

Original Research Article

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Gamma Rays Induced Mutations on Morphological and Yield Attributing Characters in M₂ Generation of Okra [*Abelmoschus esculentus* (L.) Moench]

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ABSTRACT

Keywords

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Abelmoschus esculentus (L.) Moench, commonly known as 'ladies finger' or 'bhindi' is an economically important common vegetable crop cultivated throughout the tropical and warm temperate regions of the world. Induced mutation is highly effective in enhancing natural genetic resources and has been used in developing improved cultivars. The effect of gamma irradiation on various morphological and yield attributing characters in M₂ generation were studied. In M₂ generation, the resulted plants of 400Gy irradiated plants showed different growth inducing morphological changes and yield attributing characters such as plant height, internode length, number of leaves/plant, number of fruits/plant and fruit characteristics such as length, girth, weight, number of seeds/ fruits and weight of 100 seeds etc and disease scoring of Yellow Vein Mosaic. The occurrence of induced growth in the morphology of the plants also increased in the metabolic activities of the plants which induce the yield parameters. In 400Gy irradiated M₂ generation plants, these changes exceeded to that of control plants also.

Introduction

The genus *Abelmoschus*, belongs to family Malvaceae is represented by 12 species (Bentham and Hooker, 1867) in which the most common vegetable crop, okra [*Abelmoschus esculentus* (L.) Moench] is included. *Abelmoschus esculentus*, commonly known as okra or lady's finger or bhindi, is a warm season flowering plant cultivated throughout the tropical and warm temperate regions of the world. The word *Abelmoschus* is derived from the Arabic "*abu-l-mosk*" meaning 'father of musk', referring to the musk-scented seeds and Latin word "*esculentus*" meaning 'edible'.

The crop was originated in tropical Africa and then gradually distributed to the Mediterranean Sea area, East Asia and Indian Subcontinent (Purseglove, 1968). Okra fruits are rich in calcium, vitamin-E and starch, protein, carbohydrate, fiber, carotene, thiamin, riboflavin, niacin, iron, etc. it is used to cure goiter, leucorrhoea, functional impotency, diabetes, constipation, catarrhal jaundice and burning in the eyes and all over the body. Warm humid tropical conditions are ideal for growth and high yield of okra. It grows best within a temperature range of 24-27°C and is highly tolerant to high

temperature and drought condition. India is the largest producer of okra covering an area of 3.8 lakh hectares with an annual production of 36.84 lakh tones (Gangashetty *et al.*, 2010). However, the widespread incidence of yellow vein mosaic disease in this crop has affected its successful cultivation (Fajinmi and Fajinmi, 2006). It is a virus disease transmitted by the white fly (*Bemisia tabaci*). Mutation breeding is one of the conventional breeding methods in plant breeding. The radiations are the best tools to induce genetic variability within a very short span of time. Induced mutation is highly effective in enhancing natural genetic resources and has been used in developing improved cultivars of cereals, fruits and other crops (Lee *et al.*, 2002). Previous authors (Norfadzrin *et al.*, 2007; Manju and Gopimony, 2009; Phadvibulya *et al.*, 2009; Hegazi and Hamideldin, 2010; Muralidharan and Rajendran, 2013) have also attempted mutation breeding by using various doses of gamma irradiations. With the objective of producing disease resistant variety gamma irradiation was done in bhindi. The effect of gamma irradiation on the morphological and yield attributing characters were reported in this study.

Materials and Methods

In the previous study, out of the 25 accessions collected from different localities of Kerala a superior variety namely Anakomban was selected based on the comparative observations on yield attributing characters. This variety was used for irradiation for further improvement of characters in the present study. The seeds were irradiated at six different dose levels such as 100Gy, 150Gy, 200Gy, 300Gy, 400Gy and 500Gy. These doses were delivered from a 3500 curie CO60 gamma cell installed at Kerala Agriculture University, Vellanikkara. The gamma source was stationery and its irradiations were done

at a dose rate of 3200 Rads/min by moving down a cylindrical gasket carrying the seeds.

