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EMS Induced Variability for Pod Yield in Groundnut (*Arachis hypogaea* L.)

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Abstract

An investigation was carried out to assess the variability in M_4 generation of GG 20 groundnut variety induced by different doses (0.2 to 0.6%) of EMS during *Kharif* 2019. Among the different doses of EMS treated GG 20 population, 0.2 % and 0.3 % EMS was found effective in inducing variability for pod and seed yield. Pod yield per plant was associated positively with seed weight per plant and number of seeds per plant in all EMS treated lines. Number of pods per plant associated negatively with hundred pod weight and positively with number of seeds per plant and seed weight per plant. The desirable mutants isolate can be useful for further improvement of Virginia bunch groundnut.

Key words *: Induced variability, pod yield, groundnut, mutagen.*

Introduction

Groundnut is an important edible oilseed legume crop grown in mainly in arid and semi-arid tropics of the world. In India, it is grown in an area of 53 lakh hectares and production of 91 lakh tonnes with average productivity of 1731 Kg/ha (1). Limited improvement of groundnut has been achieved through recombination breeding due to high self pollinated nature and difficulty in hybridization and poor seed set.Induced mutagenesis is one of the most important approaches for broadening genetic base and creating the variability (2). Induced mutagenesis on groundnut was reviewed periodically by (3,4,56,7,8) Mutagenic treatment resulted in increased genetic variation for pod yield (3) and other morphological characters. High to moderate yield were recorded per plot (9). Development of desirable 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 (10,11). In groundnut using mutagenesis followed by hybridization and selection high yielding and large seeded varieties (TG1,TG17,TG 22, TG39, Somnath, TPG 41) have been developed by Bhaba Atomic Research Center (BARC), (7,8,12,13). However, to create additional variability for pod and seed yield traits of groundnut, mutation breeding was resorted using the popular groundnut variety GG 20.

Materials and Methods

GG 20 is a Virginia bunch groundnut variety released for cultivation mainly in Gujarat. One thousand five hundred pure, healthy and dry seeds (moisture, 12%) of the groundnut variety GG 20 was treated with five concentrations (0.2, 0.3, 0.4, 0.5 and 0.6%) of Ethyl Methane Sulphonate (EMS) and planted in 5 rows of 0.2 % EMS, 7 rows of 0.3 % EMS, 3 rows of 0.4 % EMS, 5 rows of 0.5 % EMS and 4 rows of 0.6 % EMS respectivelyto raise M_1 generationat ICAR-Directorate of Groundnut Research, Junagadh, Gujarat, India during *kharif*-2014. Seeds of the M_1 generation were sown in *Rabi/summer* 2015 and plants harvested individually to gave rise to M_2 population. From M_2 generation, 1695 M_3plants (922 in 0.2%; 275 in 0.3%; 271 in 0.4 %; 158 in 0.5% and 69 in 0.6%) were harvested based on distinct morphological and pod features during *kharif*, 2015. Of these, 798 mutants (122 in 0.2%; 311 in 0.3%; 184in 0.4 %; 109 in 0.5% and 72 in 0.6%) selected from M_3 generation based on pod yield and component traits were planted during *kharif* 2019. Data on pod yield per plant, seed yield per plant, hundred pod weight, shelling out turn (%), number of seeds per plant and number of pods per plant were recorded in M_4 generation. 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 traitswere plottedand correlation coefficients for pod and seed yield were estimated using Past Software.

Results and Discussion

Variability for pod and seed yield traits induced by different doses of EMS : A wide range of variation was observed among different EMS treatments in M_4 generation (Table-1) for pod and seed yield traits. Lower concentrationsof EMS (0.2% and 0.3%) could able to

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Table-1 : Variation for pod and seed yield among different treatments in M_3 generations.

