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NB Mehetre
Research Scholar PhD, School of Agriculture (OPJS) Om Prakash Jogender Singh University Churu, Rajasthan, India

RM Kshirsagar
Associate Professor, School of Agriculture (OPJS) Om Prakash Jogender Singh University Churu, Rajasthan, India

Ashwini V Jadhav
Assistant Professor, Samarth Agriculture College, D. Raja, Buldana, Maharashtra, India

Corresponding Author:
NB Mehetre
Research Scholar PhD, School of Agriculture (OPJS) Om Prakash Jogender Singh University Churu, Rajasthan, India

Studies on morphological characters by gamma rays in soybean cultivar JS-335

NB Mehetre, RM Kshirsagar and Ashwini V Jadhav

Abstract
Soybean JS-335 was treated with 200 Gy, 250 Gy and 300 Gy doses of gamma rays to study the effect of gamma radiation on germination, 100 seed weight and grain yield in M_2 generation. The experiment was conducted in the farm of Samarth Agriculture College D. Raja Dist. Buldana during kharif and rabi 2017-19. Gamma rays reduced germination in M_1 and increased in M_2 generation. 100 seed weight decreased in all treatments highest mean value was in 200 Gy (12.12 gm) and lowest in 300 Gy (10.94 gm) as compared to control (12.98 gm). Plant produced the most grain yield in T_2 (6.97 gm) and the least in T_1 (5.97 gm). The variability showed the coefficient of variation increased in all treatment. In M_2 generation germination and yield per plant increased significantly in all treatments and 100 seed weight significantly decreased in all treatments as compared to control.

Keywords: Soybean JS 335, gamma rays, germination, 100 seed weight, grain yield

Introduction

Soybean (*Glycine max* (L.) Merrill) is referred as "Golden bean" and "Miracle crop" of 21st century. It is one of the important oilseed as well as legume crop. It contributes more than 50% to the global production of edible oil. Soybean contains 20% oil and 40% protein. Soybean protein is rich in all essential amino acids, vitamin A, B and D; health promoting phytochemicals like isoflavones, hence, soybean referred as "Wonder crop" or "Golden bean". Soybean oil is used as edible oil in Indian diet. It contains low level of saturated fatty acids. Therefore, soybean oil is better for human health. Soybean is highly self pollinated crop. Taxonomically soybean belongs to the order Fabales and family "Leguminoseae" and subfamily "Papilionidae" and the genus Glycine. Global output of soybean was reported as 155.1 million metric tonnes, and the main producers were the United States, Brazil, Argentina, China, and India (Anonymous, 2000) [1].

Soybean originated in North Eastern China. It entered in India during 6 century AD. USA, Brazil, China, Argentina and India are the major soybean producing countries in the world. These countries accounts for 90% of the world production. India ranked 5" position in respect to area and production. The largest soybean producing states in India are Madhya Pradesh, Maharashtra and Rajasthan. In India, Maharashtra ranks second in area and production (Anonymous, 2016) [2].

The concept of inducing mutation and utilizing them in plant breeding was first given by Hugo de vries (1903) for generating variability and achieving the goal of generating of new strains of cultivated crop plants. Among the various kinds of irradiation used for producing variation in crop plant, X-ray and gamma rays produce gene mutation more efficiently. Both these are ionising radiations and have many identical properties, but differing in the form of origin. Gamma rays an ionizing physical mutagen capable of inducing mutation in plants. Gamma rays are electromagnetic radiations similar to X-rays in their physical characteristics and action on the organism they are therefore, natural X-rays but of very short wavelength by virtue of which they are more penetrating. Most of the gamma rays wavelengths are of less than 0.01 Ao as compared to 0.5Aoof X-rays. Kharkwal and Shu (2009) [7] Gamma rays are known to be an affordable and powerful type of ionising radiation because of their ease of access and their ability to infiltrate tissues. A variety of chemical and physical mutagens are commonly utilised to cause genetic diversity in plants.

Keeping in view the above aspects, the present study was undertaken to create variable population and select morphologically distinct mutants from the population.

Materials and Methods

Dry healthy and genetically pure seeds of soybean cultivar JS-335 were used in this investigation. The seeds of JS-335 were irradiated by gamma rays at Bhabha Atomic Research Centre, Trombay, and Mumbai. Equal quantity of seeds (i.e. 500 g of each lot) were irradiated by different dosages of gamma beams treatment. These seed were treatmented by three diverse dosages of gamma beams i.e. 200 Gy, 250 Gy and 300 Gy (Co60at BARC, Trombay, Mumbai).