The experiment was laid out in Randomised Block Design, with seven treatments and four replications. The 140 seeds of each of the seven treatments were sown on the third day of treatment at the rate of 20 progeny rows/treatment with proper randomization. The seeds were soaked overnight to facilitate uniform pre-soaking. In our previous study, data on qualitative and quantitative characters of M₁ generation were gathered from 25 plants/treatments. Among the six doses of gamma irradiations used, 300Gy and 400Gy exposure was found to increase plant height, internode length, number of leaves/plant, number of fruits/plant and fruit characters such as length, girth, weight, number of seeds/fruit, weight of 100 seeds and shows resistance in Yellow Vein Mosaic disease. In order to study the effects of the mutagen in M₂ generation, in the present investigation 300Gy and 400Gy irradiated plants were raised and data on morphological and yield attributing characters were recorded.

For scoring of Yellow Vein Mosaic disease intensity in the irradiated populations (M₂ generation), the rating scale suggested by Arumugam *et al.*, (1975) was used. For noting germinability of the seeds, the seeds were sown in moist soil. The number of seeds germinated was counted every day for 15 days. The percentage of germination of each treatment was then calculated. The survival of seedling was recorded on the 10th day onwards after sowing.

Results and Discussion

The irradiated plants show different changes in morphological and yield attributing characters in M₂ generation. The main morphological changes are in plant height, leaf morphology, flower arrangements, more

than one fruit from single node, fruit length, number of locules in fruit, number of seeds/fruit and 100 seed weight. The effect of gamma rays in M₂ generation on various traits shows in Table 1. Variations in morphological mutations on plant height were mainly recorded in 400Gy irradiated plants. In M₂

generations, three groups of plants were identified in 400Gy irradiated plants- tallest plants, plants with intermediate height (intermediate plants) and dwarf plants. All the characters of tallest plants of 400Gy M₂ generation exceeded to that of 400Gy M₁ plants.

Photo plate.1 Induced morphological traits in 400Gy irradiated plants in M₂ generation



Fig: 1. Plants with larger fruits



Fig: 2. Two leaves from single node



Fig:3. Three ovaries with 11 stigmata

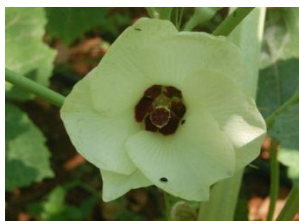


Fig: 4. Flower with six petals

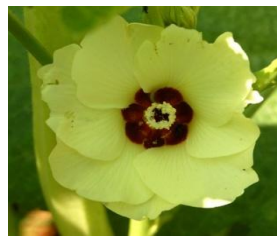


Fig: 5. Flower with seven petals



Fig: 6. Two fruits from a single node

Photo plate.2 Abnormal morphological traits in 300Gy irradiated plants in M₂ generation



Fig: 7. Lethality in young stage



Fig: 8. Crumbled corolla



Fig: 9. Flower without stigmata



Fig: 10. Flower with four petals

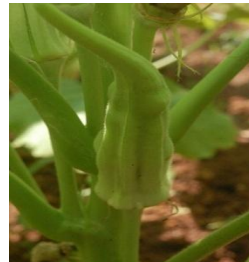


Fig: 11. Plants with small fruits



Fig: 12. Fruits with sterile seeds

Table.1 Effect of gamma rays (400Gy & 300Gy) on various traits of M₂ generation of *Abelmoschus esculentus* (L.) Moench

