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Assessment of variability created through chemical mutagen in mungbean [*Vigna radiata* (L.) Wilczek]

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Abstract
The present experiment was conducted during *Kharif* 2022 with mutagen treated (EMS 0.1%, 02%, 0.3%, 0.4%.0.5%) 360 M_2 progenies of Mungbean variety Shikha in augmented design. Analysis of variance (Table-1) revealed that, between progenies show highly significant differences between the M2 progenies for all the characters studied, the 'within progeny variances however, were found not significant for all the characters. progenies in each treatment groups recorded a wider range of values than the control but their mean values was closely comparable to control mean. Although, their coefficient of variances was comparable to each other but higher than the control variance.

Keywords: Mutation, variability, ethyl methane sulphonate, Mungbean

Introduction
Pulses are an important group of food crops that play a key role in national food & nutritional security and the availability of quality proteins to the country's predominantly vegetarian population. It's a good source of plant-based proteins, vitamins, and minerals that's also inexpensive. Mungbean [*Vigna radiata* (L.) Wilczek], also known as greengram is an ancient pulse crop widely cultivated in India. High protein, easy digestibility and low flatulence production made this crop more acceptable by the people world over. Mungbean is a short day, warm-season crop, grown mainly in arid and semi-arid regions it is a self-pollinated crop belongs to family Fabaceae and sub family papilionaceae with chromosome number 2n=2x=22 (genome size of 579 Mb). The origin of crop is considered in India. Mungbean has 24-26% protein which is nearly 2.5 times more than cereals. Its seeds contain about 124 mg calcium, 326 mg phosphorus, 7.3 mg iron, 1.3% fat, 4.1% fiber and having 334 kcal calorific value. Therefore, induction of mutation of mutation is the only alternative leaf to increase variability.

Material and Methods
The present investigation was carried out during *Kharif*-2022 at Agricultural Research Station, Ummedganj, Agriculture University Kota, Rajasthan. Sowing was done on July 14, 2022. The experimental material consisted of 360 ethyl methane sulphonate (0.1%, 02%, 0.3%, 0.4%.0.5% and 0.6%) mutagen treated M_2 progenies was evaluated in augmented design These M_2 progenies were sown in single row of three-meter length during *kharif*-2022. The check variety *viz*, Shikha was repeated after every 60 rows of M_2 progenies. The distance between plant to plant and row to rows was maintained at 10 cm. x 30cm, respectively. The recommended agronomic package & practices and plant protection measures were followed to raise good and healthy crops. Observations recorded for 9 characters *viz*., days to 50 percent flowering, days to maturity, plant height (cm), number of branches per plant, number of pods per plant, pod length(cm), number of seeds per pod, 100-seed weight and seed yield per plant(g) were subjected to genetic variability analysis using standard procedures.

Results and Discussion
Analysis of variance (Table-1) revealed that, between progenies show highly significant differences between the M2 progenies for all the characters studied (Table -1). The equal number of progenies were taken from different mutagenic treatments; therefore, they were also examined for their contribution towards the variances. For all the characters the treatment component of "between progeny" variance was highly significant.

The progeny within treatment component of the variance was also highly significant for all the characters except test Wight however, the 'within progeny variances however, were found not significant for all the characters.

The estimation of mean, range & coefficient of variation are presented in Table-2. A perusal of the data revealed the following

a. The range exhibited by M2 progenies was invariably wider than the control for all the characters.
b. The mean of various treatment groups was more or less comparable to each other's.
c. The coefficient of variation (CV) values of certain characters such as plant height (cm), yield per plant, number of pods per plant and 100 seed weight were relatively higher than the remaining characters. Similar results confirm by Khan and Wani (2006) [10], Bolbhat and Dhumal (2009) [1], Khan and Goyal (2009), Selvam *et al*. (2010) [6], Sri devi and Mullainathan, (2012) [8], Nair and Mehta (2014) [5], Vairam *et al*. (2017) [9] and Mahto *et al*. (2018) [3].

In Table-3, twenty-five high yielding progenies have been listed in their decreasing order of magnitude. Besides the mean and CV of yield per plant the magnitude of mean and CV in respect of other yield attributes have also been mentioned. This Table revealed that these progenies are often associated with significantly higher mean for plant height, branches per plant, and no of pods per plant further, for most of the characters including yield per plant, the CV among the elite progenies was considerably higher than the control. Similar results confirm by Singh *et al*. (2000) [7], Khan *et al*. (2006) [2], Bolbhat and Dhamal (2009) [1], Selvam *et al*. (2010) [6], Sri devi and Mullainathan, (2012) [8], Nair and Mehta (2014) [5], Vairam *et al*. (2017) [9] and Mahto *et al*. (2018) [3].

