

Original Research Article

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Impact of Gamma Rays on Quantitative Traits of Soybean (*Glycine max* (L.) Merrill) in M₂ Generation

H. V. Kalpande, S. B. Borgaonkar* and S. K. Chavan

Department of Agril. Botany, Vasant Rao Naik Marathwada Krishi Vidyapeeth,
Parbhani, (Maharashtra), India

*Corresponding author

ABSTRACT

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Induced mutation by gamma rays irradiation is one way to increase genetic variability of plants. The seeds were irradiated by gamma rays mutation doses, namely 10 kR, 20 kR and 30 kR with response of two soybean cultivars were studied in the M₂ generation. Increase in heritability and genetic advance was noticed for some economic traits like seed yield plant⁻¹, 100 seed weight, number of seeds plant⁻¹, pod weight plant⁻¹ and germination per cent in M₂ offering good scope for selection.

Introduction

Soybean (*Glycine max* (L.) Merrill) is one of the most important oilseed-cum leguminous crop gaining importance during recent years.

Importance of soybean in Indian Agriculture is obvious because of its high protein (42 %) and oil (20 %) content.

In order to induce more variability and utilize useful mutations for efficient plant breeding. The present manuscript was undertaken to gather information on the consequences of induction of physical mutations in soybean.

Materials and Methods

Dry seeds of two Soybean (*Glycine max* (L.) Merrill) cultivars, viz., MAUS 47 and JS 97-52 were treated separately with the gamma rays to 10, 20 and 30 kR dose of gamma rays (CO⁶⁰) with a dose rate of 2.39 kR per minute at Nuclear and Agriculture Division, B. A. R. C. Trombay, Mumbai-400 085 and the same number of untreated seeds of each variety served as control.

Ten normal looking plants from each treatment in M₁ were selected randomly to raise M₂ generation. From these, 50 plants per

replication were raised in a randomized block design with three replication for each treatment in M₂ generation. All recommended cultural operations namely, irrigation, weeding and plant protection methods were carried out during the crop growth period. All the data were statistically analysed and results were expressed in comparison with control.

Results and Discussion

The extent of variability for various quantitative characters including seed yield available to a breeder determine the extent of the success that can be achieved in the genetic improvement of that species. If a genotype shows increase in mean, there is scope for making genetic advance by selection and thus improving the character.

In induction programme of mutation, the choice of genotype to be treated is very important, since different genotypes differ in their response to mutagenic treatments. In the present investigation, the effect of polygenic mutations for quantitative characters in M₂ generation was studied in the form of their range, mean, phenotypic and genotypic coefficients of variation, heritability and genetic advance are presented in Table 1.

In the present study, there was a inhibition of germination is taken as an indication of degree of radiosensitivity and the extent of genetic as well as physiological damage caused by the mutagen. In the present investigation, gamma rays treatments had an adverse effect on germination. Reduction in germination was dose dependent for gamma rays treatments in both the genotypes. Even though, linearity between seed germination and dose was noticed, the genotypes responded differentially i.e. MAUS 47 was more sensitive than JS 97-52. Inhibition effect was more pronounced at higher doses. Similar types of results have been reported by

Nandanwar *et al.*, (2005), Patil (2006), Patil and Wakode (2011) and Satpute and Fultambkar (2012) in soybean. Shift in population mean value towards positive direction was observed for seed yield plant⁻¹, 100 seed weight, number of seeds plant⁻¹, pod weight plant⁻¹ in all the gamma treated in both the genotypes.

The deviation of treatment variance and coefficient of variance from control indicated that the mutagens tried are effective and have induced the variability for pod weight plant⁻¹ in both the genotypes of soybean. It is seen from the Table 1 that the widest range of variation recorded for pod weight plant⁻¹. As regards the mutagenic treatments 20 kR dose gamma rays recorded enlarged ranged for populations variance for pod weight plant⁻¹ in M₂ generation as compared to other gamma rays doses in the cultivar JS 97-52 and MAUS 47. The coefficient of variation in 20 kR dose gamma rays induced highest coefficient of variation (56.73 and 38.82) in M₂ generation in both the genotypes.

