

# Evaluation of M<sub>1</sub> Generation Yield and Yield Attributes in Blackgram (*Vigna mungo* L. Hepper) Mutant Under EMS Induced Mutagenesis

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**Abstract** – The present research work was carried out with the blackgram accession (IC 436524) collected from NBPGR regional centre, Hyderabad, at experimental farm, Department of Genetics and biotechnology, Osmania University, Hyderabad. The seeds of Blackgram (IC 436524) were treated with EMS at different four concentration viz., 0.2, 0.3, 0.4, 0.5%. The treated seeds (M<sub>0</sub>) were sown in pots in three replications. The observation was recorded in yield and yield contributing traits. The results showed that the significant variability was found among the blackgram mutants due to treatments for all traits except 100 seed weight. The results also showed that the yield and other yield contributing characters recorded higher at lower EMS concentration and lower at higher EMS concentration. The overall results revealed that the selected blackgram mutant grown under 0.2% EMS concentration has showed higher seed yield among all other mutant and untreated blackgram genotype. The mutant could be useful for development of higher yield genotypes in further crop developments and also for farmer benefit.

**Keywords** – Blackgram, EMS (Ethyl Methane Sulphonate), Mutagenesis, M<sub>1</sub> Generation and Seed Yield.

## I. INTRODUCTION

Blackgram (*Vigna mungo* L. Hepper) also known as urad, mash bean is one of the most economically important legume crops of South-East Asia and it is widely adapted to both semi-arid and sub-tropical areas. It is a self pollinated, diploid legume belongs to the family Leguminaceae under the genus *Vigna* and subgenus *Ceratotropis*. The seeds are good source of protein, carbohydrates, calcium and phosphoric acid and is popular for its fermenting action. (Chaturvedi *et al.*, 2019). Despite its importance, the crop however has very limited genetic variability (Arvind Kumar *et al.*, 2007) Therefore, development of new plant types for different agro climatic regions is required. The major limitation in improving the blackgram production in India were lack of high yielding varieties. Artificially induced mutations are the best way to enlarge genetic variability considerably within a short time. Mutagenesis has been widely used as a potent method of enhancing variability for crop improvement (Singh and Singh, 2001; Sanjay, 2012; Patil *et al.*, 2003;). Use of induced mutants in the breeding programmes for developing superior varieties is known as mutation breeding which has been used extensively for developing new crop cultivars and for changing the plant traits. (Wongpiyasatid *et al.*, 2000) Mutations may induce both qualitative and quantitative variation comparatively in a shorter time by altering alleles at known loci as well as at previously unknown loci, besides altering linkage groups. (Ahloowalia *et al.*, 2004). Ethyl Methane Sulphonate (EMS) is mutagenic and carcinogenic organic compound, it produces random mutations in genetic material by nucleotide substitution; particularly by guanine alkylation and it is reported to be the most effective and powerful mutagen and typically produces only point mutations (Dixit *et al.*, 2000). For inducing morphological mutations, EMS doses are between 0.01 to 0.8%. The dose to be used in the treatment varies from species to species with very small differences. Optimum dose of mutagen produces the maximum

frequency of mutations with minimum hazard. An optimum dose can be determined with a preliminary treatment. Over doses of mutagens will kill too many plants while under dosing will produce low mutation frequencies (Solanki *et al.*, 2011). However, lower frequencies may give an advantage of having fewer undesirable background mutations being induced in addition to the mutation being sought. (Sonu Goyal and Saimullah Khan *et al.*, 2010; Hajara, 1979).

## II. MATERIALS AND METHODS

The present research work was carried out at experimental farm, Department of Genetics, Osmania University, Hyderabad during *Kharif* season, 2021. The black gram accession IC436524 was collected from NBPGR, regional centre, Hyderabad. Based on our previous studies along with other genotypes, the accession IC-436524 has performed same trend for yield parameters under three seasons and identified this genotypes giving moderate yield and has not showed deviation in yield and yield contributing traits. Hence we want to study the yield related traits by using chemical mutagen EMS which could be utilized to develop new varieties in Blackgram. (Sonu Goyal *et al.*, 2010) The chemical mutagen of EMS was obtained from HIMEDIA Laboratory limited, Mumbai, India. For EMS mutagen treatment, healthy and uniform size of blackgram (IC436524) seeds (100) were surface sterilized with 0.1% mercuric chloride solution for about one minute, washed thoroughly and soaked for 6 hrs in distilled water and treated with EMS in four different concentrations *viz.*, 0.2, 0.3, 0.4 0.5% and control (untreated). Keep the above five sets in incubator shaker at 180 rpm at room temperature of ( $27 \pm 1$  °C) for 3 hrs. After three hrs, the seeds were thoroughly washed in running tap water to remove the residual mutagen from seed surface. The treated seeds ( $M_0$ ) of each concentration were sown in pots in farm experiment in complete randomized block design (CRD) with three replications along with untreated seeds and recorded for yield and yield contributing traits at harvest stage in  $M_1$  generation.

