

Original Research Article

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## Effect of Gamma Irradiation on Seed Germination and Seedling Vigour of Mungbean [*Vigna radiata* (L.)]

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### ABSTRACT

#### Keywords

Mungbean, Gamma rays, LD<sub>50</sub>, Seedling vigour

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The pure, healthy and dry seeds of four mungbean varieties *i.e.*, Meha, K 851, GM 3 and GM 4 were irradiated with different doses of gamma rays (400, 500 and 600 Gy) for study the effect on seed germination and seedling vigour such as germination per cent, shoot length (cm), root length (cm), fresh weight (g) and dry weight (g). For LD<sub>50</sub> recorded near to the 600 Gy gamma rays as per survival per cent in the all four mungbean varieties. The GM 4 was observed more sensitive, whereas, Meha was recorded more resistance for most of all traits. The present results clearly indicated that different doses of gamma rays can be effectively utilized to create variability for different quantitative characters in all the four varieties.

### Introduction

Mungbean [*Vigna radiata* (L.) Wilczek] is the most important pulse crop in India. In the traditional vegetarian diet of Indian population, pulses occupy second place next to cereal and is the main source of protein, ranking after chickpea and pigeonpea. Mungbean, an important seed legume, is a short duration crop and plays vital role in meeting the quantitative and qualitative

requirement of food and protein throughout the world. Mungbean provide 24 per cent protein and the seeds are considered to be easily digestible (Chauhan and William, 2018). It also provides nutritional fodder to the cattle and improves the soil fertility through atmospheric nitrogen fixation with the help of *Rhizobium* species. Plant breeders always look for large and diverse gene pool of variability as it is a prerequisite for success in any breeding programme. In mungbean, natural

variability is limited and hybridization is little difficult due to cleistogamous and small flower structure. Therefore, induced mutation technique was followed to create genetic variability by artificial means.

### **Materials and Methods**

The true pure seeds of four mungbean varieties *viz.*, Meha, K 851, GM 3 and GM 4 were procured from the Pulse Research Station, SDAU, Sardarkrushinagar. Pure, healthy and mature seeds of the selected varieties were exposed to different doses of gamma rays (400 Gy, 500 Gy and 600 Gy) with an intensity of 18 Gy per minute at Bhabha Atomic Research Centre (BARC), Trombay. Seeds not irradiated to gamma ray which were concern as a control. In each treatment, In laboratory condition, 25 seeds were sown treatment wise in the cement pipe structure with proper plant as well as row spacing during summer-2014. Germination of seeds were carefully examined everyday and the emergence of cotyledonary leaf was taken as the induction of germination, germinated seeds of each treatment were counted on eighth day after sowing and germination percentage was calculated. Fifteen days of after sowing, shoot and length were measured in centimeter and fresh weight (g) was recorded, seedlings were put in oven at constant 50°C temperature for 48 hours and after these seedling weight was recorded as dry weight (g) and total number of seedlings survived were counted after fifteen day of sowing and plant survival percentage were calculated in the M<sub>1</sub> generation.

### **Results and Discussion**

In present study, the highest mean germination per cent (88, 96, 96 and 92) and survival per cent (88, 96, 96 and 92) was observed in control treatment, whereas lowest mean germination per cent (56, 68, 68 and 60) and survival per cent (48, 48, 60 and 40) was

recorded at 600 Gy in four varieties Meha, K 851, GM 3 and GM 4, respectively (Table 1). Mean germination per cent was reduced in all four varieties with the increase in gamma rays doses. The perusal of the results suggested that the dose of gamma rays was increased when, the germination per cent and survival per cent were reduced. Differential genotypic sensitivity to different mutagen doses within a species have also been reported by several workers *viz.*, Balai and Krishna, 2009; Kumar *et al.*, 2010; Sagade and Apparao, 2011, Singh and Singh, 2013 and Hemavathy, 2015 in *Vigna radiata*. Cherry and Hageman (1961) opined that impairment of mitosis or, virtual elimination of cell division in the meristematic zone during germination in irradiated seeds with higher doses led to seed lethality. However, Selim *et al.*, (1974) reported that reduction in germination due to higher exposure to radiation was due to production of active radicals. Sato and Gaul (1967) reported that seedling injury led to slow growth culminating in early mortality. Chromosomal aberrations as impacted by irradiation caused reduction in fertility and enhancement of physiological disorders causing seedling injury, slow growth and ultimately early mortality (Mehetre *et al.*, 1994; Avinash and Tewari, 1998). Higher degree of damage incited by irradiations to chromosomal materials also results in inhibition of growth hormones. All these factors cumulatively may be attributed as the reason for reduction of plant survival.

