Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(5): 1817-1820
Received: 12-07-2019
Accepted: 14-08-2019

BS Bhoite
M.Sc. Agri Student, RCSM College of Agriculture, Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

MS Kamble
Asst. prof., RCSM College of Agriculture, Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

AR Aher
Asst. prof., RCSM College of Agriculture, Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

MV Chavan
M.Sc. Agri Student, College of Agriculture, Latur, Maharashtra, India

Corresponding Author:
BS Bhoite
M.Sc. Agri Student, RCSM College of Agriculture, Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Mutagenic sensitivity in M_1 generation of three verities of soybean (*Glycine max* L.)

BS Bhoite, MS Kamble, AR Aher and MV Chavan

Abstract
In this study, variability was induced by gamma rays in three soybean genotypes *viz*. Phule Agrani (KDS-344), Phule Sangam (KDS-726) and KS-103 were selected for mutagenic treatment. Their seeds were exposed to three doses of gamma-radiation 200, 300, and 400 Gy in order to study their mutagenic effects in the treated seeds in M_1 generation. The observations were recorded on germination percentage and survival percentage. The gamma ray treatment was done at Mutation Breeding Section, Department of Nuclear and Agriculture, BARC, Trombay, Mumbai. The observations on mutagenic effects in M_1 generation revealed dose dependent reduction in seed germination and survival. Among the genotypes, KS-103 soybean was more sensitive for mutagenic treatments than Phule Agrani and Phule Sangam. The LD_{50} dose between 300-400 Gy gammas were found to be ideal for mutagenic treatments irrespective of the genotype.

Keywords: Induced mutation, gamma rays, *Glycine max*, Gray (Gy)

Introduction
Soybean (*Glycine max* L.) possess a very high nutritional value. It contains about 20% oil and 40% protein. Soybean protein is rich in valuable amino acid lysine (5%), in which most of the cereals are deficient. In addition, it also contains a good amount of minerals, salts and vitamins such as thiamine and riboflavin (Chauhan *et al*., 2002) [3]. It is self-pollinated consequently the extent to which soybean cultivars may be improves conventional breeding method in plant breeding as a source of increasing variability and could confer specific improvement without significant phenotype (Ojomo *et al*., 1979) [10].
Experimental mutagenesis is an important source produce mutation in higher frequencies in cultivated crops. Excellent source of valuable materials for breeding work can be provided by establishing extensive collection of mutations based on productive characters. The simultaneous realization on different breeding objective could be made possible through induced mutagenesis, especially in grain legumes like soybean. Mutation breeding may be an effective tool for generating variability in the existing varieties and selecting desirable early maturing lines which would be proved to be an ideal crop for summer seasons (Khan & Goyal, 2009) [8]. Mutation breeding has been employed successful for soybean (Dhole *et al*., 2003; Karthika and Subba Lakshmi, 2006; Ganapathy *et al*., 2008 and Pavadai *et al*., 2009) [4, 7, 5, 12]. Induced mutations delivered fairly good amount of genotypic coefficient of variation, the heritability, GA as percent of mean with respect to number of seeds per plant.
Several breeding workers used radiation very extensively for inducing mutations in crop plants sincerely for inducing mutation in crop plants since 1928. Radiation might be ionizing and non-ionizing. A gamma rays is a packed of electromagnetic energy photon. Gamma photons are the most energetic photons in the electromagnetic spectrum. Gamma rays are emitted from the nucleus of some unstable atoms. Gamma rays were used by Sharma, 1965; Geetha; 1994 and Pavadai, 2006 [11]. It has been demonstrated by many workers that genetic variability for several desired characters can be induce success practical value in plant breeding programme has been established. The present programme was undertaken to investigate the mutagenic effects of gamma ray's variability and genetic advance within the Soybean cultivars and hence improve its production.

Materials and Methods
Experimental site
The research work in Soybean (*Glycine max* (L.) Merrill.) was carried out at Post-graduate research farm, RCSM College of Agriculture, Kolhapur (M. P. K. V. Rahuri) during Summer 2017-2018 for M_1 generation. The materials used and methods adopted for various studies under this investigation are presented below.

