Effect of gamma irradiation on seed germination and seedling growth of *Vigna radiata* (L.Hepper)

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Abstract

Seeds of mungbean were treated with various doses of gamma irradiation (100 to 500 GY) for studying seed germination and seedling growth. The sensitivity of gamma irradiation was observed on different germination and growth parameters such as germination rate (%), seedling height (shoot length), root length and number of lateral branches per primary root. The results showed that depressive effects were increased with increasing radiation dosages and 50 per cent reduction in germination and seedling size (injury) was observed at 400 GY of gamma ray irradiated seedlings and it was considered as LD 50 value (optimum dose) for gamma ray in mungbean variety Vamban 3.

Key words: Mungbean, gammaray, sensitivity index

Introduction

Mungbean (*Vigna radiata* L.Hepper) is an important pulse crop in India. It is grown in an area of three million hectare with a production of one million tones. The average productivity of the crop is quite low (450kg/ha) compared to other pulses. Lack of adequate genetic variability in economically important quantitative traits are considered to be one of the major impediments in yield improvement of mungbean. Several approaches have been takenup for enhancement of genetic variability in greengram and induction of mutation is considered to be quite promising. Gamma rays, the physical mutagen are non particulate ionizing radiations, having high energy and penetrable capacity in biological tissues and make changes in base, disruption of hydrogen bonds between complementary strands of DNA. Majority of mutant varieties (64%) were developed by the gamma rays (Ahlowalia *et al.* 2004). Keeping the above facts in view, the present investigation in greengram was undertaken to induce genetic variability following gamma irradiation in economic important traits for yield improvement of the crop.

Materials and Methods

The authentic seeds of mungbean variety Vamban 3 were procured from the National Pulse Research Centre, Vamban, Tamil Nadu. Healthy dry seeds of the selected variety were subjected to the gamma ray irradiation by using the Gamma ray chamber available at Center for Plant breeding and Genetics, TNAU, Coimbatore. The doses employed were 100GY, 200 GY, 300 GY, 400 GY and 500 GY. Seeds not exposed to gamma ray were treated as control. Each treatment was carried out for 300 seeds. In laboratory condition germination studies was taken up using 50 number of seeds of irradiated and control by germination paper towel method in three replications. Germination of seeds were carefully observed everyday and the emergence of cotyledonary leaf was taken as the induction of germination, germinated seeds of each treatment were counted on 5^{th} and 10^{th} day and germination percentage was calculated. Length of the shoot from cotyledonary node to the tip of the shoot and root length from the cotyledonary node to the tip of primary root were measured on 15^{th} day of seedlings and expressed in cm. Number of lateral branches of primary root was also counted and the data were recorded.

Results and Discussion

A general observation showed that the percentage of seed germination, seedling height (shoot length), root length, number of lateral branches per primary root and seedling vigour were decreased with an increase in the dose of mutagen (Table 1, and 2). The germination level was ranged from 12.44 (500GY) to 37.33 (100 GY) (Table 1) and the same results were reported earlier in mungbean (Auti 2005, Sangsiri *et al*., 2005, Khan *et al* 2006), chickpea (Toker *et al* 2004, Barshile 2006), in pea (Mahna *et al* 1990) and cowpea (Apparao B.J. 2005) and Urdbean (Sagade A.B. (2008).

Seedling height (shoot length) was decreased according to the higher doses of gamma ray and the shoot length was ranged from 2.72 and 2.4 (500GY), 5.78 and 6.4 (100GY) and root length, number of lateral branches per primary root were gradually decreased with increasing level of dosages and the range was from 2.12 (500GY) to 4.90 (100GY)(Table 3) . The results were in conformity with other reports (Khan *et al*., 2004, Raut *et al.* 2004). The 50 % reduction in seedling height (injury) was observed in 400GY treatment.

The percentage of seed germination for different doses was worked out and taking control as 100 percent and considerable reduction in germination percentage was observed with dosage increase. The percent seed germination of control was 83.32%. The present seed germination decreased upto 24.88% at 500 GY dose. The results also revealed that the mungbean variety was more sensitive to the gammaray mutagen. Among the doses maximum germination reduction percentage was observed in 500GY (75.14%) and the 50% of germination was observed in 400GY (51.32%) (Table 3) and it was fixed as LD 50 value for gamma ray for the Vamban 3 greengram variety. Same results were given in urdbean (Sagade (2008)) and mungbean (Auti (2005), Sangsiri *et al* 2005, Khan *et al* 2006.)

Conclusion

Generally reduction of seedling growth parameters is one of the most common responses of plant subjected to ionizing radiation. As a effect of gammy rays studied quantitatively on the seed germination and other seedling characters of greengram var Vamban 3 in the laboratory conditions it was revealed that the germination percentage, seedling injury were observed with increased doses of gamma rays and the LD 50 value was set at 400 GY.

Table 1: Effect of gamma rays on seed germination of greengram variety Vamban 3

S.No.	Doses (GY)	No. of seeds sown	No. of seeds germinated on 5th day	No. of seeds germinated on 10th day	Total number of seeds germination
1	Control	50	28.23 ± 0.34	13.66 ± 0.20	41.66 ± 0.54
2	100 GY	50	26.33 ± 0.24	11.0 ± 0.30	37.33 ± 0.54
3	200 GY	50	25.00 ± 0.23	9.66 ± 0.31	34.66 ± 0.54
4	300 GY	50	23.66 ± 0.22	8.33 ± 0.09	31.99 ± 0.31
5	400 GY	50	19.02 ± 0.21	6.66 ± 0.49	25.66 ± 0.70
6	500 GY	50	10.05 ± 0.18	2.44 ± 0.03	12.44 ± 0.22

Table 2: Gamma rays effects on seedling growth of greengram variety Vamban 3

Doses	Shoot length (cm)		Root length (Cm)		No. of lateral branches per primary root	
	Range	Mean	Range	Mean	Range	Mean
Control	5.8-6.2	6.7 ±0.24	7.0-7.8	7.4 ±0.14	5-6	5.52 ± 0.18
100GY	5.0-5.7	5.78 ± 0.18	6.0-6.8	6.47 ± 0.11	4-5	4.91 ± 0.15
200 GY	4.3-4.8	5.18± 0.14	5.2 -5.8	5.5 ± 0.10	4-5	4.82 ± 0.11
300 GY	4.2-4.6	4.08 ± 0.12	4.2-4.8	4.5 ± 0.08	3-4	3.14 ± 0.10
400 GY	3.8- 4.0	3.52 ± 0.10	3.0 - 3.1	3.1 ± 0.06	2-4	3.00 ± 0.09
500 GY	2.7-3.0	2.72 ± 0.05	2.0-2.8	2.4 ± 0.05	1-5	2.12 ± 0.06

Table 3: Determination of LD 50 value for Vamban 3 Greengram

S.No.	Doses	Seed germination (%)	Percent control	Reduction over control
1	Control	83.32	100.00	-
2	100GY	74.66	86.66	-13.34
3	200 GY	69.32	80.31	-19.69
4	300 GY	63.98	74.78	-25.22
5	400 GY	51.32	50.58	-49.42
6	500 GY	24.88	24.86	-75.14

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