Table 1: Analysis of variance of various quantitative traits in M_2 generation of mungbean.

Source of variance	DF	Mean sum of squares of various traits								
		Days to 50% flowering	Days to 75% maturity	Plant height (cm)	No. of branches per plant	No. of pods per plant	Pod Length (cm)	No. of seeds per pod	100 seed Weight (g)	Seed yield (g)
Between progenies	359	9.3646**	8.5195**	18.1370**	1.1284**	10.7283**	0.1793**	0..8272**	0.0673**	0.5114**
Treatment	5	93.9800**	80.3111**	120.7565**	2.3974**	35.8401**	1.3550**	7.3923**	0.3671**	4.1904**
Progeny within treatment	354	1.8406**	1.7001**	2.3446	0.2111	1.7094	0.0306	0.1418	0.0116	0.0716
Within progenies	1440	1.5559	1.4272	3.5260	0.2211	2.1300	0.0325	0.1418	0.0127	0.0954
Control	59	165.4110	365.307	78.8361	2.8100	5.5242	2.5410	6.8998	0.6258	0.6986

*Significant at p=0.05 & **significant at p=0.01level of significance

Table 2: Mean, rang and coefficient of variation observed for various quantitative traits in M_2 generation of mungbean.

Character		Control	Ethyl methane sulphonate treatment					
			0.1% EMS	0.2% EMS	0.3% EMS	0.4% EMS	0.5% EMS	0.6% EMS
Days to 50% flowering	Mean	42.50	44.53	44.69	42.85	42.68	44.58	41.75
	Range	41-44	41-48	39-53	38-48	38-51	38-50	38-46
	CV	3.94	0.62	1.93	0.82	0.99	1.02	0.63
Days to maturity	Mean	63.17	64.88	65.46	63.65	63.35	65.07	62.48
	Range	62-66	61-68	60-73	58-68	58-72	58-70	58-68
	CV	3.94	0.37	1.78	0.52	0.67	0.64	0.47
Plant height (cm)	Mean	29.33	32.56	30.27	33.24	29.68	30.79	32.32
	Range	27.60-30.40	21.80-40.4	25.2-34.6	21.2-41.6	22.6-40.8	23.8-39.2	26-41.4
	CV	3.94	1.75	2.06	2.55	1.78	1.71	1.61
No. of branches per plant	Mean	5.54	5.90	6.13	5.73	5.95	5.60	6.02
	Range	5.40-5.64	4.60-8.00	3-10.8	4.8-7.5	4.4-8.8	4-7.1	4.2-7.2
	CV	3.94	1.49	4.49	1.54	1.85	1.68	1.71
No. of pods per plant	Mean	7.75	7.94	6.79	9.30	9.20	7.71	8.05
	Range	7.10-8.60	5.00-15.0	3-14.8	5.2-16.4	5.2-19.8	4.4-12.2	5-11
	CV	3.95	3.33	5.03	3.27	3.92	3.11	2.64
Pod length (cm)	Mean	5.27	5.60	5.60	5.92	5.59	5.52	5.76
	Range	5.0-5.4	5-6.40	4.8-6.6	5-7.3	4.8-6.9	5-6.2	5-7.1
	CV	3.94	1.03	1.86	1.06	0.85	0.80	0.90
No. of seeds per pod	Mean	8.67	9.56	9.42	10.40	9.76	9.52	9.78
	Rang	7.80-9.0	7.0-11.0	7.2-11.4	7-12.4	8-11.6	7-11.2	8-11.6
	CV	3.95	1.14	2.00	1.13	1.12	1.28	1.11
100 seed weight (g)	Mean	2.23	2.84	2.91	2.90	2.89	2.73	2.74
	Rang	3.50-5.79	2.40-3.80	2.5-3.8	2.5-3.5	2.6-3.4	2.2-3.2	2.5-3.1
	CV	4.24	1.47	2.18	1.10	1.10	0.96	0.65
Seed yield per plant (g)	Mean	2.73	3.14	2.85	3.51	3.27	2.91	2.89
	Rang	2.54—6.37	2.09-5.38	1.06-6.92	2.02-5.12	2.08-4.5	1.56-3.76	1.8-3.64
	CV	4.28	2.99	4.53	2.47	2.53	2.21	2.44

Table 3: Magnitude of various yield attributed of M_2 progenies showing higher seed yield per plant in mungbean.