Biological material

Three diverse genotypes of soybean (*Glycine max* (L.) Merrill) *viz*., Phule Agrani (KDS344), Phule Sangam (KDS-726) and KS-103 were selected for mutagenic treatment. The seeds of first two genotypes were obtained from Agriculture Research Station Kasabe-Digraj, Dist-Sangli whereas; KS-103 was obtained from Agril. Botany Section, RCSM College of Agriculture, Kolhapur.

Physical mutagen

The mutagen Gamma rays (cobalt-60 serves as source of gamma rays.) were used in the study. Dry, uniform and healthy seeds of soybean varieties *viz*., PhuleAgrani, PhuleSangam and KS-103 were treated with gamma rays. The gamma ray treatment was done at Mutation Breeding Section, Department of Nuclear and Agriculture, BARC, Trombay, Mumbai 400 085. (M.S)

Mutagenic treatment with gamma rays

Sr. No	Genotype	Dose of Irradiation with Gamma rays (Gray)
1	PhuleAgrani (KDS-344)	0 (Control), 200, 300, 400
2	Phule Sangam (KDS-726)	0 (Control), 200, 300, 400
3	KS-103	0 (Control), 200, 300, 400

Details of experiment

The size of experimental plot was 3x2.5 cm with fertilizer dose 50:75:25 kg ha^{-1} The spacing maintained was 45x5 cm. All the recomonded package of practices were followed during crop growth. The experiment was planted in second week of February 2018.

Handling the mutated populations

Two hundred treated seed were sown for each treatment. The following observations were taken on each plant to check the mutagenic sensitivity and the average performance was worked out.

Seed germination (%)

Germination counts were recorded starting from 5th day of sowing and continued up to 15th day and expressed as percentage of germinated seedlings to the total seeds sown after moderating the germination percentage of control. Germination percentage was calculated by using the following formula:

$$\text{Germination \%} = \frac{\text{No. of seeds germinated}}{\text{No. of seeds sown}} \times 100$$

Germination was expressed as the percentage of control.

Seedling survival (%)

Observation on survival was made on 30th day after sowing. Plants with at least two primary leaves above the cotyledonary leaves were considered as surviving. Survival percentage was calculated by using the following formula:

$$\text{Survival \%} = \frac{\text{No. of seedlings survived}}{\text{No. of seeds germinated}} \times 100$$

Survival was expressed as the percentage of control.