Trait	Treatment	N	Min	Max	Mean	Variance	SE	SD
Number of Pods per Plant	Control	15	11	19	15.20	9.03	0.78	3.00
	0.2 % EMS	122	4	34	9.9	17.6	0.4	4.2
	0.3 % EMS	311	3	28	10.8	18.4	0.2	4.3
	0.4 % EMS	184	3	24	10.6	16.5	0.3	4.1
	0.5 % EMS	109	3	28	12.3	38.7	0.6	6.2
	0.6 % EMS	72	4	20	9.2	9.8	0.4	3.1
Pod weight per Plant (g)	Control	15	11.4	17	13.63	2.02	0.37	1.42
	0.2 % EMS	122	3.4	26.9	8.6	12.5	0.3	3.5
	0.3 % EMS	311	2.8	27.2	9.4	13.6	0.2	3.7
	0.4 % EMS	184	2.4	18.75	8.7	10.5	0.2	3.2
	0.5 % EMS	109	2.6	23.6	9.9	23.4	0.5	4.8
	0.6 % EMS	72	2.6	18.1	6.7	8.7	0.3	2.9
Hundred pod weight (g)	Control	15	74	118	91.80	176.89	3.43	13.30
	0.2 % EMS	122	62	160	88.0	189.1	1.2	13.8
	0.3 % EMS	311	54	148	88.5	211.2	0.8	14.5
	0.4 % EMS	184	48	130	83.9	189.4	1.0	13.8
	0.5 % EMS	109	50	118	82.7	166.8	1.2	12.9
	0.6 % EMS	72	29	118	72.6	285.7	2.0	16.9
Seed weight per Plant (g)	Control	15.00	9.00	14.00	9.87	1.84	0.35	1.36
	0.2 % EMS	122	3	18	6.2	6.4	0.2	2.5
	0.3 % EMS	311	1	20	6.8	7.4	0.2	2.7
	0.4 % EMS	184	1	13	6.0	5.2	0.2	2.3
	0.5 % EMS	109	2	17	7.0	12.0	0.3	3.5
	0.6 % EMS	72	1	13	4.7	5.2	0.3	2.3
Number of Seeds per plant	Control	15	20	30	24.33	9.67	0.80	3.11
	0.2 % EMS	122	7	48	16.7	49.8	0.6	7.1
	0.3 % EMS	311	4	88	18.1	71.2	0.5	8.4
	0.4 % EMS	184	6	37	17.1	43.1	0.5	6.6
	0.5 % EMS	109	6	49	19.6	105.5	1.0	10.3
	0.6 % EMS	72	4	35	14.8	31.5	0.7	5.6
Shelling Out turn (%)	Control	15.0	60.0	82.0	71.7	31.4	1.4	5.6
	0.2 % EMS	122	54	78	71.7	17.4	0.4	4.2
	0.3 % EMS	311	47	79	71.6	17.6	0.2	4.2
	0.4 % EMS	184	52	77	68.5	18.4	0.3	4.3
	0.5 % EMS	109	51	78	69.6	18.5	0.4	4.3
	0.6 % EMS	72	42	77	68.0	50.6	0.8	7.1

produce a wide range of pod yield and seed yield per plant.Number of pods per plant ranged from 3 to 34 and highest pod number (34) was observed in 0.2% EMS derived lines. Pod weight per plant varying from 2.6g to 27g and 3.4g to 26g in 0.3 % EMS and 0.2% EMS derived lines respectively. Hundred pod weight was minimum (29g) in 0.6% EMS derived lines and maximum (160g) in 0.2% EMS derived lines (Fig.-1).Seed weight per plant ranged from 1g to 29g and 3g to 18g in 0.3% EMS and 0.2% EMS derived lines respectively. 0.2 % EMS could able to produce highest number of seeds per plant (88). There was no significant effect on shelling out turn was observed. Thus it has been observed that, among the different doses of EMS derived GG 20 derived lines, 0.2% to 0.3% EMS was found to be effective in inducing variability for number of seeds per plant and hundred pod weight in M_4generation.

Relationship between physical and yield traits : Estimated phenotypic correlation coefficients of pod and seed yield traits in $M_4$are presented in Table-1. The results showed that pod yield per plant was associated positively with seed weight per plant and number of seeds per plant in materials under study. Number of pods per plant associated negatively with hundred pod weight and positively with number of seeds per plant and seed weight per plant. There was significant positive association was

Table-2 : Phenotypic correlation coefficients for pod and seed yield in M_3 generation.

Character	Treatment	Pod weight per Plant (g)	Number of seeds per Plant	Seed weight per plant (g)	Hundred pod weight (g)	Shelling Out turn (%)
Number of pods per Plant	Control	.942**	.823**	.930**	-.781**	-.595*
	0.2 % EMS	.945**	.953**	.924**	-.201*	-
	0.3 % EMS	.928**	.786**	.915**	-.242**	-
	0.4 % EMS	.916**	.870**	.888**	-.263**	-
	0.5 % EMS	.951**	.929**	.938**	-.299**	-
	0.6 % EMS	.827**	.879**	.755**	-	-
Pod weight per Plant (g)	Control	1	.817**	.987**	-.626*	-
	0.2 % EMS	1	.949**	.985**	-	-
	0.3 % EMS	1	.797**	.988**	-	.121*
	0.4 % EMS	1	.861**	.979**	-	-
	0.5 % EMS	1	.947**	.990**	-	-
	0.6 % EMS	1	.918**	.983**	.564**	.395**
Number of seeds per Plant	Control		1	.848**	-.688**	-
	0.2 % EMS		1	.942**	-	-
	0.3 % EMS		1	.796**	-	.156**
	0.4 % EMS		1	.867**	-	.147*
	0.5 % EMS		1	.951**	-	.200*
	0.6 % EMS		1	.888**	.364**	.327**
Seed weight per plant	Control			1	-.639*	-
	0.2 % EMS			1	-	-
	0.3 % EMS			1	-	.232**
	0.4 % EMS			1	-	.220**
	0.5 % EMS			1	-	.213*
	0.6 % EMS			1	.637**	.499**
Hundred pod weight (g	Control				1	.536*
	0.2 % EMS				1	-
	0.3 % EMS				1	-
	0.4 % EMS				1	-
	0.5 % EMS				1	-
	0.6 % EMS				1	.633**

observed between shelling out turn and seed weight per plant.

