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RESEARCH ARTICLE

INDUCED PHYSICAL AND CHEMICAL MUTAGENIC STUDIES IN M1 GENERATION OF MUNGBEAN [*Vigna Radiata*(L.)WILCZEK]

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ABSTRACT

The Mungbean [*Vigna radiata* (L.) Welczek] is one of the most important pulse grain crops of the Indian subcontinent having a high amount of protein. In the present study seeds of two varieties of mungbean were with gamma rays (100Gy, 200 Gy, 300Gy and 400Gy), EMS, and SA (0.1%, 0.2%, 0.3%, and 0.4%) respectively. In the M_1 generation, it was noted that physical mutagen gamma rays showed a comparatively higher percentage of germination than chemical mutagens EMS and SA. It also showed a higher rate of survival and plant fertility. The rate of germination in gamma-ray treated seeds AKM- 8802 ranged from 82 to 93.65%, and in the case of AKM-4 it was 87.30 to 88.88%, which was very close to respective controls. However, the trends observed that increase in the dose or concentration of mutagen there is a decrease in the rate of germination, rate of plant survival, and rate of plant fertility in all mutagens. These mutagens also showed a significant effect on the sterility of plants and thereby affecting fertility of the plants.

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INTRODUCTION

The Mungbean [*Vigna radiata* (L.) Welczek] is a member of the legume family Fabaceae whichis a widespread plant family andoccupies the third position as the largest family of flowering plants with approximately 650 genera and over 20,000 species (Doyle, 1944).Mungbean is an important pulse crop supplementing high plant protein in subtropical zones of globally. It is widely grown in the Indian subcontinent as a short-duration crop between two principal crops. Mungbean contains about 51% carbohydrate, 24 to 26% protein, 4% mineral, and 3% vitamins (Afzal *et al.,* 2008). Besides providing protein in the diet, Mungbean has the remarkable quality of helping the symbiotic root rhizobia to fix atmospheric nitrogen and hence enrich soil fertility(Anjum *et al.,* 2006). Worldwide efforts are being made to improve the qualitative and quantitative traits of this crop. However,it's narrowing genetic base is reportedly the major cause of concern for the breeding programs for Mungbean improvement as well as for crop production and productivity in the climate change scenario as a narrow genetic base also increase the vulnerability of this crop to various biotic and abiotic stress (Datta *et al*., 2012). Mutation induced by various physical and chemical mutagensis a way to create generic variability and creation of new varieties with improved character (Wongpiyasatid, 2000).Mutation breeding supplements conventional plant breeding as a source of increasing variability and could confirm specific improvement without significantly altering its acceptable phenotypes (Konzak *et al.,* 1996; Koche and Joshi-Saha, 2018).

Physical mutagens like gamma rays affect plant growth by altering the morphological, physiological, biochemical,and genetic features at the cellular level (Gunckel *et al.,* 1961) gamma rays and EMS can produce high ending new varieties (Khatri *et al.,* 2005; Jagadeesan and Ponniyamoorthy, 2023). Mutation breeding mainly depends upon the efficiency and effectiveness of mutagen. The required mutation depends on the option of an effective and efficient mutagenic agent (Solanki *et al.,* 1994). The current study is an attempt to induce the mutation in two mungbean cultivars, AKM-8802 and AKM-4 by gamma rays, EMS, and SA, and its M1 generation observations are presented in this article.

MATERIALS AND METHODS

Seed Material: The seeds of Mungbeanvarieties AKM-4 and AKM-8802 were obtained from Pulse Research Center, Dr. P. D. K. V. Akola (MS). Dry, uniform, and healthy seeds of Mungbean with a moisture content of 10 to 12% were used for experimental treatments.

Treatment Details: The experiment was conducted to determine the lethal dose (LD50) suitable dose of gamma rays and concentration of EMS, Sodium Azide, and duration of seed treatment. The dose of gamma rays decided after that were100 Gy, 200 Gy, 300 Gy and 400 Gy and that of EMS and sodium Azidewere 0.1% , 0.2%,0.3% and 0.4% were finally selected for the seed treatment, and duration fixed was for 4 hours. Selected seeds were soaked in distilled water for 10 hours and the wet seeds were treated with different concentrations of EMS and Sodium Azidefor 4 hours.

The untreated control was sown on either side of each plot. The seeds treated with different concentration of sodium Azide and EMS was washed thoroughly under tap water for 1 hour. The treated seeds from each treatment were used for raising M_1 generation in the field during 2021-22.

Experimental Site: The present investigation was carried out at the experimental field located at Mazod, Taluka and District Akola(M. S.). The soil type of the experimental field was slightly deep and calcareous with good drainage. The average minimum temperature was recorded as 18.65°C and the maximum as 34.63°C with an average annual rainfall of 671.09 mm (World Weather online, 2023).