Results and Discussion

Germination percentage

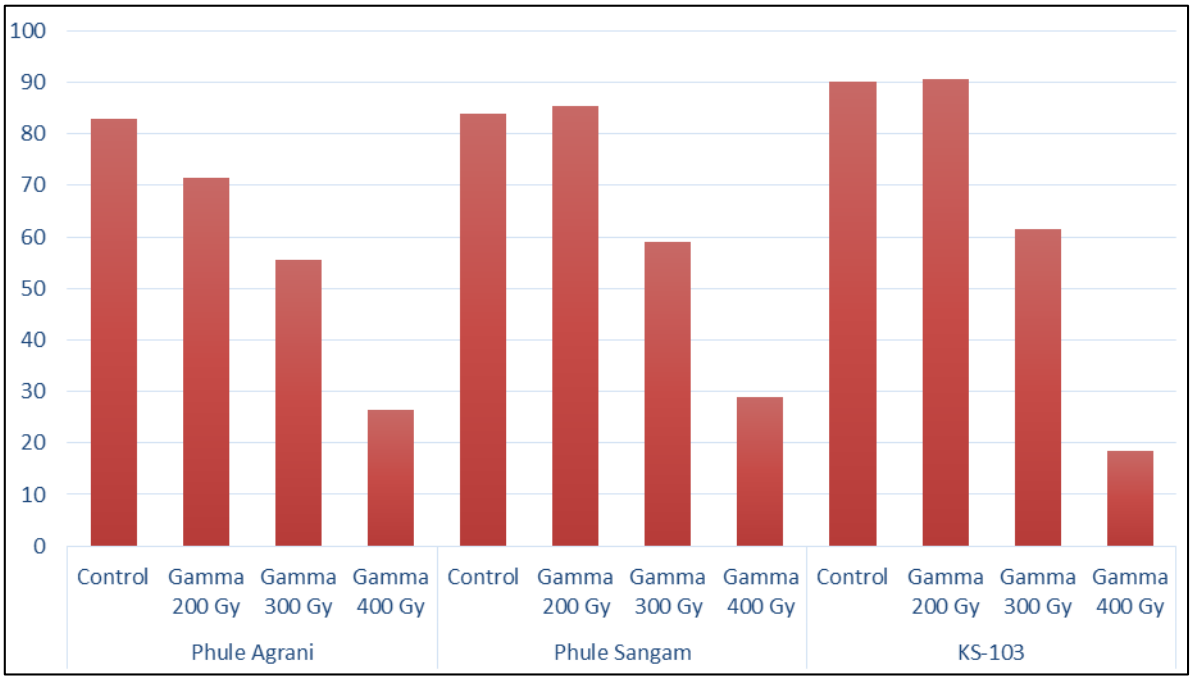
In the variety PhuleAgrani (KDS-344), initial germination was recorded after 10 days of sowing both in control and in irradiated seeds in M_1. The germination has been presented in Table-1. The percentage of germination observed in Control, 200 Gy, 300 Gy and 400 Gy doses were 83, 71.5, 55.5, and 26.5 per cent respectively. A perusal of the data indicated that there was a pronounced effect of gamma rays on germination in all doses. The germination percentage decreased considerably with increasing doses of gamma rays. Similar result was reported by Addai and Kantanka (2006) [1]

The observations on germination of the variety Phule Sangam (KDS-726) in M_1 was recorded and have been presented in the Table.1. The percentage germination observed in control and 200 Gy, 300 Gy, 400 Gy doses was 84, 85.5, 59, and 29 per cent. In 200 Gy dose germination percentage was slightly increased as compare to control. Similar results were reported by Karthika and Subbalakshmi (2006) [7]

In KS-103 the percentage of germination observed in control and 200 Gy, 300 Gy, 400 Gy, doses were 90, 90.5, 61.5, and 18.5 where germination percentage was highly decreased with increase in dose of mutagen. Similar result in soybean were also reported by Padavai and Dhanavel (2004) and Satpute and Fultambkar (2012) [14].

Table 1: Effect of mutagens on germination in M_1generation of soybean genotypes

Genotype	Treatments	Total seed sown	Germinated seed	Germination %
PhuleAgrani (KDS-344)	Control	200	166	83
	Gamma 200 Gy	200	143	71.5
	Gamma 300 Gy	200	111	55.5
	Gamma 400 Gy	200	53	26.5
Phule Sangam (KDS-726)	Control	200	168	84
	Gamma 200 Gy	200	171	85.5
	Gamma 300 Gy	200	118	59
	Gamma 400 Gy	200	58	29
KS-103	Control	200	180	90
	Gamma 200 Gy	200	181	90.5
	Gamma 300 Gy	200	123	61.5
	Gamma 400 Gy	200	37	18.5