## III. RESULTS AND DISCUSSION

The ANOVA results of all yield and yield contributing characters *viz.*, Plant height, branches, leaves, clusters, pod number, seed number, seed yield, root length and root nodules were highly significant ( $p < 0.01$ ) for treatments and non significant for 100 seed weight showed in Table 1. The effect of induced EMS on different quantitative traits *Viz.*, Plant height, branches, leaves, clusters, pod number, seed number, seed yield, root length and root nodules showed in Fig. 1 to Fig. 10. It clearly indicates that there are ample amount of variability among the blackgram mutant due to treatments. The mean performance of yield and yield contributing traits of blackgram variety IC-436524 when treated with EMS (Ethyl Methane Sulphonate) at different concentrations ranging from 0.2% to 0.5% and compared with control showed in Table 2. The trait seed yield recorded with 2.97 gm/plant at 0.2% of EMS conc. followed by 2.29 g/pl at 0.3% of EMS conc., 2.17 g/pl at 0.4% of EMS conc., 1.69 g/pl at control and 1.42 g/pl at 0.5% of EMS conc. Similarly the other yield contributing characters *viz.*, number of pods per plant (21.00), number of seeds per plant (90.00), 100 seeds weight (3.29g/pl) has also showed highest at 0.2% of EMS concentration and followed by at 0.3% EMS conc. Plant height has been observed higher at 0.2% with 49.87 cm and also more branches 3.33 per plant followed by 45.63cm (0.3% and Control) 36.90cm (0.4%), 34.10cm (0.5%). The number of leaves per plant data shows that at 0.2% of EMS due to mutagenic effect leaves produced were more (19.33) when compared to other concentrations. The range of plant height from (34.10cm-49.97cm). The root length was recorded highest in the mutant grown under 0.2% EMS concentration (21.00 cm) followed by 18.67cm (control), 16.33 cm (0.5%), 16.00 cm (0.4%) and 14.67 cm

(0.3%) respectively. The root nodules were found to be more in number at 0.2% EMS by 81.67, followed by 71(0.3%), 65.33(control), 64(0.4%), 56(0.5%) respectively.

Table 1. Analysis of variance of blackgram mutant under EMS mutagenesis for quantitative characters.

Source of variations	DF	MSSQ									
		Characters									
		Pl. Ht(cm)	No. Br/PI	No. L/PI	No. Cl/PI	No. P/PI	No S/PI	S. Y(g)/PI	100 S. Wt(g)	R. L(cm)/PI	No. R.N/PI
Replications	2.00	41.91	0.07	10.06	0.07	0.867	32.467	0.04	0.005	1.867	106.067
Treatments	5	131.847**	1.100**	30.833**	20267**	55.100**	916.167**	1.064**	0.007NS	18.833**	269.833**
Error		8.745	0.15	2.483	0.567	4.45	41.467	0.041	0.002	2.033	18.733
SEd		2.415	0.316	1.287	0.615	1.722	5.258	0.166	0.037	1.164	3.534
CV(%)		6.9	15.29	10.74	21.3	15.59	9.960	9.61	1.41	8.23	6.4

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

Table 2. Effects of EMS on various biological parameters in M<sub>1</sub> generation of black gram.

EMS Conc.	Pl. Ht(cm)	No. Br/PI	No. L/PI	No. Cl/PI	No. P/PI	No S/PI	S. Y(g)/PI	100 S. Wt(g)	R. L(cm)/PI	No. R. N/PI
0.2%	49.87	3.33	19.33	5.00	21.00	90.00	2.97	3.29	21.00	81.67
0.3%	45.63	3.00	16.00	3.33	12.33	70.00	2.29	3.27	14.67	71.00
0.4%	36.90	2.33	14.33	3.33	12.00	66.00	2.17	3.29	16.00	64.33
0.5%	34.10	2.00	11.00	2.67	10.00	44.33	1.42	3.21	16.33	56.00
Control	45.63	2.00	12.67	3.33	12.33	53.00	1.69	3.19	18.67	65.33

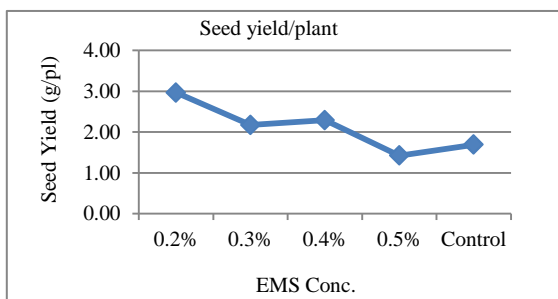


Fig. 1. Effect of of EMS on seed yield(g/pl).