Isolation of desirable mutants for pod and seed yield : Superior mutants isolated for pod and seed yield traits are presented in Table-3. Mutants *viz.*, #55 (160g), #423 (148g), #118 (120g) and #144 (143g) showed higher hundred pod weight (g) compared to GG 20 (91g). Number of pods per plant was highest in four mutants (# 39, #206, #636 and 691) each had 34 pods compared to 15 pods in GG 20. Mutant 423 showed as high as 88 seeds per plant compared to GG 20 (24 seeds per plant). Two mutants #206 (20g) and #39 (18g) showed high seed weight per plant than GG 20 (10g). Pod yield per plant was highest in three mutants #206 (27g), #39 (26g) and # 691 (23g) compared to GG 20 (14g).

Conclusions

Mutagenesis by EMS treatment generated considerable variation forpod and seed yield traits. Of the total of 798 mutants, more than 20 mutants showed superior pod and seed yield attributes than GG 20. It has been observed that the lower dose of mutagen (0.2% - 0.3% EMS) could able to produce desirable mutants for pod and seed yield. The superior mutants identified in M_4 generation with respect to pod yield per plant could be useful donors in Virginia breeding programme.These mutants need to be evaluated for furtherconfirmation in large scale evaluation.

Table-3 : Desirable mutants for pod and seed yield isolated in M_3 generation.

Treat	Mutant	PN	Treat	Mutant	PWT	Treat	Mutant	SN	Treat	Mutant	SWT	Treat	Mutant	HPW	Treat	Mutant	SP
T_1	39	34	T_2	206	27.2	T_2	423	88	T_2	206	20	T_1	55	160	T_2	288	79
T_2	206	28	T_1	39	26.9	T_2	206	52	T_1	39	18	T_2	423	148	T_2	216	79
T_4	636	28	T_4	691	23.6	v	714	49	T_4	666	17	T_2	144	143	T_1	86	78
T_4	691	28	T_4	666	23.1	T_1	39	48	T_4	691	16	T_2	381	135	T_2	317	78
T_4	666	26	T_4	636	22.4	T_4	691	48	T_2	307	16	T_2	389	130	T_2	312	78
T_4	714	26	T_1	106	22	T_1	106	47	T_4	714	16	T_3	543	130	T_2	297	78
T_1	106	25	T_4	669	21.5	T_4	636	45	T_1	106	16	T_3	471	128	T_1	121	78
T_2	157	25	T_4	714	21.4	T_4	669	45	T_4	636	15	T_2	446	125	T_4	737	78
T_4	637	25	T_2	307	21.3	T_4	666	44	T_4	669	15	T_2	284	124	T_1	71	78
T_4	669	25	T_4	673	21.2	T_4	740	42	T_2	162	14	T_2	239	123	T_1	50	78
T_4	739	25	T_2	162	20.4	T_2	211	42	T_2	294	14	T_1	100	123	T_1	40	78
T_2	162	24	T_2	294	19.5	T_4	739	42	T_4	637	14	T_2	327	123	T_2	422	78
T_2	211	24	T_2	157	18.8	T_4	673	40	T_2	157	14	T_2	405	123	T_2	254	78
T_3	559	24	T_3	509	18.7	T_2	162	40	T_3	509	13	T_2	154	122	T_2	448	77
T_3	509	23	T_4	637	18.6	T_2	307	39	T_2	344	13	T_3	588	121	T_2	300	77
T_4	647	23	T_2	226	18.2	T_2	157	39	T_1	70	13	T_2	406	120	T_5	806	77
T_4	673	23	T_5	812	18.1	T_4	637	39	T_2	226	13	T_2	392	119	T_2	319	77
T_4	683	23	T_2	325	18	T_4	702	39	T_5	812	13	T_2	434	119	T_1	38	77
T_4	740	23	T_2	344	18	T_2	304	39	T_2	302	13	T_4	724	118	T_2	182	77
T_2	226	22	T_2	285	17.9	T_2	226	38	T_2	325	13	T_2	295	118	T_2	337	77
T_2	307	22	T_4	740	17.8	T_3	509	37	T_2	285	13	T_5	742	118	T_1	118	77
T_3	506	22	T_2	302	17.8	T_3	595	37	T_4	740	13	T2	268	117	T_2	159	77
T_2	269	21	T_3	595	17.7	T_2	302	36	T_4	720	13	T_3	616	117	T_2	214	77
T_3	595	21	T_1	70	17.5	T_4	720	36	T_3	595	12	T_1	94	116	T_2	171	77
	GG 20	15		GG 20	13.6		GG 20	24					GG 20	91.8		GG 20	71

