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Gamma Ray Induced Variability in Mung bean [*Vigna radiata* (L.) Wilczek] Var.PDM-11

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Abstract: **Grains legumes including the mung bean [*Vigna radiata (L.) Wilczek]* are the important source of dietary protein for exponentially growing population in developing countries. In an attempt to generate the variability for selection of desirable variants/mutants the seeds of mung bean variety PDM-11 were irradiated at 15, 25 and 35 Krad doses of gamma radiation and the effect of mutagen on various parameters viz. germination, survival, plant height, stem perimeter, branches per plant, nodes per plant, number of leaves, leaf lamina width, leaf lamina length, number of clusters, pods per cluster, number of pods, pod length, seeds per pod, 100 seed weight, yield per plant, pollen fertility and nodules per plant in order to study the effect of mutagen over two generations. Data were subjected to statistical analysis for calculation of Actual mean ±S.E. followed by analysis of variance (ANOVA) to test the significance of mean difference due to treatment (Table 1 and 2). T-test was performed to determine the significance of difference between the treatments.**

Keywords: **Gamma radiation, mutants, Mutagen, Vigna radiata (L.) Wilczek.**

1. INTRODUCTION

Protein is the chief body building material and it is obtained from the pulses by the vegetarian People. Mung bean possesses high nutritional value due to its higher digestible protein content and so it is grown on a vast stretch of land in India. It also serves as bio fertilizer and fodder for cattle.

Sigurbjournson and Micke (c.f. IAEA, 1979) have rightly stated that, "Mutation breeding is one of the gimmicks of the atomic age, a much heralded breeding shortcut''. The skilled use of this technique has resulted in noteworthy plant improvement. Mutagenesis is a unique force in creating variation. Application of mutagens can increase the mutation frequency thus allow the breeder to use mutations within the ambit of his limited nursery and in the time span of a few plant generations.

2. MATERIAL AND METHODS

In an attempt to generate the variability for selection of desirable variants/mutants, the seeds of mung bean variety PDM-11 were selected and four sets of hundred seeds each were made out of these four, three were irradiated (Source Co^{60}) at N.B.R.I. Lucknow at 15, 25, and 35 Krad doses of gamma radiation. The seeds were sown at the experimental field of Botany Department, Lucknow University in three replicates to raise M_1 generation. Each replicates included four lines per rows, one for control and three rows for each dose. In each row 25 seeds were sown and data was recorded for various parameters during M_1 and M_2 generations. Data was also subjected to statistical analysis to test the significance of treatment. T-test was performed to test significance of difference between different treatments.

3. RESULTS AND DISCUSSION

Parameters like germination (Plate 1A) plant survival, pollen fertility showed declining trend with increase in doses of gamma radiation. Subramanian (1980) reported the decrease in germination with increase in doses of gamma rays. Raghuvanshi et al. (1978) reported gradual decrease in germination with increase in dose in *Phaseolus aureus.* Plant height

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showed an increase at lower two doses in M_1 and only a slight increase in M_2. Khan et al. (2000) reported MMS induced increase in Plant height. Khan (1983) studied mutations in *V. radiata* using gamma-rays and hydrazine hydrate and observed increase in plant height. Branches per plant showed an increase at 15 and 25 Krad in M_1 and only at 15 Krad in M_2. Bhatt et. al. (1972) reported increased vigour in isolated variants at 20 Krad dose of gamma radiation. Yield components including Pod/Cluster, number of pods number of Clusters, 100 seed weight and yield showed enhancement at doses. Similar results were reported by Sarma (1998) by gamma rays, EMS and combined treatment of EMS and gamma rays on green gram. Singh et al. (2001) reported an enhancement in 100 seed weight with increasing gamma ray treatment/doses on mung bean cv. PS16. Mir et al. (2020) reported Potential of mutation breeding to sustain food security. Jegadeesan and Punniyamoorthy (2023) studies the potential of mutation breeding in genetic improvement a pulse crops. Nodulation also showed enhancement at does (Plate-1B). Rangaswami et al. (1973) reported increased nodulation at doses of x-rays in comparison to control in *Phaseolus aureus.* Cytological studies showed decrease in mitotic index together with chromosomal anomalies like clumping, bridges, laggards and high percentage of nucleolar persistence. (Plate-2) Reddy et al. (1992) noticed mitotic abnormalities induced by single and combined treatment of gamma rays and EMS in Lens culinaris var. LL-19 and P-332. Breakage of chromosome has also been reported by Natrajan and Upadhyay (1964), Mikaelson et al. (1968).

