

ISOLATION AND MORPHOLOGICAL CHARACTERIZATION OF M₁ VARIANTS OF SOYBEAN

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Abstract:

Soybean is botanically described as *Glycine max* (L.) Merr. Soybean is widely cultivated as a major source of protein and oil. Variability in existing varieties of soybean can be induced through induced mutation breeding programme. This induced variability can be exploited for the crop improvement. In present study the seeds of soybean variety Phule Kalyani (DS-228) were mutagenized with various doses of physical mutagen gamma rays and various concentrations of chemical mutagens Sodium azide and Ethyl methanesulphonate. The M₁ generation was raised from mutagenized seeds. Entire M₁ generation was studied for various biological parameters. Some morphological variants in comparison with control were isolated. Their morphological characterization was carried out. The seeds of all these variants were collected separately. The true breeding nature of these variants will be checked in M₂ generation. It seems that these variants will certainly generate novel mutants with desired characteristics in M₂ generation.

Keywords: Soybean, morphological variants, M₁ generation.

Introduction:

The triple-benefit crop known as soybean [*Glycine max* (L.) Merrill] has a protein content of approximately 40%, 20% oil that is rich in polyunsaturated fatty acids, particularly omega-6 and omega-3 fatty acids, 6–7% total minerals, 5–6% crude fiber, and 17–19% carbohydrates (Chauhan *et al.*, 1988). Soybean is referred as "wonder crop" or "golden bean" as it contains high amount of necessary amino acids, vitamins A, B, and D, as well as health-promoting compounds such as isoflavones. In Indian eating habits, soybean oil is utilized as an edible oil. It contains minimal amount of saturated fats. Soybean oil is therefore healthier for people. Soybean is highly self-pollinated crop and belongs to family Fabaceae. Global production of soybean was reported as 420.76 million metric tonnes, and the main producers were the United States, Brazil, Argentina, China, and India (Foreign Agricultural Service, 2025). Mutations are the ultimate source to create variability in organisms. Mutations can be used for plant breeding in many different ways. Induced mutation is thus the ultimate source to alter the genetics of crop plants that may be difficult to bring through other breeding procedures. In the present study, mutations were induced in the Soybean variety Kalyani (DS-228) by treating these seeds with different doses/concentrations of gamma rays, Sodium azide and Ethyl methanesulphonate. The plants of M₁ generation were screened and morphological variants were isolated.

Material and Methods:

The genetically pure seeds of Soybean variety Kalyani (DS-228) were procured from Agricultural Research Station Kasbe Digraj from Mahatma Phule Krushi Vidyapith, Rahuri. Four

hundred dry and healthy seeds were subjected to different doses of gamma rays 200Gy, 400Gy and 600Gy at the Department of Chemistry, Rashtrasant Tukadoji Maharaj Nagpur University Campus, Nagpur using ^{60}Co as gamma source. Two chemical mutagens SA and EMS were also used to induce the mutations. In this case, dry seeds were subjected to 18 hours for mutagen treatment. These seeds were treated with 0.001%, 0.003%, 0.005% SA and 0.02%, 0.04% and 0.06% of EMS, separately. After the treatment, the seeds were then kept in distilled water for 1 hour for post soaking and sown in field following randomized block design. The seeds exposed to gamma rays were also sown in field with control and M_1 generation was raised. The entire M_1 generation was thoroughly screened and several morphological variants were isolated. The morphological characterization of these variants was carried out. The seeds of these variants were collected separately.

Results and Discussion:

All the three mutagens (Gamma rays, SA and EMS) were found to be effective in inducing variations in soybean variety Kalyani (DS-228). In almost all the treatments, various morphological variants were recorded. All these variants showed distinct variations in various morphological characters as compared to control. The morphological characterization of all these variants was carried out for the parameters days to flowering, days to maturity, plant height, number of pods per plant, number of seeds per pod and 100 seeds weight.

Tall variants:

In this study total 5 tall variants were observed. The average height was 144 cm, it is more than the control (49.32 cm). Tall variants were observed in gamma rays dose of 200Gy, in sodium azide concentrations of 0.001% and 0.003%. Tall variant was also recorded in ethyl methanesulphonate concentration of 0.04%. Flowering period of these variants was 37 days. They have taken 94 days for maturity. The average pod number of tall variants was 56 and average number of seeds per pod was 2.20. 100 seeds weight of tall variants was 8gms.

