.90	32.30
	Control	30.10	10.20	50.50	24.09	32.20	1.94	28.73	37.00	45.70	21.87
	0.3% EMS	36.90	15.84	68.20	19.10	26.30	2.00	36.90	48.97	59.83	30.30
ICG76	0.4% EMS	35.60	14.50	64.90	20.10	27.30	1.97	35.57	46.90	57.77	28.70
	0.5% EMS	34.30	13.30	62.10	21.10	28.30	1.95	33.80	44.97	54.93	26.93
	Control	30.80	9.80	50.68	24.10	33.30	1.94	26.17	37.47	43.90	21.20
	0.3% EMS	36.80	15.76	71.90	19.90	26.40	2.00	34.77	50.87	60.00	29.97
	0.4% EMS	35.40	14.10	64.60	20.90	27.40	1.97	33.20	48.77	57.17	28.30
	0.5% EMS	34.30	12.80	62.30	21.80	29.10	1.95	31.43	45.90	53.43	26.57

Pl. Ht- Plant height (cm), No.of Bran/PI- Branches per plant (number), No.of Lea/PI- Leaves per plant (number), Flow.ini- Flower initiation (days), 50% Flow.ini- 50% of flower initiation (days, No.of Seeds/Pod- Seeds per pod (number), No.of Pods/PI- Pods per plant (number), Pod.Wt (g/PI)- Pod weight (g/pl), No.of seeds/PI- Seeds per plant (number), Seed.Wt (g/PI)- Seed weight (g/pl).

ICG2106 genotype in control with 23.87 days and for the days to late flowering in ICG2106 genotype in 0.5% EMS with 32.37 days. The genotype ICG5236 recorded early flower initiation in control with 24.20 days and late flowering was observed in the mutants of 0.5% EMS with 29.83 days. The genotype ICG76 recorded early flower initiation in control with 24.47 days and late flowering was observed in the mutants of 0.5% EMS with 31.67 days. Kumar (2020) reported by the decrease in the number of days until flower initiation under EMS induced conditions. The days to 50% of flowering was observed early in ICG5236 genotype in control with 32.63 days and for the days to late 50% of flowering in ICG2106 genotype in 0.5% EMS with 38.90 days. The genotype ICG2106 recorded early 50% of flowering in control with 33.43 days and late 50% flowering was observed in the mutants of 0.5% EMS with 38.90 days. The genotype ICG5236 recorded early 50% of flowering in control with 32.63 days and late 50% flowering was observed in the mutants of 0.5% EMS with 36.40 days. The genotype ICG76 recorded early 50% of flowering in control with 33.10 days and late 50% flowering was observed in the mutants of 0.5% EMS with 37.10 days (Fig.1). Gupta, (2019) and Kalyanababu (2019) reported by conversely, EMS mutagenesis can also cause mutations that lead to delayed flowering, resulting in longer days to 50% of flowering.

The mean performance of number of seeds per pod was recorded highest in ICG2106, ICG5236 and ICG76 at control by 1.93 and lowest number of seeds per pod was recorded in ICG2106, ICG5236 and ICG76 at 0.5 percent EMS with 1.87. The highest number of pods per plant was recorded in ICG2106 at control by 39.40 and lowest number of pods per plant was recorded in ICG5236 at 0.5 percent EMS with 27.03. For the genotype ICG76, the character number of pods per plant

was recorded highest in control by 33.21 and lowest pods per plant were observed at 0.5 percent EMS with 27.57 (Fig.2). Increased EMS doses and decreased yield characters was observed earlier in groundnut by Chen *et al.*, (2020) and Sudhakar, (2019), Gunasekaran and Pavadai (2015). The results also showed that the highest pod weight per plant was recorded in ICG2106 at control by 22.18 gm and lowest pod weight per plant was recorded in ICG76 at 0.5 percent EMS with 15.03 gm.

