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Original Research Article

Effect of Gamma Radiation on Germination and Seedling Parameters of Mung Bean (*Vigna radiata*)

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A B S T R A C T

The present experiment was conducted during short term training programme organised by BARC, Mumbai and RARS, Karjat on "Mutation Breeding for Crop Improvement. The Mung bean variety (TARM 1) cultivated under laboratory condition to examine differences in radio sensitivity to gamma radiation during the winter season of 2018. Dry seeds of mung bean were exposed to gamma radiation (at BARC) during training programme ranging from 50 to 800 Gy for the determination of their responses to radiation and the effective radiation dose for mutation breeding. The significant variation was observed in M1 generation. The mean performance of various growth parameters i.e., germination per cent, shoot length, root length, total seedling length and vigour index was 82.33%, 18.96cm, 1.69cm, 20.65cm and 1701.21 observed, respectively. The irradiation treatment of 374.14 Gy was found to be fit for GR_{50} while desired reduction in seedling height was observed in irradiation treatment of 238.09 Gyfor GR_{30}. The 375.52Gy is the LD50 value for mung bean. So, the 350Gy to 500Gy was the best range which could be useful for further significant improvement in Mung bean.

Keywords

Mung bean, Mutation breeding, Radio sensitivity, GR50, GR30 gamma irradiation

Introduction

Mungbean (*Vigna radiata* (L.) Wilczek) (2n=2x=22) is a self-pollinated legume originated in South Asia is considered rather wild as it still gives low seed yield (<1 t/ha), with uneven maturity (Micke and Donini, 1993). This opens an ample room for mungbean breeders to improve the crop. Besides natural genetic variation available in mung bean germplasm collections, mutation techniques are proven useful in obtaining novel traits and creating genetic variability (Gupta, 1996). Mutation is the tool to create stable genetic changes. It is useful for creating genetic variations, improvement in specific traits and break tight linkages. Gamma irradiation as a mutagen can induce useful as well as harmful mutation in plants (Micke and Donini, 1993). To start mutation breeding experiments, it is essential to know best suitable mutagenic dose. The mutagenic dose which will give minimum mortality and maximum mutants (LD50) is useful to get best results. This study was therefore carried out on released mung bean variety (TARM 1) to determine the optimum mutagen doses and their effect on growth parameters in mung bean.

Materials and Methods

In present investigation, the seeds of mung variety viz., TARM 1 were treated with

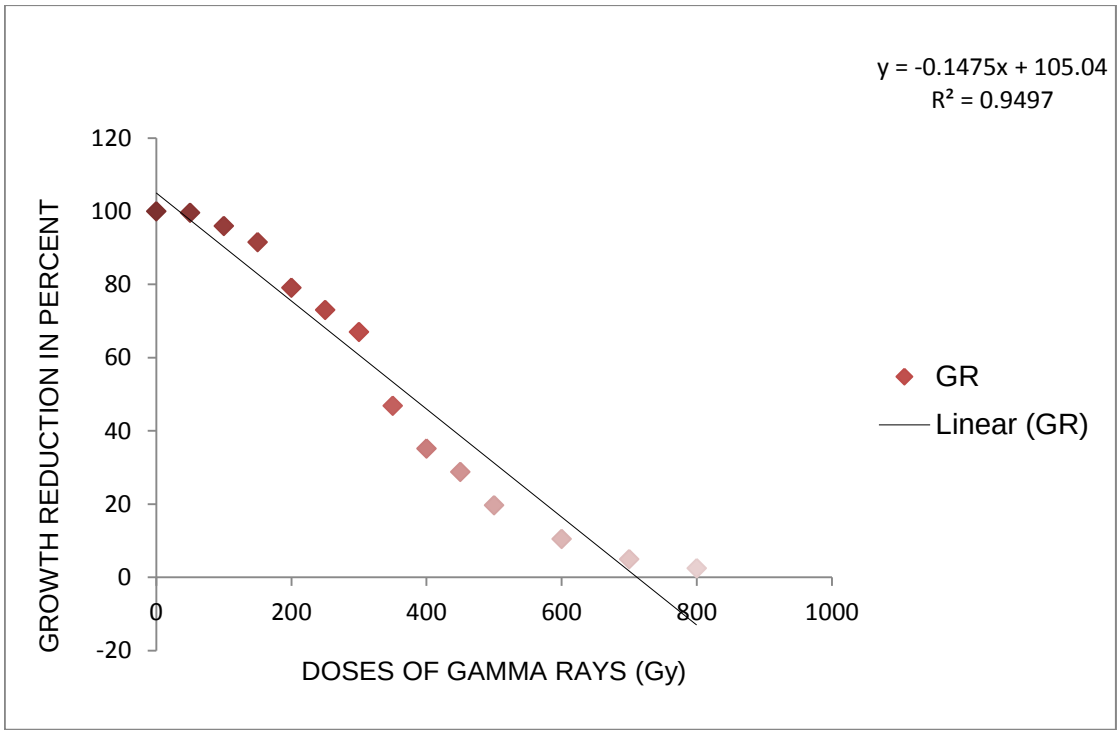
different thirteen doses of gamma rays (*viz*., 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700 and 800 Gy) at BARC, Mumbai for the estimation of different growth parameters. The treated seeds along with control (untreated seeds) are sown in tray using flat-bed method in laboratory at RARS Karjat. The growth of the seedling is measured on 15th day after sowing. The LD50, GR_{50} and GR_{30} is calculated using graphical analysis on Microsoft excel sheet. The standard statistical analysis was done by formulae given by Panse and Sukhatme (1985) (Fig. 1–3).