Leaf mutants, chlorophyll mutants and mutants for height and branching were isolated (Plate-3).

Pramanik et al. reported gamma ray induced chlorophyll mutants in lentil (2003). Yasmin and Arulbalchandran reported Morphogenetic and photosynthetic pigment alternation of Black gram by gamma radiation (2022). Ahir et al. (2023) also studied effect of mutation on seed yield per plant and chlorophyll content in M_3 generation of green gram [*Vigna radiata* (L.) Wilczek].

Explanation of figures

The effect of different doses of gamma rays (15, 25 and 35 Krad) on different characters of *V. radiata* var. PDM-11 in M_1 generation

Fig. A: Seeds showing dampened rate of germination
at doses (from left to right;
Ist row: Control and 15 Krad
IInd row: 25 Krad and 35 Krad

Fig. B: Positive impact on nodulation
(from left to right)
Control, 15, 25 and 35 Krad

Fig. C: Variant with bifoliate leaf and reduced growth with control plant.

Fig. D: Variant with fused leaflet at 35 Krad

Fig. E: Variant with bifoliate leaf at 25 Krad

Fig. F: Variant with bifoliate, tetra foliate leaves at 35 Krad

Fig. G: Variant with tetra foliate leaf at 15 Krad

Fig. H: Photograph showing range of variation in M_1.
Ist row : Control
IInd row : 15 Krad
IIIrd row : 25 Krad
IVth row : 35 Krad
(From up to down wards)