C = Control (GG 20), T_1 = 0.2% EMS, T_2 = 0.3%, T_3 = 0.4%, T_4 = 0.5%, T_5 = 0.6%
PN = Number of pods per plant, PWT = Pod yield per plant, SN = Seeds per plant, SWT = Seed yield per plant, HPW = Hundred pod weight, SP = Shelling out turn (%)

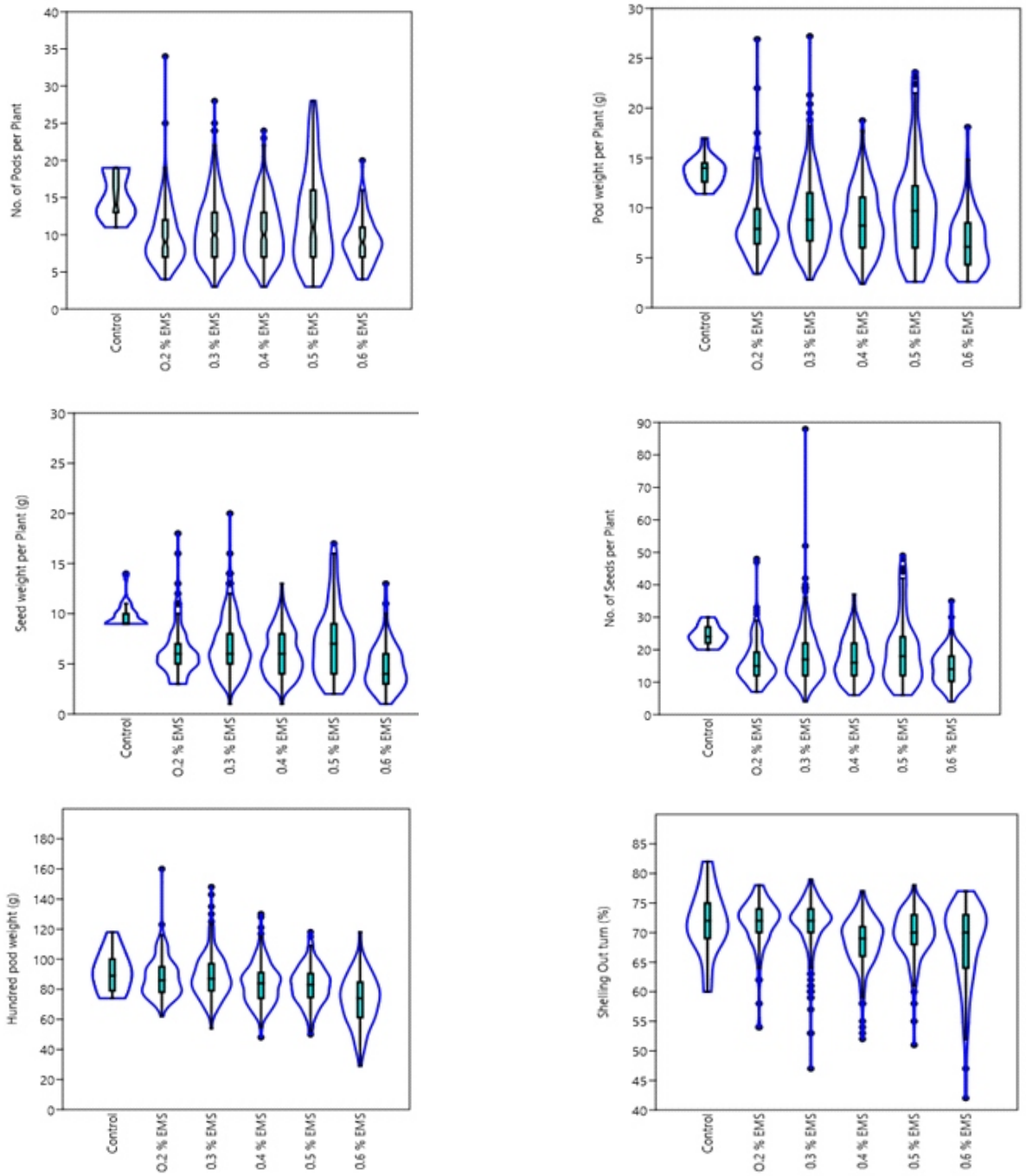

Fig-1 : Violin box plot variation for pod and seed yield among different EMS treatments in M_3 generation of GG 20.

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