As regard the mutagenic treatments 20 kR dose gamma rays observed highest variance (3099.18 and 4825.46) for number of seeds plant⁻¹ in JS 97-52 and MAUS 47 respectively as compared to their control. The same trends was also observed for coefficient of variation in M₂ generation for both the genotypes. In 100 seed weight, the data revealed that the largest population variance, coefficient variation (5.16, 21.56 per cent) was recorded in 30 kR dose of gamma rays in JS 97-52 populations. In MAUS 47 populations the highest variance, coefficient variation i.e. 5.77, 22.26 per cent was observed in 20 kR dose of gamma rays against the respective control. Estimates of variance and coefficient of variations as affected by mutagenic treatments for seed yield plant⁻¹ in M₂ generation of soybean genotypes are presented in Table 1.

Table.1 Mean and components of variance for pod weight plant⁻¹, no. of seed plant⁻¹, 100 seed weight and seed yield plant⁻¹ in gamma treated generation of two soybean cultivars

Mutagen	Germination percent	Mean ± SE				Variance				CV			
		Pod weight plant ⁻¹	No. of seeds plant ⁻¹	100 seed weight	Seed yield plant ⁻¹	Pod weight plant ⁻¹	No. of seeds plant ⁻¹	100 seed weight	Seed yield plant ⁻¹	Pod weight plant ⁻¹	No. of seeds plant ⁻¹	100 seed weight	Seed yield plant ⁻¹
JS 97-52													
Control	94.16	14.03 ± 0.33	116.42 ± 2.79	10.19 ± 0.15	11.85 ± 0.33	6.49	468.62	1.38	6.59	18.15	18.59	11.53	21.66
10 kR	90.37	17.38 ± 0.81	117.52 ± 5.49	10.39 ± 0.26	12.24 ± 0.56	39.76	1808.97	4.11	19.13	36.27	36.19	19.51	35.73
20 kR	85.92	12.46 ± 0.91	105.03 ± 7.19	10.14 ± 0.24	10.84 ± 0.84	50.04	3099.18	3.46	42.43	56.73	53.00	18.35	60.07
30 kR	81.03	17.84 ± 0.68	120.62 ± 5.54	10.53 ± 0.29	12.66 ± 0.67	27.43	1838.88	5.16	27.33	29.37	35.55	21.56	41.29
MAUS 47													
Control	93.86	19.41 ± 0.47	103.33 ± 2.07	10.56 ± 0.17	10.92 ± 0.29	13.04	258.02	1.83	4.97	18.60	15.54	12.82	20.41
10 kR	89.28	24.46 ± 0.92	116.20 ± 4.61	10.84 ± 0.20	12.51 ± 0.53	50.96	1273.79	2.43	17.01	29.18	30.71	14.38	32.98
20 kR	86.64	27.18 ± 1.36	147.22 ± 8.97	10.89 ± 0.31	15.58 ± 0.94	111.33	4825.46	5.77	53.57	38.82	47.18	22.26	46.96
30 kR	82.03	29.66 ± 1.17	157.7 ± 7.96	10.90 ± 0.29	16.83 ± 0.75	81.70	3807.37	5.09	33.80	30.48	39.13	20.68	34.54

It was observed from the above table that the variance and coefficient of variation found highest in 20 kR gamma rays (42.43, 60.07 per cent) and then the control in JS 97-52 population. While in another populations MAUS 47, in 20 kR gamma rays (53.57, 46.96 per cent) in radiation treatments against their control.

These expressions indicated the scope for improvement of these traits by selection procedure and subjecting these populations to directional selection would improve these traits. These finding are in accordance with the results obtained by Manjaya (2009), Tambe and Apparao (2009), Khan and Tyagi (2010), Pavadai *et al.*, (2010) and Dhanavel *et al.*, (2012).

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