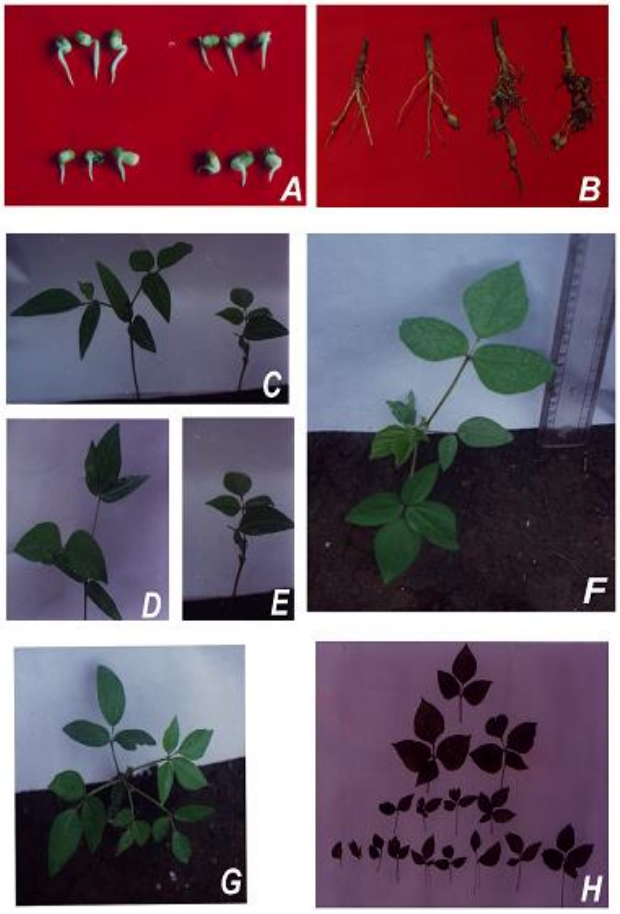

Plate -1

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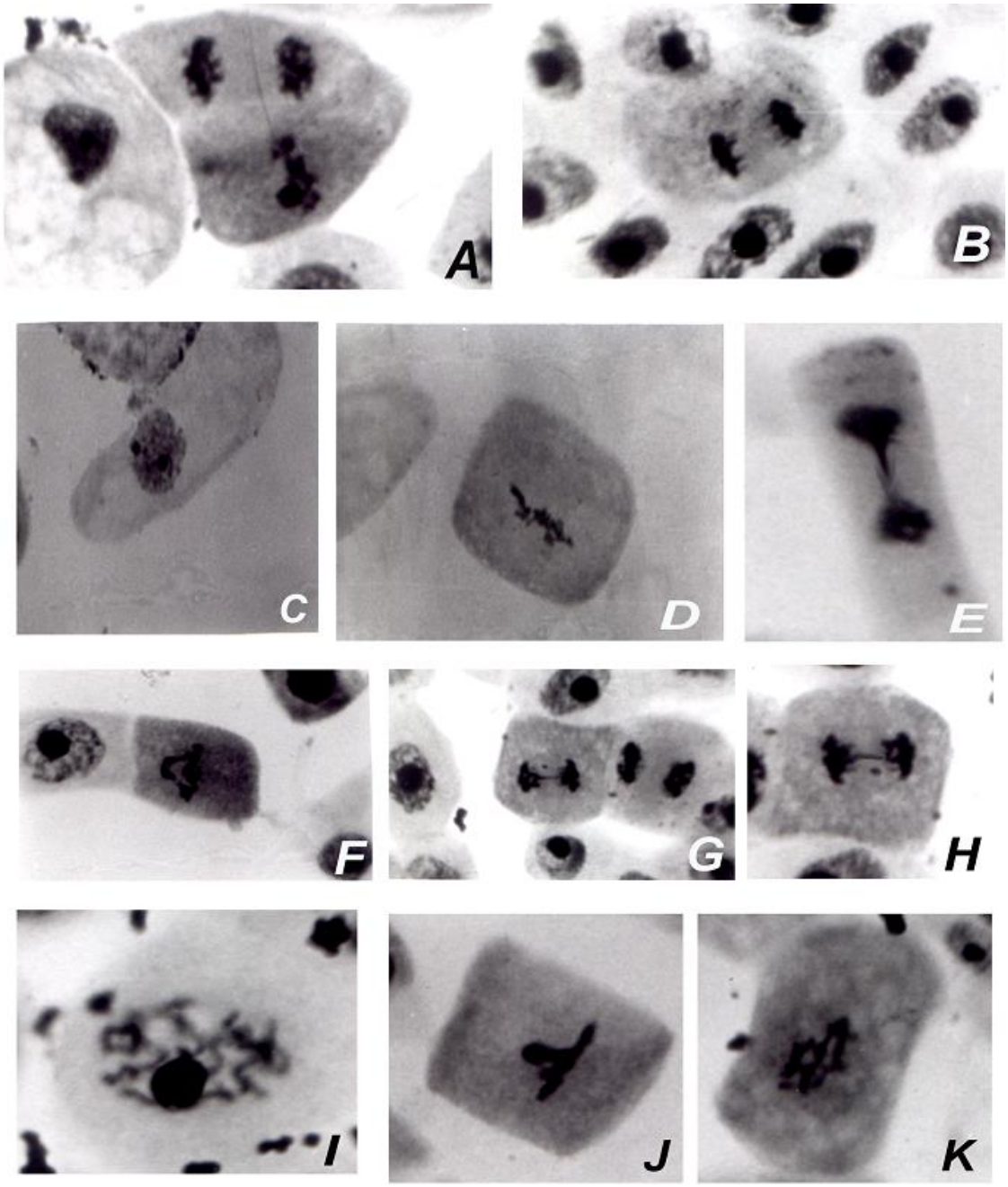

Plate – 2

Explanation of Figures

A- Chromosomal clumping

B- Normal Anaphase.

C- Binucleolate condition

D- Chromosomes at metaphase plate.

E- Telophase with stickiness and lagging chromosomes

F- Chromosomal clumping

G- Bridges at Anaphase

H- Bridges and lagging chromosome

I- Normal prophase.

J- Balloon shaped nucleoli.