Prog any no.	Seed yield per plant (g)		Plant height (cm)		No. of Branches per plant		No. of pods per plant		Pod length (cm)		No. of seeds per pod		100 seed weight (g)	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
79	6.92**	21.47	34.8	11.81	7.00	18	7.8	12.43	5.8	6.89	9.8	9.89	3.8	2.36
4	5.38**	19.47	38.63	14.57	4.60	21.95	9.20	39.67	6.00	7.12	10.40	9.32	2.70	3.70
184	5.2**	16.15	40.6	1.18	6.3	6.82	14.8	33.44	5.5	8.0	9.5	8.84	3.2	3.12
135	5.12**	9.96	40	2.72	6.2	12.90	10.4	4.61	6.0	6.98	10.4	4.61	3.0	2.33
162	5.12**	18.35	39.6	2.55	6	10.5	11.8	21.06	5.99	4.76	10.52	4.70	3.5	2.85
191	5.1**	2.74	33.2	9.1	5.4	4.28	11.2	13.03	5.6	8.57	10	6.3	3.4	7.35
117	5.1**	18.0	32.8	3.53	7.2	20.27	15	14.6	6.2	8.06	9.6	10.52	3.4	3.82
323	5.1**	29.21	31.6	6.74	6.2	7.25	10.2	7.25	5.2	25.38	10.2	13.82	2.8	2.14
126	5.08**	11.6	38.6	12.61	5.4	16.48	11.8	24.74	6.3	7.61	10.8	10.74	2.6	2.30
13	4.88**	15.57	31.40	8.66	7.00	20.14	9.20	20.10	5.80	6.89	10.60	9.15	2.90	1.37
178	4.62**	34.41	38.6	6.86	5.6	7.42	13.6	65.36	6.9	2.89	11	8.09	3.0	4.0
12	4.62**	14.50	31.60	10.69	6.20	16.29	15.00	17.33	5.80	6.89	10.20	15.68	2.50	2.8
166	4.52**	8.62	40.8	1.87	5.9	10.67	12.8	12.5	6.1	3.27	10.4	4.61	3.2	2.18
110	4.5**	21.11	34.6	6.67	4.8	30.41	9.4	18.93	5.5	8.0	10	12	3.0	5.66
114	4.5**	15.5	25.6	5.82	4.6	32.39	11.6	15.94	6.4	7.5	10.8	6.85	3.8	12.10
124	4.45**	20.67	33.2	6.11	6.4	15.78	13	39.46	6.5	7.38	12.4	9.35	2.7	2.59
5	4.44**	11.7	39.00	1.89	6.00	10.5	11.20	0.30	6.00	5.67	10.20	9.50	2.66	5.26
168	4.42**	17.64	41.6	2.42	5.2	6.37	11.6	25.86	5.1	3.92	9.2	8.04	3.2	3.75
194	4.4**	8.88	30.4	9.18	5.8	4.93	15	21.46	6.0	7.65	9.4	10.74	3.1	5.80
120	4.38**	14.61	33.4	9.91	6.4	7.5	14.4	18.88	5.5	10.90	10.2	7.26	3.0	13
9	4.32**	10.41	30.80	2.40	6.20	16.29	8.20	14.14	5.40	7.40	11.00	8.09	2.70	3.70
130	4.22**	30.33	37.6	10.55	6.2	25.80	16.4	45.54	6.4	6.25	11.2	11.78	2.6	1.53
196	4.22**	9.71	26.8	9.81	6.2	9.35	10.8	13.51	6	4.76	10	14.11	3.0	2.66
188	4.2**	9.76	30.4	3.32	5.6	4.36	11	14	5.6	6.60	9.34	6.74	3.3	4.24
115	4.02**	30.80	26.2	6.10	3.2	13.75	11	63.18	6.4	12.5	11.4	15.26	3.5	2.85
control	2.73	4.28	29.33	3.94	5.54	3.94	7.75	3.95	5.27	3.94	8.67	3.95	2.23	4.24

Conclusion

The statistical analyses recorded that the analyses of variance revealed that mean squares between the progenies were highly significant for all the traits studied. However, variance within progenies showed non-significant differences for all the traits. The range exhibited by M2 progenies was invariably wider than the control for all the characters. Twenty-five high yielding progenies have been listed in out of 360 progenies. Progenies showing highly significant mean value coefficient of variation then the control, showing segregation which provide possibility for further improvement through selection.

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