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Studies on effect of physical and chemical mutagens on *Vigna mungo* (L.) Hepper

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Abstract

Mutation breeding is one of the trending methods in the development of desirable mutant. Induced mutagens including both physical and chemicals are commonly used in crop improvement. The present investigation was conducted during the kharif season of 2022; seeds of black gram [*Vigna mungo* (L) Hepper] were treated with sodium azide 0.01, 0.02, 0.03%, ethyl methane sulphonate 0.05, 0.10, 0.15% and exposed to gamma rays doses at 10, 20, 30, 40, 50 and 60 KR to determine the effects on morphological characters. Wide range of chlorophyll and viable morphological mutations affecting almost all the parts of plant and were isolated in M_2 generation.

Keywords: *Vigna mungo;* Black gram; Gamma rays; Sodium azide (SA); Ethyl methane sulphonate (EMS)

1. Introduction

'Black gram' [*Vigna mungo* (L.) Hepper] contains vegetable protein and supplement to cereal based diet. It plays an important role in Indian sub-continent and Southeast Asian diet [1]. It is enrich in proteins, minerals and vitamins. Blackgram provides a major share of the protein requirement of the vegetarian population of the country [2]. It is highly useful for the diabetic person and sexual problems including impotency, premature ejaculation and thinness of the semen. Mutation breeding is one of the conventional breeding methods in plant breeding. The chlorophyll mutation frequency in M_2 generation is the most dependable index for evaluating the genetic effects of mutagenic treatments [3]. The purpose behind current investigation was to generate informative data on the magnitude of impact of induced mutagens like Sodium azide (SA), ethyl methane sulphonate (EMS) and gamma rays of different concentrations on black gram.

2. Material and methods

2.1. Experimental site

All the experimental field work has been carried out at Pangari, Dist. Parbhani while laboratory work in Government Institute of Forensic Science, Aurangabad (MS), India.

2.2. Experimental plant material

The seed samples used in present investigation were obtained from Agriculture Research Station Badnapur, Dist. - Jalna, Maharashtra, India.

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2.3. Mutagenic treatment

The dry seeds were exposed to 10, 20, 30, 40, 50 and 60 KR gamma radiations at Government Institute of Forensic Science, Aurangabad. Different concentrations of SA 0.01, 0.02, 0.03% and EMS 0.05, 0.10, 0.15% were made for the mutagenic treatments. Healthy and well dried seeds with uniform size were surface sterilized with 0.1% mercuric chloride ($HgCl_2$) solution for about one minute and washed thoroughly with distilled water. Seeds were presoaked in distilled water for 6 hours. The mutagenic chemicals were prepared freshly in aqueous medium at room temperature of 25 ± 2 °C prior to treatment. Presoaked seeds were immersed in the mutagenic solution and conical flasks were kept on electric shaker. The treatment was given for 6 hours of SA and 5 hours of EMS with intermittent shaking.

2.4. Sowing of Mutagen Treated Seeds

The post soaked seeds for 2 hours were dried in folds of blotting filter paper. Seeds of each doses along with equal number of control (untreated) seeds were grown in randomized block design to study the M_1 generation during kharif (rainy season) 2022, all the surviving plants were selfed and harvested individually to raise the M_2 generation, M_2 population was screened in next rainy season.

3. Results and discussion

The data recorded on different morphological aspects and physical characters of mutagen treated population were statistically analyzed separately and the details of analysis of standard mean and standard error are furnished in Tables 1 and 2. In the present study, Germination percentage, Seedling height (cm), Plant height (cm), No. of leaves/plant, No. of pods/plant, No. of seeds/pod, 100-seed weight, Seed yield per plant (g), Survival at Maturity (%) was recorded in M1 generation while in M_2 different viable mutant recorded. Seed germination was determined in the laboratory as well as on field. Increase in per cent seed germination was recorded due to SA 0.02 and EMS 0.05%. Among all the treatments, 10 kR Gamma rays recorded highest percentage of seedling height and no. of leaves per plant. EMS 0.05% shows lowest lethality. SA 0.02 and EMS 0.05% shows highest frequency of morphological and chlorophyll mutants in M_2 generation. Budhavant & Ambhore (2023) reported similar kind of results in M_1 generation [4]. Overall the significant positive and beneficial mutant lines was observed in SA 0.02, EMS 0.05% and 10 kR gamma rays treatment after M_2 generation.

Table 1 Effect of Chemical Mutagenic treatments of SA and EMS on different morphological characters in M_1 of Black gram

Sr. No.	Character Observed	Chemical Treatments						
		Control	SA (%)			EMS (%)		
			0.01	0.02	0.03	0.05	0.10	0.15
1	Germination %	90	90	100	90	100	80	80
2	Seedling height (cm)	5.46±0.335	6.73±0.346	6.46±0.424	6.31±0.247	6.01±0.375	6.66±0.332	6.85±0.431
3	Plant height (cm)	38.2±0.372	45.7±0.341	40.8±0.352	42.3±0.435	49.9±0.337	45.6±0.330	48.7±0.346
4	No. of leaves/ plant	11.00±0.281	12.62±0.277	15.6±0.214	13.77±0.263	11.22±0.255	11.11±0.218	9.71±0.233
5	No. of pods/ plant	17.55±0.342	13.87±0.323	21.5±0.387	15.55±0.351	17.55±0.320	18.55±0.337	16.28±0.357
6	No. of seeds/ pod	4.55±0.284	5.12±0.256	6.1±0.245	4.77±0.278	4.88±0.266	4.77±0.234	4.85±0.256
7	100-seed weight	4.96	4.89	4.92	4.78	4.90	4.71	4.69
8	Seed yield per plant (g)	6.84±0.321	6.60±0.365	6.86±0.266	6.71±0.367	5.98±0.227	6.80±0.286	5.88±0.220