RESULTS

After treatment by each mutagen with specific doses, the treated seeds of both mungbean cultivars were sown in the different plots of the experimental field. Later, the field and the growing crop in each plot were monitored closely for the rate of germination, rate of survival and rate of sterility, and fertility of plants. All the observations were noted and then the rate of germination, rate of survival, and rate of sterility in the mutagenized population was calculated. The results of AKM–8802 are presented in table 1 and that of the AKM-4 variety in table-2. The variety AKM 8802 showed 98% germination, 95% rate of survival, and 100% plant progeny. Gamma-ray-treated seeds showed germination in the range of 82 to 93.65%, the EMS-treated seeds showed germination ranging from 82.53 to 90.00 %, and SA- treated seeds showed germination rate in the range of 59.20 to 82.25%. The plant survival rate in gamma-ray irradiated progeny was between 85.33 to 98.00%, in EMS treated population it was from 54.00 to 77.19%, and in SA treated population it ranged from 70.50 to 75.65%. The fertility rate in M1 plants treated with gamma rays was between 93.80 to 100%, in EMS-treated plants it was between 87.40 to 91.70% and in SA-treated plants of AKM-8802 it ranged between 79.80 to 87.70% (Table-1). The variety AKM -4 showed 94.25% germination, 96.66% rate of survival and 100% plant progeny. Gamma-ray-treated seeds showed germination in the range of 87.30 to 88.88%, the EMS-treated seeds showed germination ranging from 80.95 to 85.71 % and SA- treated seeds showed germination rate in the range of 68.33 to 93.65%.

Table 1. Rate of seed germination, plant survival, sterility, and fertility in mutagenized M1 population of Mungbean variety AKM – 8802

Sr. No.	Treatment	Doses	Seeds Sown	Germination Rate (%)	Survival Rate (%)	Sterility Rate (%)	Fertility Rate (%)
1	Control	--	300	98.00	95.00	00	100
2	Gamma Rays	100 Gy	300	93.65	98.00	00	100
3		200 Gy	300	87.50	91.42	1.20	98.80
4		300 Gy	300	84.12	88.69	4.60	95.40
5		400 Gy	300	82.00	85.33	6.20	93.80
6	EMS	0.1 %	300	90.00	77.19	8.30	91.70
7		0.2 %	300	82.53	40.38	11.75	88.25
8		0.3 %	300	85.71	64.81	12.60	87.40
9		0.4 %	300	89.28	54.00	9.25	90.75
10	SA	0.1 %	300	82.25	75.65	12.30	87.70
11		0.2 %	300	78.33	72.50	16.25	83.75
12		0.3 %	300	65.50	68.62	17.66	82.34
13		0.4 %	300	59.20	70.50	20.20	79.80

Table 2. Rate of seed germination, plant survival, sterility, and fertility in mutagenized M1 population of Mungbean variety AKM – 4

Sr. No.	Treatment	Doses	Seeds Sown	Germination Rate (%)	Survival Rate (%)	Sterility Rate (%)	Fertility Rate (%)
1	Control	--	300	94.25	96.66	--	100
2	Gamma Rays	100 Gy	300	89.36	98.25	3.25	96.75
3		200 Gy	300	88.88	89.33	7.69	92.31
4		300 Gy	300	87.88	85.86	8.33	91.67
5		400 Gy	300	87.30	90.20	12.65	87.35
6	EMS	0.1 %	300	85.71	93.25	8.30	91.70
7		0.2 %	300	80.95	88.63	11.11	88.89
8		0.3 %	300	80.95	85.35	15.66	84.64
9		0.4 %	300	85.71	68.54	17.28	82.72
10	SA	0.1 %	300	93.65	68.55	09.65	90.35
11		0.2 %	300	80.15	63.25	16.33	83.67
12		0.3 %	300	72.66	52.36	18.22	81.78
13		0.4 %	300	68.33	46.85	21.21	78.79

A B

Fig. 1. Germination A. Control AKM- 8802 and B. 200 Gy gamma irradiated M_1 progeny

C D

Fig. 2. Germination C. Control AKM- 4 and D. 200 Gy gamma irradiated M_1 progeny

The plant survival rate in gamma-ray irradiated progeny was between 90.20 to 98.25%, in EMS treated population it was from 68.54 to 93.25%, and in SA treated population it ranged from 46.85 to 68.55%. The fertility rate in M_1 plants treated with gamma rays was between 87.35 to 96.75%, in EMS-treated plants it was between 82.72 to 91.70%, and in SA-treated plants of AKM-4 it ranged between 78.79 to 90.35% (Table-2).

DISCUSSION AND CONCLUSION

Our study results indicated that both physical and chemical mutagen has an impact on germination, growth, survival, and plant fertility. It was noted that in both varieties, the rate of germination decreases as there is an increase in the dose or concentration of chemical mutagen. Similarly, the rate of plant survival follows the same trend i.e. there is a decrease in the rate of survival as there is an increase in mutagen doses. Plant sterility in the treated population is also found to increase with an increase in mutagen doses. This also reciprocally affects the number of fertile plants in the treated population. Similar results are reported by various workers in different crop plants. Solanki and Sharma (1994) in lentils, Wongpiyasatid *et al*., (2000) and Sofia *et al*., (2019) in mungbean, Khatri *et al*., (2005) in *Brassica juncea*, Bogawar *et al*., (2017) and Aher and Koche (2023) in Cicer. Konzak *et al*., (2018) revealed that mutagens affect the growth and development of plants. From the study, it could be concluded that physical and chemical mutagens like gamma rays, EMS, and SA havea significant impact on plants' morphology, biochemistry, and genetics and thereby affect the rate of germination, survival, and fertility. These mutagens could be used to alter the genetic composition of mungbean for certain trait improvements.

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