Treatment	Germination (%)	Survival (%)	Internode length (cm)	Plant height (cm)	Total number of leaves	Effective flowering period (days)	No. of fruits/plant	Fruit length (cm)	Fruit girth (cm)	Fruit Weight (gm)	No. of locules in the fruit	No. of seeds/fruit	100 Seed weight (gm)	Mean disease rating of YVM
Control	80.00	90.00	5.21 ± 0.49	102.17 ± 2.15	30.01 ± 0.43	65-80	13.21 ± 0.81	35.26 ± 2.83	9.51 ± 0.26	44.72 ± 1.98	6,7	74.81 ± 9.63	7.582	3.40
400Gy (Tall plants)	78.00	72.00	8.41 ± 0.37	150.03 ± 1.85	39.84 ± 0.39	60-90	15.18 ± 0.65	44.01 ± 2.10	10.52 ± 0.34	71.65 ± 1.85	5,6,7,8,10	122.64 ± 6.42	7.982	2.04
400Gy (Intermediate plants)	78.00	72.00	5.98 ± 0.28	85.56 ± 1.96	24.61 ± 0.28	60-71	10.64 ± 0.55	38.14 ± 1.97	9.50 ± 0.42	50.56 ± 1.78	5,6,7,8	84.13 ± 4.41	7.251	2.26
400Gy (Dwarf plants)	78.00	72.00	4.51 ± 0.32	62.28 ± 1.63	15.72 ± 0.31	68-79	5.14 ± 0.31	34.56 ± 1.74	9.04 ± 0.31	43.74 ± 1.64	5,6,7	27.46 ± 3.98	5.012	3.13
300Gy	58.00	44.00	5.17 ± 0.41	88.35 ± 1.89	21.46 ± 0.35	65-77	6.23 ± 0.28	29.58 ± 1.95	7.15 ± 0.28	30.47 ± 1.25	5,6,7	46.17 ± 3.34	6.515	3.31

The tallest plants attained a maximum height of 150.03 ± 1.85 cm with strikingly larger fruits, upto 44.01 ± 2.10 cm long (Fig. 1). The fruit contained 122.64 ± 6.42 seeds. The plants showed the abnormalities like extra leaf lobbing, abnormal branching, two leaves from a single node (Fig. 2), bulging of three ovaries with 11 stigmata (Fig. 3), ovary with six stigmata and extra ovary with elongated stigma (Fig. 3), flower with six petals (Fig. 4) and seven petals (Fig. 5), two fruits from a single node (Fig. 6) and fruits with ten locules and fruit with different sized seeds.

Induction in different morphological parameters increases the photosynthetic and metabolic efficiency of the plants which also directly related to the yield of the plants. Same results were also reported by many researchers (More, A.D and Jag tap, S.S. 2016). The analysis of our observations also confirmed the previous studies.

In intermediate plants the values of all the characters were lower than that of 400Gy M₁ plants. Both tallest and intermediate plants showed resistance to YVM disease. In the case of dwarf plants, extremely small plants with higher seed sterility were obtained. But the plants showed moderate resistance to the disease.

But in the case of 300Gy M₂ plants, the values of all the characters were lower than that of 300Gy and 400Gy M₁ plants as well as 400Gy M₂ plants (Table 1). The fruits were 29.58 ± 1.95 cm long, containing 46.17 ± 3.34 seeds compared to control. The plants showed the abnormalities such as lethality at young stage (Fig. 7), stunted growth, flowers with crumbled corolla (Fig. 8), flower without stigma (Fig. 9), flowers with four petals (Fig. 10), plant with smallest fruit having 10.5 cm in length (Fig. 11) and fruit with sterile seeds (Fig. 12). These plants were moderately resistant to the disease.

In M₂ generation, the resulted plants of 400Gy irradiated plants were shows different growth inducing morphological changes and exceptionally taller size with larger fruits. The occurrence of induced growth in the morphology of the plants also increased in the metabolic activities of the plants which induce the yield parameters. In 400Gy plants, these changes exceeded to that of control plants also. Among these 16 plants which showed resistance were selected and M₃ generation is being raised for further selection of desirable mutants.

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