The genotype ICG2106 recorded highest pod weight per plant by 22.18 gm with control and lowest in 0.5 percent EMS with 16.84 gm. Mahtab *et al.* (2015) studies have also reported similar findings, including decreased pod weight per plant and decreased yield attributes in groundnut plants treated with EMS. The highest number of seeds per plant was recorded in ICG76 at control by 56.13 and lowest number of seeds per plant was recorded in ICG5236 at 0.5 percent EMS with 39.80. The genotype ICG 2106 recorded highest number of seeds per plant by 55.10 with control. The highest seed weight per plant was recorded in ICG76 at control by 15.97 gm and lowest seed weight per plant was recorded in ICG5236 at 0.5 percent EMS with 10.64 gm. The genotype ICG2106 recorded highest seed weight per plant by 15.45 gm with control followed by 0.3 percent EMS with 12.16 gm, 0.4% EMS with 11.53 gm, and 0.5 percent EMS with 10.99 gm respectively.

For the genotype ICG5236 was recorded highest seed weight per plant by 14.06 gm in control followed by 0.3 percent EMS with 12.77 gm, 0.4 per cent EMS with 11.32 gm and 0.5 percent EMS with 10.64 gm (Fig.3) respectively. For the genotype ICG76 the character seed weight per plant was recorded highest in control with 15.97 gm followed by 0.3 percent EMS with 14.25 gm, 0.4 percent EMS with 13.53 gm and 0.5 percent EMS with

10.95 gm respectively (Fig.3). Wang *et al.*, 2015 were also reported that the similar decreased trend for various traits in groundnut under EMS induced mutagenesis.

In M_2 generation (Table- 6) displays the average number of pods per plant in our population. ICG2106 at 0.3% EMS had the highest pods per plant (42.10), while ICG76 at control had the lowest (26.17). In the genotype ICG2106, 0.3% EMS produced the most pods per plant (42.10), followed by 0.4% EMS (38.10), 0.5% EMS (35.20), and control (29.13). Among the genotype ICG5236, 0.3% EMS produced the most pods per plant (36.90), followed by 0.4% EMS (35.57), 0.5% EMS (33.80), and control (28.73). The highest character number of pods per plant for the genotype ICG76 was found in 0.3% EMS (34.77) followed by, 0.4% EMS (33.20), 0.5% EMS (31.43) and control with (26.17) respectively. Kumar 2020 was also reported that the similar results for pods per plant increase trend for various traits in groundnut under EMS induced mutagenesis (Fig.4). The table-6 displays the average pod weight (g) per plant for our population. ICG2106 at 0.3% EMS had the highest pod weight (g) per plant, measuring 56.70 (g), while ICG5236 at control had the lowest pod weight (g), measuring 37.00 (g).

The genotype ICG2106 had the highest pod weight per plant, measuring 56.70 (g) for 0.3% EMS, 51.90 (g) for 0.4% EMS, 48.90 (g) for 0.5% EMS, and 38.70 (g) for the control. With 48.97 (g) for 0.3% EMS had the highest pod weight per plant for the genotype ICG5236. This was followed by 4.90 (g) for 0.4% EMS, 44.97 (g) for 0.5% EMS, and 37.00 (g) for control. The character pod weight per plant for the genotype ICG76 was recorded highest in 50.87 (g) for 0.3% EMS followed by 48.77 (g) for 0.4% EMS, 45.90 (g) for 0.5% EMS and 37.47 (g) for control respectively. Patel 2020 was also reported that the similar results for

pod weight (g) per plant increase trend for various traits in groundnut under EMS induced mutagenesis. According to the table-6, which displays the average number of seeds per plant in our population, ICG2106 at 0.3% EMS had the most seeds per plant (70.37), while ICG76 at control had the fewest (13.90%). The genotype ICG2106 produced the most seeds per plant with 0.3% EMS (70.37), followed by 0.4% EMS (64.00), 0.5% EMS (58.90), and control (47.40). The highest number of seeds per plant for genotype ICG5236 was recorded by 0.3% EMS (59.83), followed by 0.4% EMS (57.77), 0.5% EMS (54.93), and control (45.70). The highest character number of seeds per plant for the genotype ICG76 was found in 0.3% EMS (60.00) followed by 0.4% EMS (57.17), 0.5% EMS (53.43) and control (43.90) respectively.