Highest shoot length (6.90, 6.71, 7.06 and 7.05 cm), root length (7.40, 7.35, 7.54 and 7.41 cm), fresh weight (1.05, 1.09, 1.15 and 1.13 g), dry weight (0.52, 0.55, 0.62 and 0.59 g) were recorded under control treatment in Meha, K 851, GM 3 and GM 4, respectively.

Mean shoot and root length as well as mean of fresh and dry weight were declined in all four varieties with increase in gamma rays dose.

**Table.1** Effect of different doses of gamma rays on seed germination and seed survival per cent in mungbean cultivars under laboratory conditions

Varieties	Treatments Gamma	Number of seeds sown	Seed germination			Per cent seed survival		
			Number of seeds germinated	Mean germination in per cent	Reduction over control per cent	Number of seeds survival	Mean survival in per cent	Reduction over control per cent
<b>Meha</b>	Control	25	22	88	-	22	88	-
	400 Gy	25	20	80	09.00	17	68	22.73
	500 Gy	25	17	68	22.73	16	64	27.27
	600 Gy	25	14	56	36.36	12	48	45.45
<b>K 851</b>	Control	25	24	96	-	24	96	-
	400 Gy	25	22	88	08.33	21	84	12.50
	500 Gy	25	18	72	25.00	18	72	25.00
	600 Gy	25	17	68	29.17	12	48	50.00
<b>GM 3</b>	Control	25	24	96	-	24	96	-
	400 Gy	25	23	92	04.17	20	80	16.67
	500 Gy	25	19	76	20.83	18	72	25.00
	600 Gy	25	17	68	29.17	15	60	37.50
<b>GM 4</b>	Control	25	23	92	-	23	92	-
	400 Gy	25	22	88	04.35	21	84	08.70
	500 Gy	25	20	80	13.04	20	80	13.04
	600 Gy	25	15	60	34.78	10	40	56.52

**Table.2** Per cent reduction in shoot length (cm) and Root length (cm) and Fresh and Dry weight (g) in mungbean cultivars under different treatments in laboratory conditions

Varieties	Treatments	Shoot length (cm)		Root length (cm)		Fresh weight (g)		Dry weight (g)	
		Mean (cm)	Per cent reduction over control	Mean (cm)	Per cent reduction over control	Mean (g)	Per cent reduction over control	Mean (g)	Per cent reduction over control
<b>Meha</b>	Control	6.90	-	7.40	-	1.05	-	0.52	-
	400 Gy	4.15	39.86	4.90	33.78	1.03	02.05	0.49	05.78
	500 Gy	3.83	44.49	4.50	39.19	0.99	06.14	0.51	01.36
	600 Gy	3.35	51.45	3.68	50.27	0.97	07.77	0.46	11.47
<b>K 851</b>	Control	6.71	-	7.35	-	1.09	-	0.55	-
	400 Gy	4.12	38.64	4.85	34.04	1.04	04.76	0.50	09.89
	500 Gy	3.75	44.14	4.40	40.13	1.00	08.55	0.52	05.23
	600 Gy	3.24	51.71	3.54	51.81	0.97	10.69	0.46	15.56
<b>GM 3</b>	Control	7.06	-	7.54	-	1.15	-	0.62	-
	400 Gy	4.30	39.14	5.02	33.42	1.09	05.22	0.55	11.21
	500 Gy	3.91	44.67	4.52	40.12	1.05	08.70	0.57	07.56
	600 Gy	3.37	52.31	3.73	50.58	1.03	10.43	0.52	15.83
<b>GM 4</b>	Control	7.05	-	7.41	-	1.13	-	0.59	-
	400 Gy	4.19	40.54	5.02	32.22	1.06	06.39	0.52	12.06
	500 Gy	3.86	45.20	4.58	38.24	1.02	10.12	0.54	08.73
	600 Gy	3.38	52.05	3.86	47.89	1.00	11.78	0.49	17.15

These traits mean values were recorded highest in control, whereas, lowest mean values were recorded at 600 Gy (Table 2). The results suggested that differential response to different doses of gamma rays. The reduction in shoot length and root length were thus more pronounced in higher doses as compared to the lower doses of gamma rays and their respective to untreated control. The varietal response of mutagen was little founded. The reduction in shoot and root length recorded in the flat studies has been attributed to changes in the levels of auxin and ascorbic acid and to physiological and bio-chemical disturbances (Gunkel and Sparrow, 1954 and Singh, 1974) or chromosomal aberrations changes in enzymatic activity and impaired mitosis in the meristematic zone of growing seedlings (Cherry and Hageman, 1961). It might be due to decrease in respiratory quotient in the seedlings obtained from treated seeds. Such chromosomal aberrations caused due to induction of mutation have also been reported by Nandanwar and Patil (2000).

In this study, GM 4 was observed more sensitive, whereas, Meha was recorded more resistance for most of all traits. The results clearly indicated that different doses of gamma rays can be effectively utilized to create variability for different quantitative characters in all the four varieties.

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