Germination percent

Survival percentage

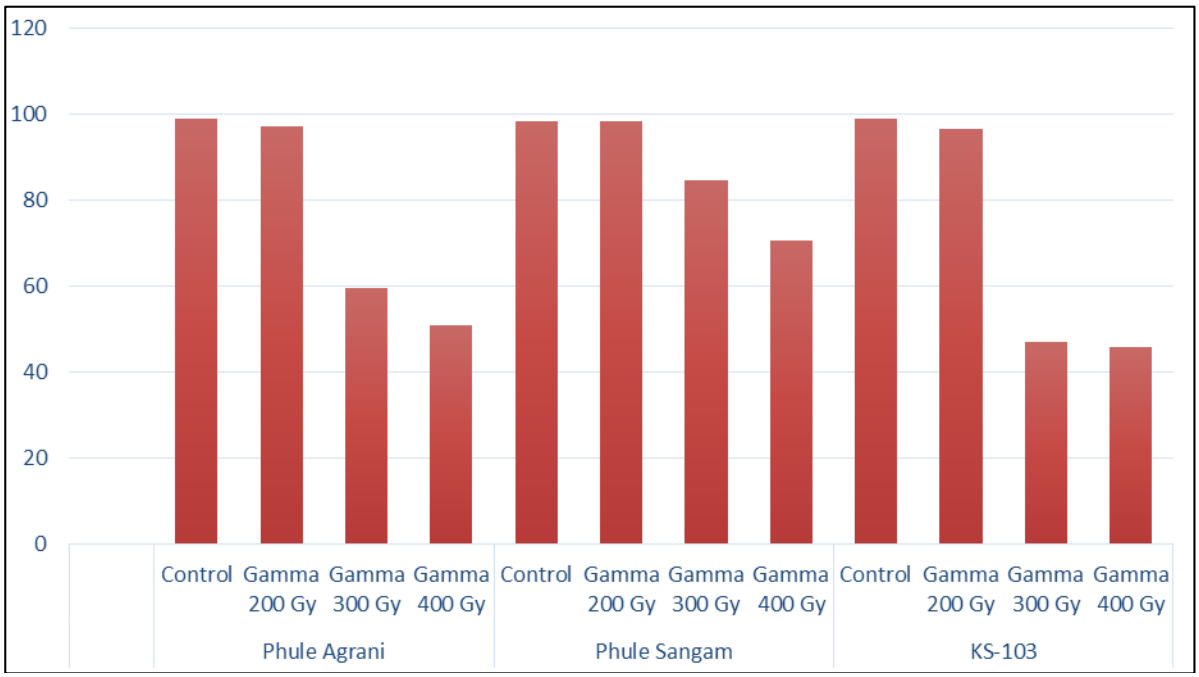
Observations on survival per cent was made on 30 days after sowing. Plants with at least two primary leaves above the cotyledonary leaves were considered as surviving. The number of plants survived of variety, PhuleAgrani (KDS-344) in M_1 was recorded and have been presented in table 2. The number of plants survived were 164, 139, 66, 27 in control, 200 Gy, 300 Gy, and 400 Gy, respectively. There was marked decrease in survival percentage of higher doses of gamma rays. Similar result also reported by Balakrishnan (1991) [2] in variety Co-1 and Co-2, Padavai and Dhanavel (2004) and Singhand Kole (2005)

The number of plants survived in the variety, Phule Sangam (KDS 726) were 165, 168, 100, and 41 in control 200 Gy, 300 Gy and 400 Gy doses (table 2). The survival percentages were 98.24, 84.74, 70.68 per cent in control 200 Gy, 300 Gy and 400 Gy doses respectively, where as it was 98.21 in control. There was makeable decrease in survival percentage of plants except at 100 Gy where maximum survival percent was observed. Maximum mortality was observed in 400 Gy.

In KS-103 the number of plants survived were 178, 175, 58, 17 in control 200 Gy, 300 Gy, 400 Gy doses respectively. The survival percentages were, 98.88, 96.68, 47.15, and 45.94 in control, 200 Gy, 300 Gy, 400 Gy doses respectively. Maximum mortality was observed in 400 Gy being lowest among the all doses of three genotypes.

Table 2: Effect of mutagens on survival in M_1 generation of soybean genotypes

Genotype	Treatments	No. of seeds germinated	No. of seedlings survived	Survival %
Phule Agrani (KDS-344)	Control	166	164	98.79
	Gamma 200 Gy	143	139	97.20
	Gamma 300 Gy	111	66	59.45
	Gamma 400 Gy	53	27	50.94
Phule Sangam (KDS-726)	Control	168	165	98.21
	Gamma 200 Gy	171	168	98.24
	Gamma 300 Gy	118	100	84.74
	Gamma 400 Gy	58	41	70.68
KS-103	Control	180	178	98.88
	Gamma 200 Gy	181	175	96.68
	Gamma 300 Gy	123	58	47.15
	Gamma 400 Gy	37	17	45.94