Reddy 2019 was also reported that the similar results for seeds per plant increase trend for various traits in groundnut under EMS induced mutagenesis. The average seed weight (g) per plant for our population is displayed in the table-6. ICG2106 at 0.3% EMS had the highest seed weight (g) per plant, measuring 37.90 (g), while ICG76 at control had the lowest, measuring 21.20 (g). The highest seed weight per plant was recorded by the genotype ICG2106 by 0.3% EMS (37.90 g), 0.4% EMS (33.90 g), 0.5% EMS (32.20 g), and control (24.70 g), in that order. The highest seed weight per plant for genotype ICG5236 was recorded by 0.3% EMS at 30.30 (g), followed by 0.4% EMS at 28.70 (g), 0.5% EMS at 26.93 (g), and control at 21.87 (g). The characteristic seed weight per plant for the genotype ICG76 was recorded highest in 0.3% EMS at 29.97 (g) followed by 0.4% EMS at 28.30 (g), 0.5% EMS at 26.57 (g) and control at 21.20 (g) respectively.

The results showed that highest percentage decrease of seed weight (g/pl)

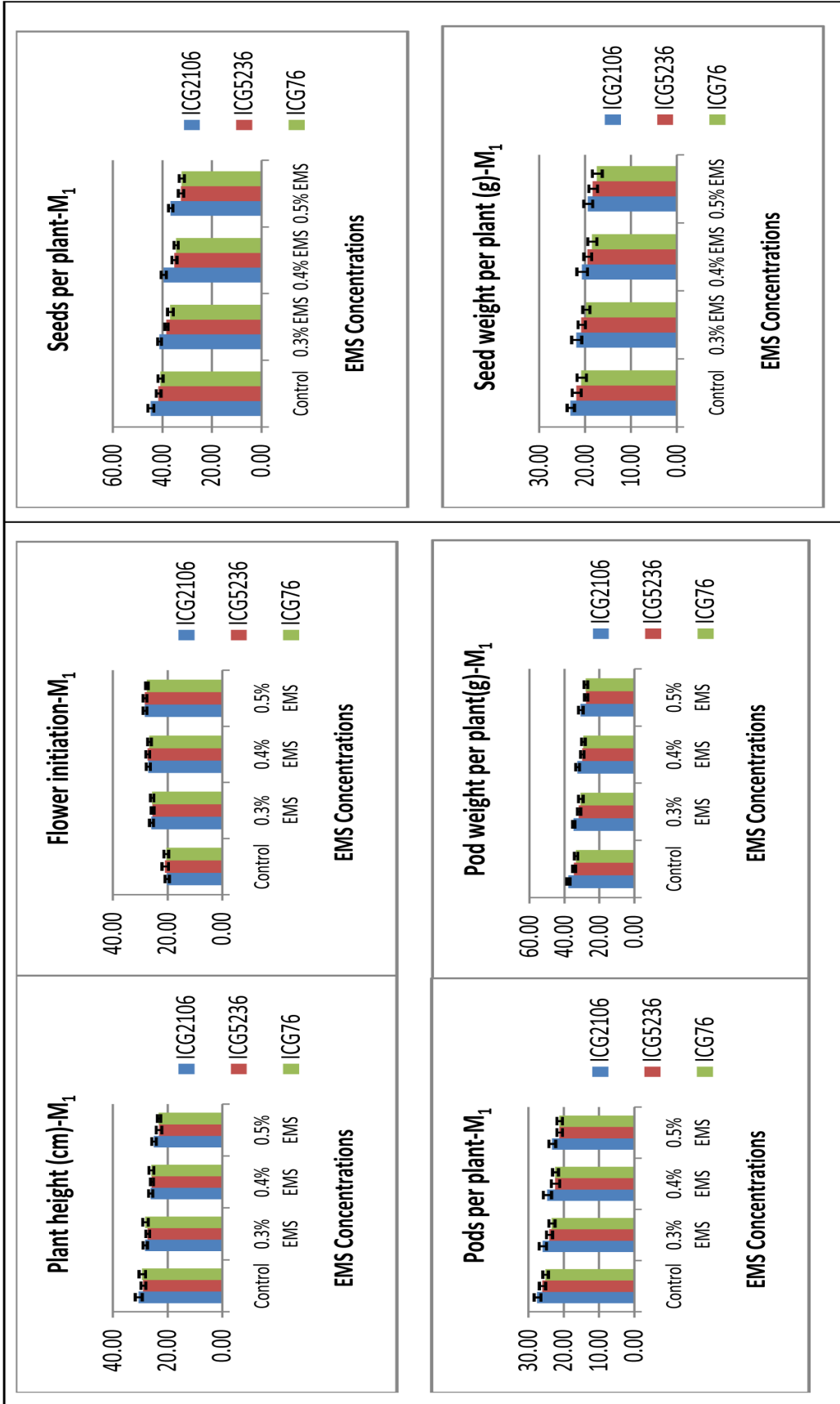


Fig 1. Graphical representation of quantitative traits in groundnut mutant in M₁ generation