Results and Discussions

Estimation of lethal dose (LD50 value)

The nature of mutation is decided by determining the correct doses and concentration of mutagens. The doses or concentration can be determined by establishing the LD50 value for the mutagen to be used. Since the LD50 value is genotype dependent, the value has to be decided for each of the genotypes to be mutagenised. Hence, the LD50 value for TARM 1 was determined based on the germination of seedlings from the seeds treated with different doses of gamma rays and adopting graphical excel analysis (Table 1 and Graph 1). The expected LD50 value for treated variety was 375.52 Gy. The LD50 for germination and survival was found to range between 350 and 400 Gy of gamma rays in Mungbean (Uma maheswari (2005), Singh and Kole (2005), Thangahemavathy (2015) and Rukesh *et al.*, (2017).

Fig.1 Effect of different doses of gamma irradiation on growth reduction



Where Y = 50
Therefore,
50 = -0.147X + 105.0
X = 374.14
Therefore GR_{50} = 374.14 Gy
Where Y = 70
Therefore,
70 = -0.147X + 105.0
X = 355.96
Therefore GR_{30} = 238.09 Gy
LD50 = 375.52 Gy

Table.1 Effect of different doses of gamma irradiation on growth parameters

Dose rate	Germination (%)	Shoot Length (cm)	Root Length (cm)	Total seedling Length (cm)	Vigour Index
T_1 : 0 Gy (Control)	85.2	19.90	1.47	21.37	1820.72
T_2 : 50 Gy	72.7	24.25	1.75	26.00	1890.2
T_3 : 100 Gy	75.1	23.50	1.65	25.15	1888.76
T_4 : 150 Gy	80.4	22.70	2.20	24.90	2001.96
T_5 : 200 Gy	81.2	20.90	1.65	22.55	1831.06
T_6 : 250 Gy	83.6	22.50	1.60	24.10	2014.76
T_7 : 300 Gy	85.0	22.10	1.85	23.95	2035.75
T_8 : 350 Gy	95.9	16.00	2.25	18.25	1750.17
T_9 : 400 Gy	92.8	17.20	2.39	19.59	1817.95
T_{10} : 450 Gy	85.5	24.20	1.90	26.10	2231.55
T_{11} : 500 Gy	83.6	16.35	1.50	17.85	1492.26
T_{12} : 600 Gy	80.3	12.70	1.20	13.90	1116.17
T_{13} : 700 Gy	76.9	10.90	1.45	12.35	949.71
T_{14} : 800 Gy	74.5	12.30	0.80	13.10	975.95
Grand Mean	82.33	18.96	1.69	20.65	1701.21
CD at 5%	**4.8**	**3.4**	**2.7**	**3.9**	**5.5**
CV	**6.9**	**5.5**	**5.2**	**5.8**	**5.1**