M_1 generation was raised in kharif 2017. The treated seeds along with the control were sown immediately after treatment to raise the M_1 generation at Samarth Agriculture College Deulgaon Raja Dist. Buldana. All the recommended cultural practices and management were given to raise a good crop and maximum multiplication of seed. The M_1 population was studied by recording observations at different growth stages. M_1 generation was screened for different morphological mutants. Seeds from each M_1 generation yielded independently and labelled with plant amount, doses and ancillary characters and stored to elevate to M_2 generation. M_2 generation was elevated within Rabi 2017. By sowing seeds of each M_1 plants separately all the harvested seeds from each treatment were sown to raise M_2 population. The sowing was undertaken on the fertile and well levelled piece of land at Samarth Agriculture College Deulgaon Raja Dist. Buldana. The statistical analysis was done for Mean, Standard deviation (S.D.) and Coefficient of Variation (C.V.) by following standard formulas suggested by Singh and Choudhary (1985) [12].

Results and Discussion

Germination percent

The impact of various treatments of gamma radiations on germination in M_1 and M_2 generations are displayed in table 1 and graphically illustrated in fig. 1. Reduced germination per cent in all the treatments was surveyed in M_1 generation as evaluated to control. Treatment T_2 and T_3 recorded the highest reduction in germination per cent (51.45 and 47.25%) respectively, while lowest in treatment T_1 (53.75%). The germination per cent in control was observed (67.71%). In M_2 generation, germination reduction was examined in all the ailments as evaluated to control. The data revealed that germination percentage increased in M_2 as evaluated to M_1 generation in all the ailments. The germination percentage in M_2 ranged from (50.85 to 72.84%). Reduction of germination percentage was highest in T_3 (50.85%) of M_2 generation while lowest in T_1 (54.60%) in contrast with control T_4 (72.84%). The experimental finding on the germination indicated that gamma beams reduced germination in M_1 generation. The germination percentage increased in M_2 generation in contrast with M_1 when the gamma rays radiate seeds. Similar to these results Satpute and Fultambkar (2012) [11] also reported decline in germination percent over control in all mutagenic therapies in the soybean cultivars MAUS-71 and JS-335. Sangsiri *et al*. (2005) [10], reported that the all genotypes, high dosages of gamma beams lowered the percentage of germination compared with placebo, but the low doses had no major impact.

100 seed weight

Data regarding 100 seed weight revealed that the 100 seed weight decreased in all treatments as compared to control are displayed in table 2 and graphically illustrated in fig. 2. The highest mean value for the character was in 200 Gy treatments (12.12 g) and lowest in 300 Gy treatments (10.94 g) as compared to their control treatment (12.98 g). The variations for the character were found to be increased in all the treatments, Maximum variation was observed in 300 Gy treatment (16.82%) followed by 250 Gy treatment (14.53%) and the minimum variation in 200 Gy treatment (8.83%) as compared to controls treatment (5.16). It was found in this study that mean of 100 seed weight in general, reduced in gamma rays treatment. Waghmare and Mehra (2000) [13] also observed the significant reduction of 100 grain weight in grass pea irradiated with gamma rays.

Grain yield per plant

Data regarding grain yield plant^{-1} revealed that the maximum grain yield plant^{-1} are displayed in table 3 and graphically illustrated in fig. 3. was observed in 250 Gy treatment (6.97 g) and minimum in 200 Gy treatments (5.97 g). The variability studies showed that coefficient of variation increased in all the treatments. The maximum coefficient of variation was noticed in 200 Gy treatments (43.89%) followed by 300 Gy treatments (40.38%) and the minimum were in 250 Gy treatments (37.30%). The variation for this parameter ranged between (37.30% to 43.89%). It is revealed that mean value of grain yield plant^{-1} in general, increased in gamma rays treatment as compared to control. Khan *et al*. (2005) [6] also observed similar result and reported that the gamma rays irradiation increased the grain yield significantly as compared to control. Mudibu *et al*., (2012) [9] studied the effects of 0.2 kGy and 0.4 kGy irradiation in M_2 generation and observed significant increase of grain yield and yield components in all the three soybean varieties cvs. Kitoko, Vuangi and TGX814-49D. Gopinath and Pavadai (2015) [4] also reported that the yield parameters like number of seeds plant^{-1}, grain yicld plant-1, recorded the moderate and high mean value of 0.5% of the EMS and 0.4% of the DES treated population in the 50 kR of gamma rays are relative to controlling plants in soybean.

It is inferred from the study that the gamma rays had the potential to induce variability in yield contributing characters of soybean. It was observed that gamma rays had significant effect on germination, 100 seed weight and grain yield plant^{-1}. The economical mutants identified needs to be observed for their breeding behaviour in further generations and their utilization in improvement of soybean.