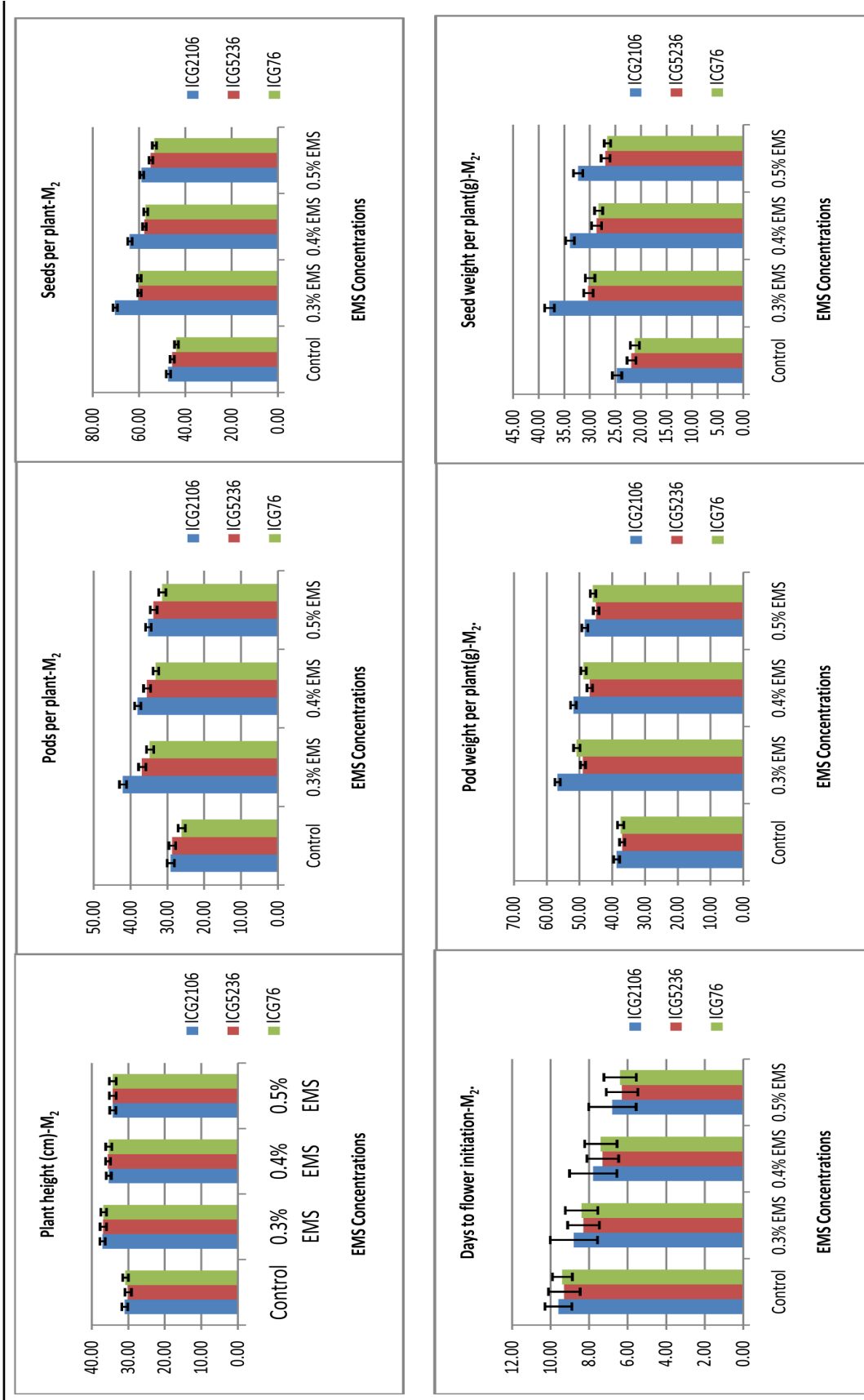


Figure 2. Graphical representation of quantitative traits in groundnut mutant in M₂ generation