Survival percent

Conclusion

From the above experiment, it is revealed that three genotypes of soybean *viz.*, Phule Agrani (KDS-344), Phule Sangam (KDS-726) and KS-103 were treated with three doses of gamma rays (200, 300 and 400 Gy) The observations on mutagenic effects in M_1 generation revealed dose dependent reduction in seed germination and survival percentage. Among the genotypes, KS-103 soybean was more sensitive for mutagenic treatments than the Phule Agrani and Phule Sangam. The LD_{50}dose between 300-400 Gy gammas was found to be ideal for mutagenic treatmenton the basis of germination and survival percentage.

Acknowledgement

Authors are very much thankful to Mutation Breeding Section, Department of Nuclear and Agriculture, BARC, Trombay, Mumbai 400 085. Without their cooperation it was difficult to formulate the expenditure.

References

1. Addai IK, Kantanka OS. Effect of 60Co Gamma Irradiation on Storability of Soybean Seed. Asian Journal of Plant Sciences. 2006; 5:221-225.
2. Balakrishnan PC. Induced mutagenesis in soybean (*Glycine max* (L.)Merill). Ph.D. Thesis, Tamil Nadu Agrl. Univ., Coimbatore, 1991.
3. Chauhan OP, Chauhan GS, Singh G, Kumbhar BK, Mishra DP. Varietal variability in the contents of nutrients and anti-nutrients in different parts of soybean seeds. J Rural Agric Res. 2002; 2(2):42-50.
4. Dhole VJ, Maheshwari JJ, Patil S. Studies on mutations induced by EMS in soybean (*Glycine max* (L.) Merrill). Agric. Sci. Digest. 2003; 23(3):226-228.
5. Ganapathy S, Nirmalakumari A, Senthil N, Souframanien J, Raveendran TS. Isolation of macro mutations and Mutagenic effectiveness and efficiency in little Millet Varieties. World. J Agri. Sci. 2008; 4(4):483-486.
6. Geetha K. Studies on induced mutation in two distinct varieties of soybean (*Glycine max* (L.) Merill). Ph.D. Thesis, Tamil Nadu Agrl. Univ., 1994.
7. Karthika R, Subba Lakshmi B. Effect of gamma rays and EMS on two varieties of Soybean. Asi. J Pl. Sci. 2006; 5(4):721-724.
8. Khan S, Goyal S. Mutation genetics studies in mungbean IV. Selection of early maturing mutants. Thai. J Agri. Sci. 2009; 42(2):109-113.
9. Maheshwari JJ, Dhole VJ, Shanti Patil, Rathod DR. Radiation induced variability for quantitative characters in soybean. J Soils and Crops. 2003; 13(2):314-316.
10. Ojomo AQ, Omueti O, Raj JA, Omucti O. Studies on induced mutation in cowpea, 5. The variation in production of radiation, Nig. J Appl. Sci. 1979; 21:61-66.
11. Pavadai. Studies on induced mutagenesis in Soybean. Ph.D., Thesis, Faculty of Science, Annamalai University, Annamalai Nagar, India, 2006.
12. Pavadai P, Girija M, Dhanavel DM. Effectiveness and efficiency and biochemical content of physical and chemical mutagens in soybean (*Glycine max* (L.) Merr.). Journal of Phytology. 2009; 1(6):444-447.
13. Pavadai P, Dhanavel D. Effect of EMS, DES and Colchicine treatment in soybean. Crop Res. 2004; 28(1, 2 & 3):118-120.
14. Satpute RA, Fultambkar RV. Effect of mutagenesis on germination, survival and pollen sterility in M_1 generation of Soybean [*Glycine max* (L.) Merill]. International journal of recent trends in science and technology. 2012; 2(3):30-32.
15. Singh R, Kole CR. Effect of mutagenic treatments with EMS on germination and some seedling parameters in mung bean. Crop Res. 2005; 30(2):236-240.
16. Sharma B. Influence of some chemical and physical mutagens on growth and development of peas in first generation. Plant Breed. Abstr. 1965; 36(3):5350.