Dwarf variant:

The dwarf variant were characterized by their short plant length. The overall growth of these plants was stunted. Total 11 dwarf variants were observed and data recorded. The average plant height of dwarf variants was 13 cm, it is lesser than control (49.32cm). Dwarf variants were observed in all the concentration of sodium azide 0.001%, 0.003% and 0.005%. These variants also recorded in ethyl methanesulphonate concentrations of 0.02% and 0.04%. Flowering period of these variants was 36.64 days. They have taken 95.09 days for maturity. The average pod number of dwarf variants was 32 and average number of seeds per pod was 1.54. The average of 100 seeds weight of dwarf variants was 8gms. Dwarf variants were observed in the M_1 generation of SA and EMS treated plants. Patil *et al.*, (2004) recorded that the plant height was also found to be significantly reduced in higher doses of mutagen and their combination treatments.

Early flowering variant:

In the control plants, flowering commenced on 39 to 40 days, where as in the early flowering variants was observed in sodium azide concentration of 0.003%, the flowering period of this variant was 33 days. It has taken 92 days to mature. The height of early flowering variant

was 38 cm. Average pod number of this variant was 38 and number of seeds per plant was found to be more (2.37) than control (1.83). The average of 100 seed weight was 10.33gms. Early flowering variants were observed in mutagen sodium azide at 0.003% concentration. Kambale(2023), studied induced mutation in the variety JS-335. The highest number of seeds per plant (23.33) exhibited by M_2T_1 followed by the treatment without mutagen i.e. M_1T_{10} (19.5). The lowest number of seeds per plant (9.00) was recorded in M_2T_5 which was significantly lower than M_2T_1 and M_2T_{10} .

Early maturing variant:

The plants in the mutagen treated populations which commenced maturation about 5 to 10 days earlier than control plants. The time period of flowering was 36 days. These variants have taken 90 days to maturity, these variants matured 10 days before than control population. The average height of early maturing variants were 75 cm. The average pod number of these variants were 126 it was more than control (34.28) and average number of seeds per pod was 2.22. The 100 seed weight of early maturing variants was more (11gms) than control (8gms). These variants were recorded in gamma ray dose of 200 Gy and sodium azide doses 0.003% and 0.005%. Patil *et al.*, (2004) in variety MACS 450, reported that in the higher doses of mutagen treatments and their combinations, days required for maturity were found to be significantly increased. The maximum prolongation in maturity was up to 8 days in 25Kr + 0.15% EMS treatment. Due to reduced vigour and prolongation of maturity period, the number of pods/plant was also significantly affected in these treatments.

Seed coat variant:

The mutagenic treatment of sodium azide concentration of 0.005% showed the shininess in seed coat, it was considered as shiny seed coat variant. It was nearly similar in morphological characters with control but the distinct character was shiny seed coat. The height of shiny seed coat variant was 75 cm, the flowering time was 40 days. The average pod numbers per plant was 33 and seeds per pod was 1.91. The average of 100 seeds weight was 8.8gms.

Table 1: Morphological characterization of soybean variants in M_1 generation

Sr. No.	Variants	DTF	DTM	Height (cm)	No. of Pods	No. of Seeds per Pod	100 Seed Weight (gms)
1	Control	40	99.33	49.32	34.28	1.83	8.43
2	Tall variant	37	94	144	56	2.20	8
3	Dwarf variant	36.64	95.09	13	32	1.54	8
4	Early flowering variant	33	92	38	38	2.37	10.33
5	Early maturing variant	36	90	75	126	2.22	11
6	Shiny Seed coat variant	40	100	75	33	1.91	8.8

DTF: Days to Flowering, DTM: Days to Maturity

Conclusion:

In this investigation, several beneficial morphological variants have been isolated. The morphological characterization of these variants was carried out. The true breeding nature of these variants will be assessed in M_2 generation.

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References:

- **Chauhan G. S., Narayan R. and Verma N. S. (1988).** Changes in the quality of soybean during storage. Part 2-effect of soybean storage on the sensory qualities of the products made therefrom. *Food Chemistry*. 30(3):181-190.
- **Google Trends. (n.d.). Foreign Agricultural Service, (2025).** Data and analysis of Soybean production from <https://www.fas.usda.gov/data/production/commodity/2222000>.
- **Kamble K. P. (2023).** Studies on ems induced mutagenesis in soybean [*Glycine max* (L.)]. (Ph. D. thesis submitted to Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S.) India.
- **Nasare P. N. (2011).** Characterisation of induced morphological mutants in *Ocimum sanctum* Linn. *Online International Interdisciplinary Research Journal*. 1(2):14-21.
- **Patil A., Taware S. P. and Raut V. M. (2004).** Induced variation in quantitative traits due to physical (γ rays), chemical (EMS) and combined mutagen treatments in soybean [*Glycine max* (L.) Merrill]. *Soybean Genetics Newsletter*. 31:6-11.