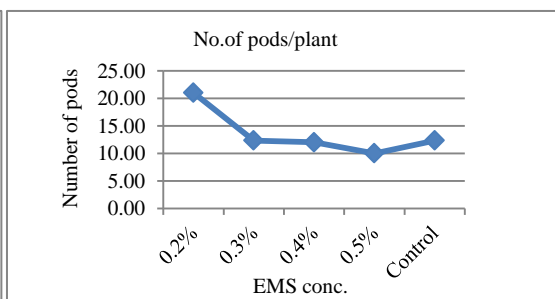


Fig. 2. Effect of of EMS on number of pods per plant.

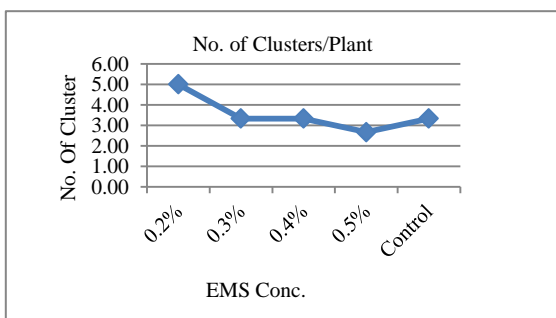


Fig. 2. Effect of of EMS on number of clusters per plant.

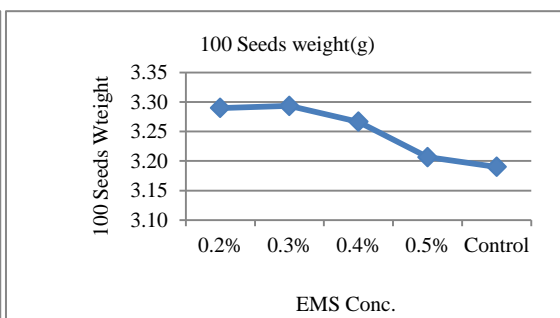


Fig. 3. Effect of of EMS on 100 seed weight (g).

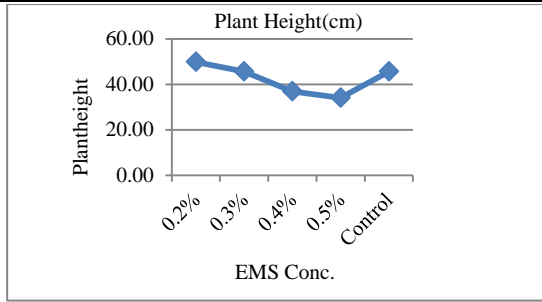


Fig. 4. Effect of of EMS on plant height (cm).

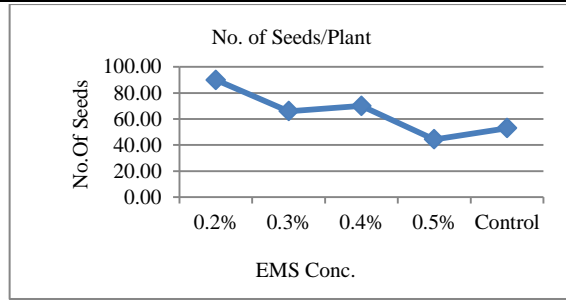


Fig. 5. Effect of of EMS on number of seeds per plant.

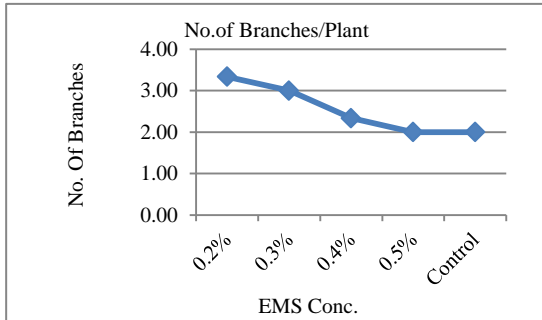


Fig. 6. Effect of of EMS on Number of branches per plant.

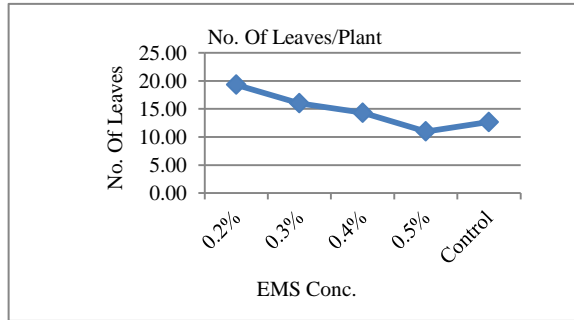


Fig. 7. Effect of of EMS on number of leaves plant.