Table 1: Effect of gamma rays treatments on germination percent in M1 and M2 generation

Treatment	Germination (%)	
	M_1	M_2
T_1 (200 gy)	53.75	54.60
T_2 (250 gy)	51.45	52.40
T_3 (300 gy)	47.25	50.85
T_4 (Control)	67.15	72.84

Table 2: Impact of gamma rays treatments on 100 seed weight (g) in M_2 generation

Sr. No	Treatments	Range	Mean	Variance	S.D	CV (%)
1	T1 (200gy)	6	12.12	1.14	1.07	8.83
2	T2 (250gy)	7	11.77	2.92	1.71	14.53
3	T3 (300gy)	6	10.94	3.39	1.84	16.82
4	T4 (Control)	2	12.98	0.45	0.67	5.16

Table 3: Gamma rays treatment effect on grain yield plant^{-1} (g) in M2 generation

Sr. No	Treatments	Range	Mean	Variance	S.D	CV (%)
1	T1 (200gy)	16	5.97	6.86	2.62	43.89
2	T2 (250gy)	13	6.97	6.76	2.60	37.30
3	T3 (300gy)	10	6.24	6.35	2.52	40.38
4	T4 (Control)	4	5.39	1.59	1.26	23.19

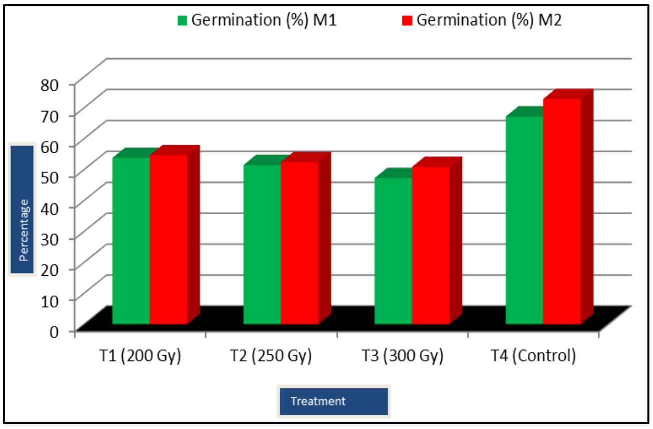

Fig 1: Impact of treatment with gamma rays on germination percentage in the M1 and M2 generation

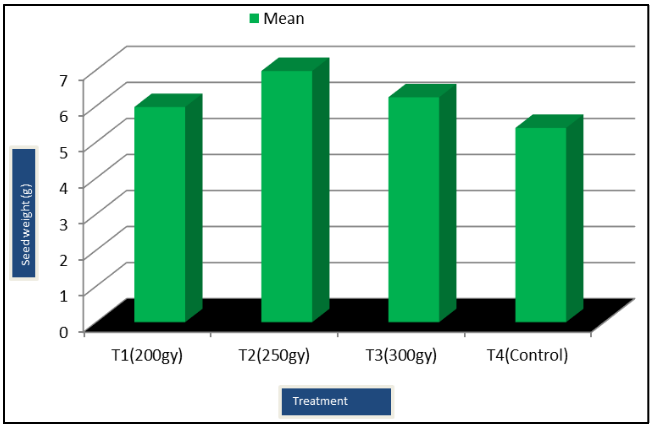

Fig 2: Impact of gamma rays treatments on 100 seed weight (g) in M2 generation.

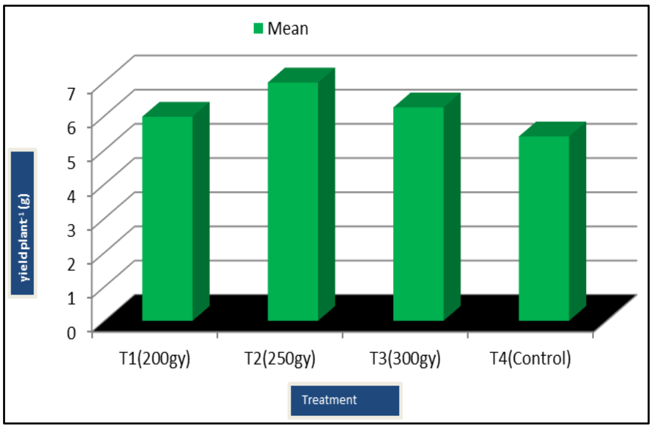

Fig 3: Gamma rays treatment effect on grain yield plant^{-1} (g) in M2 generation

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