Fig.2 Effect of different doses of gamma irradiation on Mung bean seedling

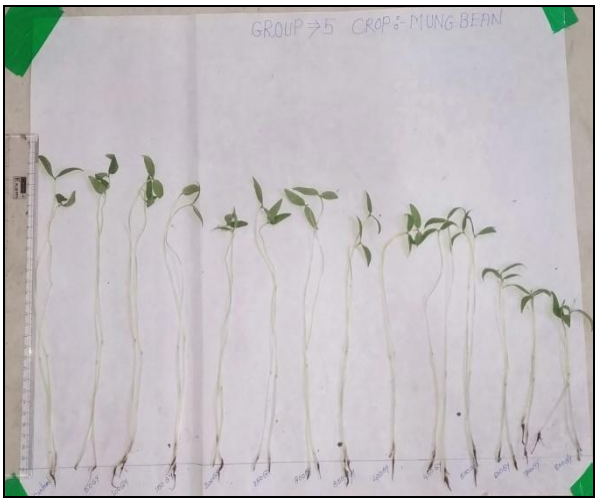


Fig.3 Effect of different doses of gamma irradiation on mean seedling height of Mung bean cultivar

Growth parameters

Germination per cent

In the present study, the percentage of seed germination, increased progressively with increasing dose of gamma radiation at specific treatment and then decreased thereafter (Table 1). The similar result also observed due to mutagenic treatment in conformity with the earlier reports of Bolbhatsadashiv *et al.,* (2012) in horsegram, Dhakshanamoorthy *et al.,* (2010) in Jatropha curcas, Khan and Wani (2005), Lavanya *et al.,* (2011) in green gram and Rukesh *et al.,* (2017) in green gram.

Shoot length

The results revealed, that shoot length of M1 plant reduced with an increase in dose of mutagens. Similar report was given by Senapati *et al.,* (2008) and Ramya *et al.,* (2014) in blackgram; Gnanamurthy *et al.,* (2012) in cowpea and Rukesh *et al.,* (2017) in green gram. While comparing the treatment dose of mutagen, 700 Gy of gamma ray registered the maximum total seedling length reduction (Table 1).

Root length

The root length was ranging from 0.80 – 2.39cm. The M1 plant showed irregular variations in root length in this experiment. Similar report was given by Khan and Wani (2005) in chickpea; Gnanamurthy *et al.,* (2012) in cowpea and Rukesh *et al.,* (2017) in green gram. While comparing the treatment dose of mutagen, 700 Gy of gamma ray registered the maximum total seedling length reduction (Table 1).

Total seedling length

Total seedling length ranged from 12.35 – 26.10cm. It is also noted that, the total seedling length of M1 plant reduced with an increase in dose of mutagens. Similar report was given by Khan and Wani (2005) in chickpea; Senapati *et al.,* (2008) and Ramya *et al.,* (2014) in blackgram, Gnanamurthy *et al.,* (2012) in cowpea, Singh and Kole (2005) and Thanga Hemavathy (2015). While comparing the treatment dose of mutagen, 700 Gy of gamma ray registered the maximum total seedling length reduction (Table 1).

Vigour index

In this study, vigour index, decreased progressively with increasing dose of gamma radiation (Table 1). The maximum vigour index was observed when seeds were treated with 450Gy of gamma radiation. The similar result also observed due to mutagenic treatment was also in conformity with the earlier reports of Bolbhatsadashiv *et al.,* (2012) in horsegram, Dhakshanamoorthy *et al.,* (2010) in *Jatropha curcas*, Khan and Wani (2005), Lavanya *et al.,* (2011) in green gram, Singh and Kole (2005), Thanga Hemavathy (2015) and Rukesh *et al.,* (2017) in green gram.

Summary and conclusion are as follows:

From this research, it is concluded that, irradiation treatment of 374.14 Gy was found to be fit for GR_{50} while desired reduction in seedling height was observed in irradiation treatment of 238.09 Gy for GR_{30}.The 375.52Gy is the LD50 value for mung bean. So, the 350 Gy to 500 Gy was the best range which could be useful for further significant improvement in Mung bean.

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