K-Chromosomes with abnormal metaphase

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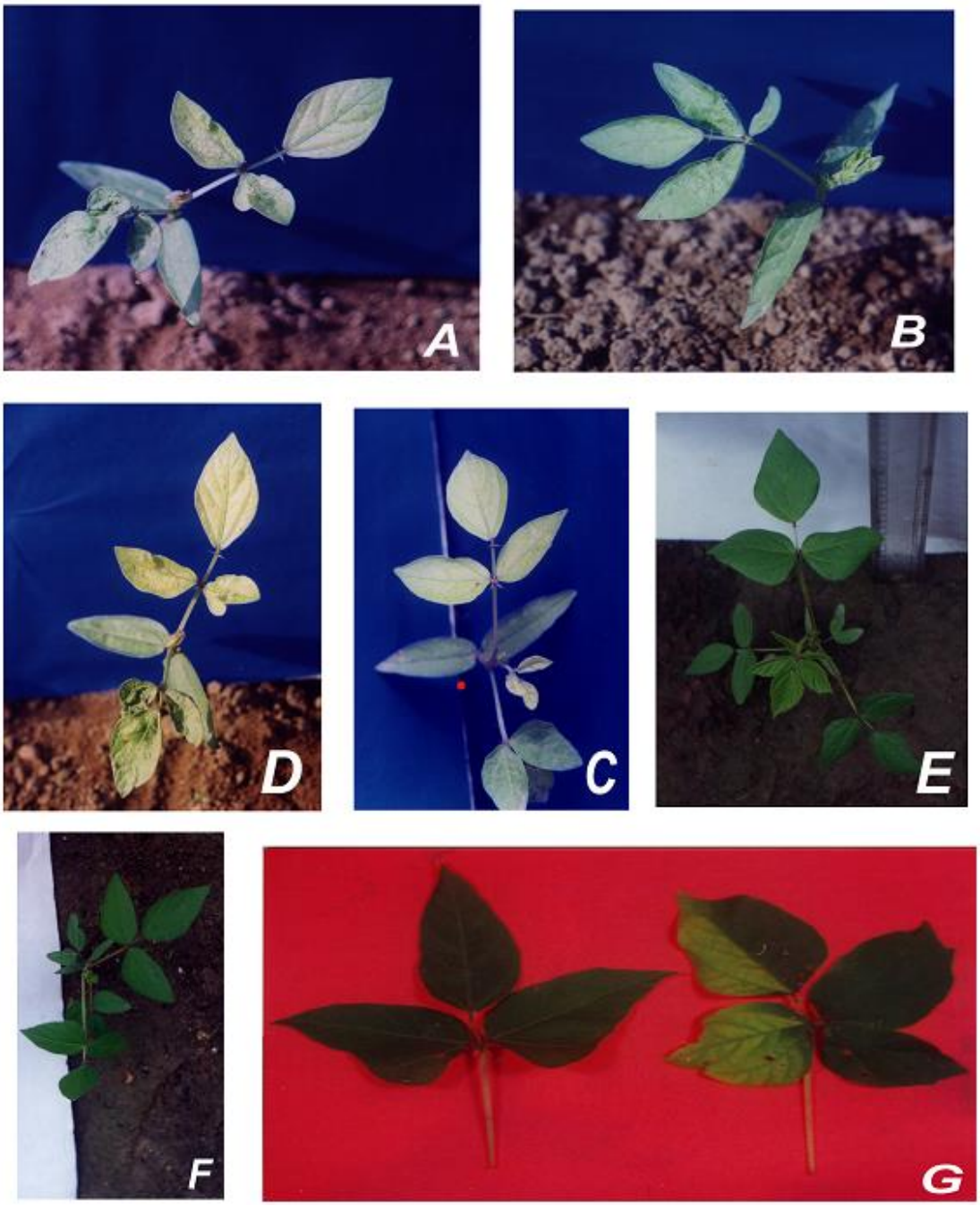

Plate -3

A – Mutant with fused leaflets with altered morphology at 25 Krad

B- Chlorophyll mutant with chlorophyll changes and altered leaf morphology at 15 Krad.

C- Chlorophyll mutant with altered morphology and bifoliate leaf.

D- Chlorophyll mutant (Albino) at 25 Krad.

E- Mutant with bifoliate, Penta foliate leaf and with reduced height.

F- Mutant with bifoliate leaves at 35 Krad.

G- Sectoral chlorophyll changes in tetra foliate leaf along with normal at 25 Krad.