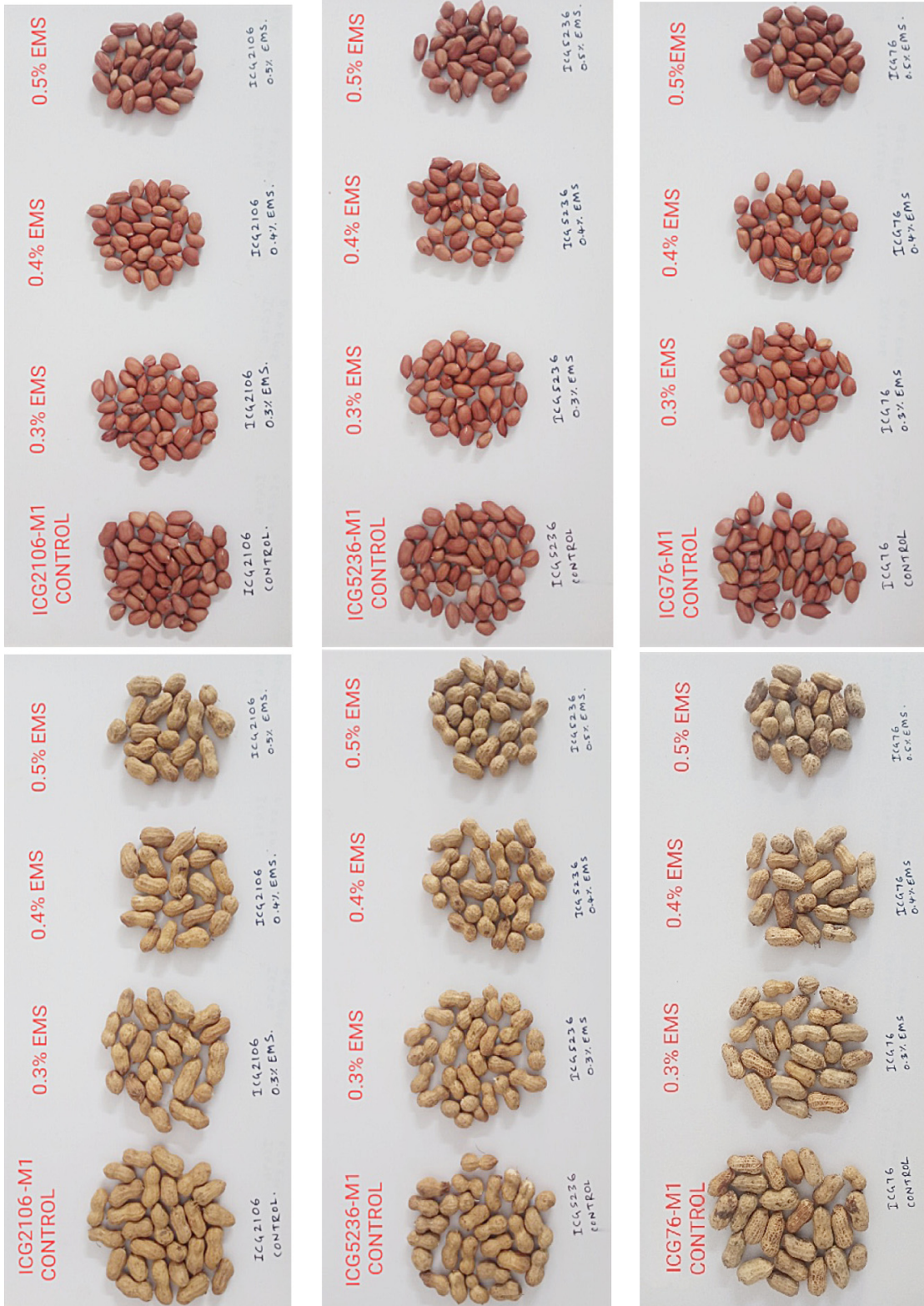


Figure 3. Photographical representation of quantitative characters in groundnut under induced EMS mutagenesis in M₁ generation.