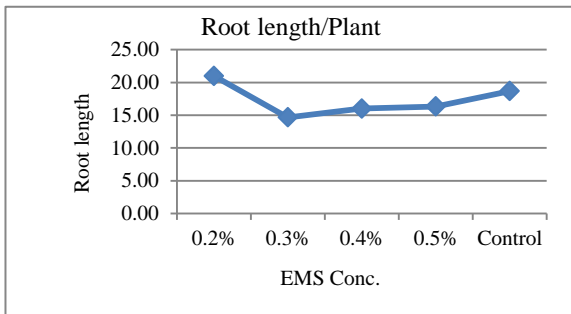


Fig. 8. Effect of of EMS on Number of branches per plant.

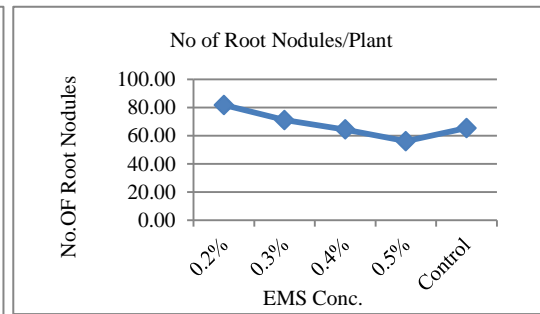


Fig. 9. Effect of of EMS on number of leaves plant.



A

B

C

D

Fig. 10. A-Pot experiment in net house; B-No. of pods per plant; C-Pod Character; D-No. of Clusters.

The overall results revealed that all ten traits studied as listed in Table 2 recorded highest at 0.2% EMS concentration and followed by 0.3% EMS conc. It indicates that 0.2% EMS is the feasible dose for creating variability in the present blackgram accession under study. As concentration has increased mutagenic effect on seed yield decreased and seed yield has reduced. (Asad Ali *et al.*, 2014) The number of pods produced per plant has reduced (same number of pods were observed at 0.3% and at control) from low to high concentration. The

significant reduction of seed yield and yield contributing traits from 0.2% to 0.5% EMS was observed in our present study due to influence of mutagenic treatment with increasing EMS concentration (Sonu Goyal *et al.*, 2020). Plant height was also found to be significantly reduced from 0.2% to 0.5% EMS conc. at higher conc, plant height was stunted (Ramya *et al.*, 2014; Zaka *et al.*, 2004; Gunckel and Sparrow 1961). Root length and root nodules per plant were observed high and more in blackgram mutant which grown at lower EMS conc. (0.2%) and lower at higher EMS conc. The assumptive origin of these stimulations by EMS treatments was due to cell division rates and an activation of growth hormone, e.g., Auxin (Zaka *et al.*, 2004 and Gunckel and Sparrow 1961). Number of clusters, number of seeds per plant, number of pods per plant and 100 seed weight has significantly observed higher at lower EMS conc. and lower at higher EMS conc. It means higher EMS doses might have reduced the number of clusters, seeds, pods, 100 seed weight (LD50 at 0.5%). Similar results were reported in the quantitative parameters such as number of primary branches per plant, number of cluster per plant, number of pods per plant, pod length, number of seeds per pod and plant yield per ha; they all decreased in gamma rays and ethyl methane sulphonate treatment than in control in M<sub>1</sub> generation of *Vigna mungo* (Tamilzhzrasi *et al.*, 2021; Ramya *et al.*, 2014). Lower doses of gamma rays and EMS were ineffective for creation of desired variability for yield and yield components in lentil (Singh *et al.*, 2006). Singh *et al.*, 2006b; have been reported the improvement in number of branches and pods due to the effect of mutagens in various pulses. An increase in mean values for pods as well as yield per plant in M<sub>1</sub> generations was observed in the variety T-9 (Kundu and Singh, 1982). Pods per plant exhibited high variability in M<sub>1</sub>, generations of urdbean varieties Vamban 1 and ADT 3 treated with 20-90 kR gamma rays (Hepziba and Subramanian, 1994). The highest level of variability was observed in pod length after gamma irradiation and in number of pods per plant after EMS treatment in the urdbean cultivars ADT-3 and Vamban 1 (Vanniarajan *et al.*, 1996). Mean values of three characters viz., plant height, pods per plant and yield per plant were negatively affected by gamma rays treatment of TAU 1 (Manapure *et al.*, 1998). The overall results revealed that the selected blackgram mutant grown under 0.2% EMS concentration has showed higher seed yield among all other mutant and untreated blackgram genotype. The mutant could be useful for development of higher yield genotypes in further crop developments and also for farmer benefit.

#### **IV. CONCLUSION**

It can be concluded that the selected blackgram mutant grown under 0.2% EMS concentration has showed higher seed yield among all other mutant and untreated blackgram genotype. The mutant could be useful for development of higher yield genotypes in further crop developments and also for farmer benefit.

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