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Table 1: Genetic variability, heritability and genetic advance for different parameters after gamma ray treatment in M1 of *V. radiata* var. PDM 11

Parameters	Population mean	Component of Variation			Coefficient of variation pooled			Heritability (%)	Genetic advance	Genetic advance over percentage of mean
		Genotypic	Phenotypic	Environmental	GCV	PCV	ECV			
Plant Height	72.55	9.08	11.42	2.34	4.1535	4.66	2.11	79.53	5.540	7.64
Stem Perimeter	1.58	0.01	0.01	0.01	6.33	6.33	6.33	39.54	0.081	4.72
Branches/Plant	2.01	0.04	0.06	0.17	9.93	12.16	7.04	62.75	0.320	15.91
Nodes/Plants	6.07	0.14	0.31	0.08	6.17	9.18	6.80	45.03	0.520	8.57
Number of leaves	10.03	0.14	0.22	0.10	3.73	4.68	2.82	65.30	0.630	6.28
Leaf lamina width	8.29	0.21	0.31	0.23	5.53	6.72	3.82	67.73	0.780	9.41
Leaf lamina length	10.94	0.06	0.29	0.06	2.24	4.92	4.38	19.38	0.220	2.01
Number of clusters	6.73	0.62	0.74	0.60	11.70	12.78	5.36	83.13	1.47	21.83
Pod/clusters	2.42	0.03	0.09	0.62	7.172	12.42	10.14	33.73	0.210	8.70
Number of pods	14.92	4.26	4.87	0.11	13.83	14.79	5.28	87.35	3.97	26.61
Pod length	6.68	0.87	0.98	0.97	13.96	14.81	4.96	88.81	1.81	27.09
Seeds/pod	11.02	9.86	10.83	0.13	8.42	29.87	8.94	91.08	6.17	56.00
100 seeds weight	2.55	0.40	0.43	0.12	24.83	25.74	7.85	91.81	1.20	47.11
Yield/plants	10.11	2.25	2.38	4.00	14.84	15.26	3.43	94.93	3.02	29.88
Nodules/plants	7.78	1.32	1.91	0.04	14.76	17.76	9.95	68.72	1.95	25.06

Table 2: Genetic variability, heritability and genetic advance for different parameters after gamma ray treatment in M2 of *V. radiata* var. PDM 11

SN	Parameters	Population mean	Component of Variation			Coefficient of variation pooled			Heritability (%)	Genetic advance	Genetic advance over percentage of mean
			Genotypic	Phenotypic	Environmental	GCV	PCV	ECV			
1	Plant Height	24.5	0.02	0.90	0.88	0.58	3.87	3.83	2.03	0.04	0.16
2	Stem Perimeter	1.72	0.0045	0.01	0.01	3.91	5.82	5.82	20.48	0.043	2.50
3	Branches/Plant	1.69	0.01	0.06	0.04	5.92	14.49	11.83	26.05	0.131	7.75
4	Nodes/Plants	6.33	0.28	0.47	0.19	8.35	10.82	6.88	59.20	0.84	13.26
5	Number of leaves	9.73	0.47	0.67	0.20	7.04	8.41	4.60	70.67	1.19	12.23
6	Leaf lamina width	6.06	0.45	0.65	0.20	11.07	13.31	7.38	69.44	1.15	18.98
7	Leaf lamina length	7.43	0.23	0.31	0.08	6.46	7.50	3.81	73.86	0.85	11.40
8	Number of clusters	8.82	2.06	2.29	0.23	16.28	17.16	5.44	89.95	2.80	31.76
9	Pod/clusters	2.37	0.26	0.31	0.05	21.54	23.52	21.54	84.04	0.96	40.22
10	Number of pods	11.70	6.03	6.29	0.26	20.98	21.43	1.71	95.92	4.96	44.81
11	Pod length	6.33	0.45	0.50	0.04	10.59	17.17	10.94	91.10	1.33	21.00
12	Seeds/pod	9.63	10.34	10.82	0.48	33.38	34.15	7.19	95.57	6.48	67.27
13	100 seeds weight	3.09	0.33	0.37	0.04	18.61	19.70	6.48	88.22	2.27	73.52
14	Yield/plants	9.63	4.92	5.17	0.25	23.03	23.61	5.19	95.15	4.46	46.31
15	Nodules/plants	7.80	1.21	1.56	0.35	14.11	16.02	7.59	77.71	2.00	25.65

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