INDUCED EMS MUTAGENESIS ON SEED YIELD OF GROUNDNUT

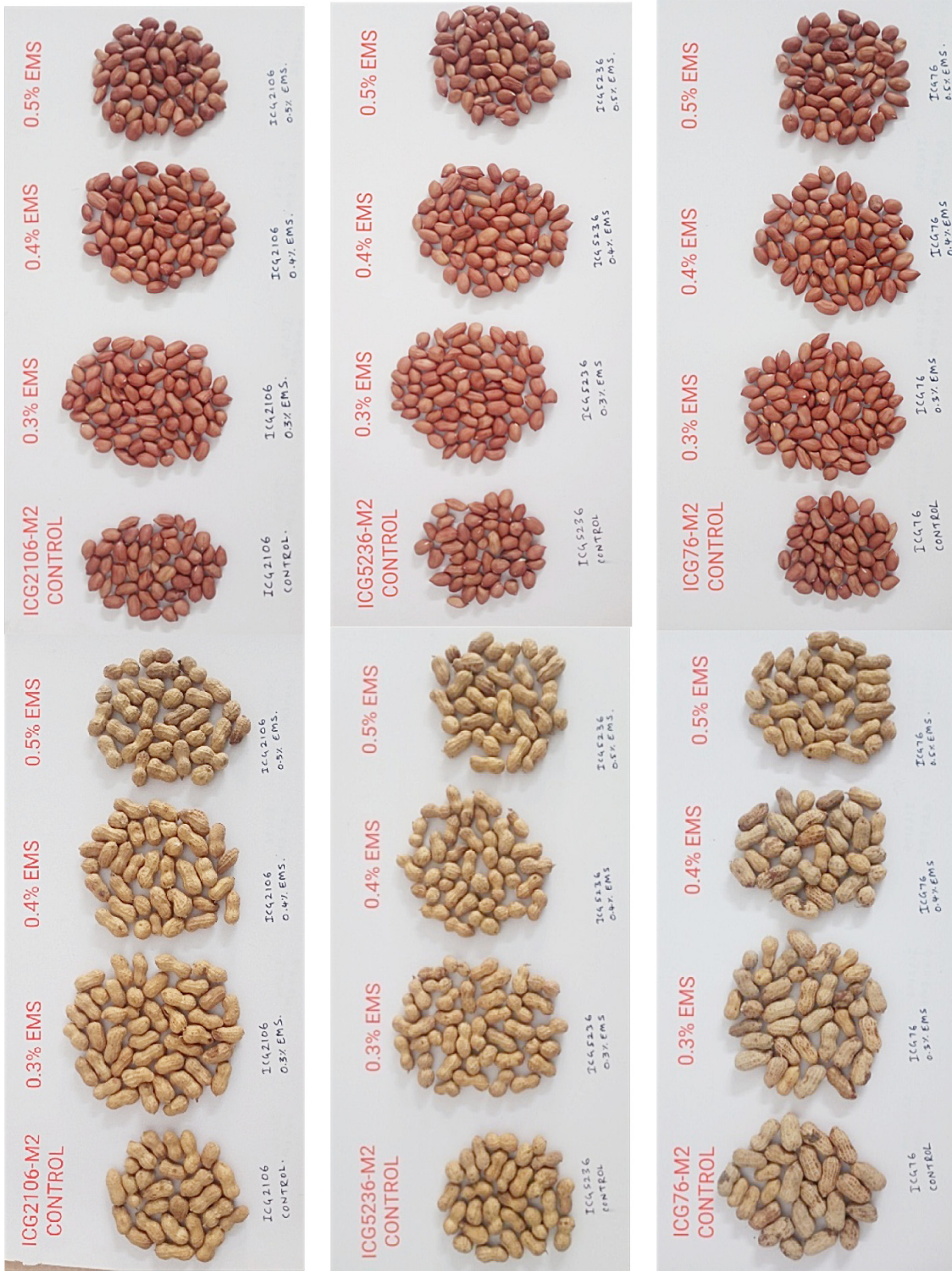


Fig 4. Photographical representation of quantitative characters in groundnut under induced EMS mutagenesis in M₂ generation.

Table 7. Percentage of increase or decrease of Seed weight (g/pl) of three groundnut mutants over its control in M₁ generation

S.No	Trait	ICG2106				ICG5236				ICG76			
		Control	0.3% EMS	0.4% EMS	0.5% EMS	Control	0.3% EMS	0.4% EMS	0.5% EMS	Control	0.3% EMS	0.4% EMS	0.5% EMS
1	Seed.Wt (g/Pl)	15.45	12.16	11.53	10.99	14.06	12.77	11.32	10.64	15.97	14.25	13.53	10.95
2	Percentage of increase or decrease over Control	0.00	-21.29	-34.00	40.58	0.00	-10.10	-24.20	-32.14	0.00	-12.07	-18.03	-45.84

Table 8. Percentage of increase or decrease of Seed weight (g/pl) of three groundnut mutants over its control in M₂ generation

S.No	Trait	ICG2106				ICG5236				ICG76			
		Control	0.3% EMS	0.4% EMS	0.5% EMS	Control	0.3% EMS	0.4% EMS	0.5% EMS	Control	0.3% EMS	0.4% EMS	0.5% EMS
1	Seed.Wt (g/Pl)	24.70	37.90	33.90	32.30	21.87	30.30	28.70	26.93	21.20	29.97	28.30	26.57
2	Percentage of increase or decrease over Control	0.00	34.83	27.14	23.53	0.00	27.83	23.81	18.81	0.00	29.25	25.09	2020