9	Survival at Maturity(%)	70	80	90	70	100	70	65

Table 2 Effect of Physical Mutagenic treatments of Gamma rays on different morphological characters in M_1 of Black gram

Sr. No	Character Observed	Control	Physical Treatments (Gamma Ray)					
			10 kR	20 kR	30 kR	40 kR	50 kR	60 kR
1	Germination %	90	90	90	90	80	80	80
2	Seedling height (cm)	5.46±0.335	6.95±0.264	6.13±0.245	5.33±0.212	5.42±0.234	5.46±0.289	5.35±0.241
3	Plant height (cm)	38.2±0.372	37.5±0.384	45.8±0.312	42.8±0.343	47.5±0.322	38.4±0.362	35.9±0.385
4	No. of leaves/plant	11.00±0.281	15.22±0.331	11.88±0.361	12±0.342	10.75±0.384	9.25±0.361	9.75±0.330
5	No. of pods/ plant	17.55±0.342	21.1±0.359	16.77±0.311	17.7±0.348	20.62±0.391	16.87±0.363	16.25±0.310
6	No. of seeds/pod	4.55±0.284	5.66±0.431	4.77±0.394	3.77±0.386	4.75±0.367	4.37±0.384	4.25±0.386
7	100-seed weight	4.96	4.87	4.84	4.81	4.69	4.72	4.66
8	Seed yield per plant (g)	6.84±0.321	6.81±0.364	6.74±0.378	6.67±0.322	6.40±0.347	5.94±0.364	5.88±0.319
9	Survival at Maturity(%)	70	90	70	70	60	60	50

Table 3 Effect of Mutagenic treatments of SA, EMS and Gamma rays on frequency of mutant in M_2 of Black gram

Sr. No.	Character Observed	Treatments												
		Control	SA (%)			EMS (%)			Gamma Ray (kR)					
			0.01	0.02	0.03	0.05	0.10	0.15	10	20	30	40	50	60
1	Total No. of Plants observed	180	180	200	180	200	160	160	180	180	180	160	160	160
2	Total No. of Chlorophyll mutants	-	4	3	2	5	4	3	4	1	2	3	3	2
3	Total No. of Leaf morphological mutants	-	1	5	4	4	2	1	2	5	3	2	1	2
4	Total No. of Fruit (Pod) morphological mutants	-	2	4	4	3	3	2	4	3	3	2	2	1
5	Total Frequency (%)	-	3.88	6.00	5.55	6.00	5.62	3.75	5.55	5.00	4.44	4.37	3.75	3.12

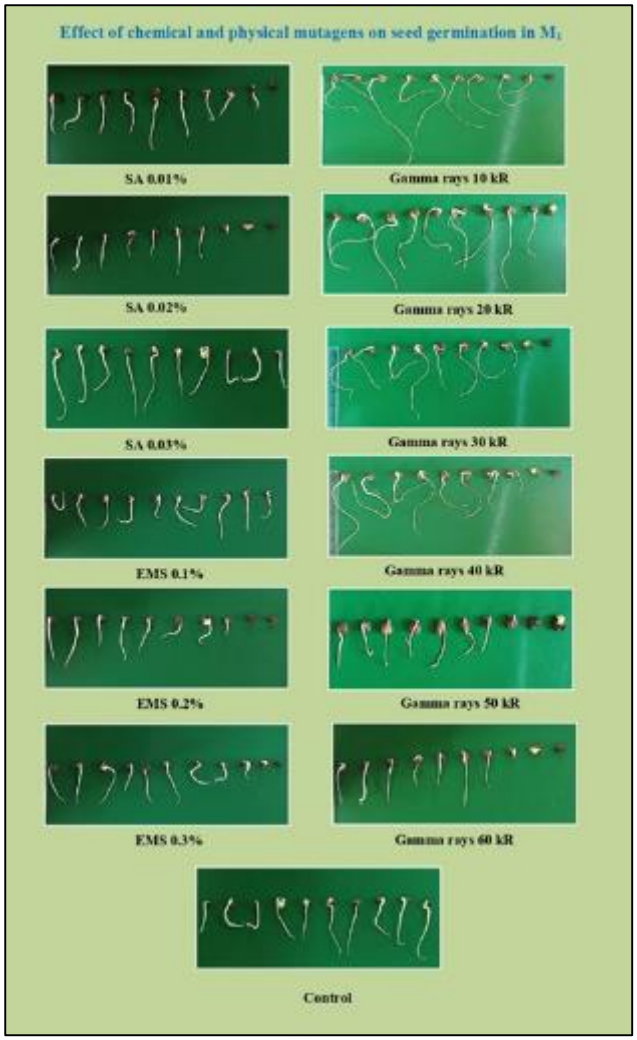

Figure 1 Effect of Chemical and Physical mutagens on seed germination

Figure 2 Morphological mutants observed in M_2 generation

4. Conclusion

Present research work was carried out to check the effect of physical and chemical mutagens on *Vigna mungo* (L.) Hepper. The significant positive and beneficial mutant lines was observed in SA 0.02, EMS 0.05% and 10 kR gamma rays treatment after M_2 generation which used for further study.

Compliance with ethical standards

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Disclosure of conflict of interest

This statement is to certify that all Authors have seen and approved the manuscript being submitted. We warrant that the article is the Authors' original work. We warrant that the article has not received prior publication and is not under consideration for publication elsewhere. On behalf of all Co-Authors, the corresponding Author shall bear full responsibility for the submission.

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