over control was observed in the mutant ICG 76 at 0.5 percent EMS with -45.84 percent and lowest percent decrease was found in the mutant of ICG 5236 at 0.3 percent with -10.10 percent in M₁ generation. The similar results are meet with Chen *et al.*, (2020) and Sudhakar, (2019), Gunasekaran and Pavadai (2015) in groundnut. The results of M₂ generation showed that highest percentage increase of seed weight (g/pl) over control was observed in the mutant ICG2106 at 0.3% EMS with 34.83 percent and lowest percent increase was found in ICG5236 at 0.5% percent with 27.83 percent in M₂ generation. The similar results are reported with singh (2020) in groundnut.

CONCLUSIONS

The results of the study revealed that when the concentration EMS increased the seed yield of groundnut is decreasing in mutants of three groundnut genotypes (ICG2106, ICG5236 and ICG76) in M1 generation. In M1 generation it was clearly observed that the control of ICG2106 (15.45 g) genotype recorded highest yield over its different concentrations viz., 0.3% EMS, 0.4% EMS and 0.5% EMS. These concentrations recorded that the 0.3% EMS (12.16 g), 0.4% EMS (11.53 g) and 0.5% EMS (10.99 g). In M2 generation the results revealed that when the concentration EMS increased the seed yield of groundnut is decreasing in mutants of three groundnut genotypes (ICG2106, ICG5236 and ICG76). Where as in M2 generation it was observed that the mutant of 0.3% EMS of ICG2106 (37.90 g) that the genotype recorded yield increased over its control (24.70 g).

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