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Gamma irradiation effect on morphological character of M1 generation of okra

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ABSTRACT

The study was done to assess the impact of various dosages of gamma beams (150, 300, 450, and 600Gy and zero portions as control) on different morphological parts of two assortments of *Abelmoschus esculentus* named BARIdherosh-1 and BARIdherosh-2. The experiment was spread out in a randomized complete block design (RCBD) with three replications. The consequences of various portions showed that gamma illumination essentially influences all boundaries i.e., plant height, number of leaves per plant, number of pods per plant, length of pod and number of seeds per plant. Plant height was significantly increased at 600 Gy (133.6cm) and 150 Gy (155.2cm) for BARIdherosh-1 and BARIdherosh-2 respectively as compared to control. At 300Gy (16.35) and 450Gy (16.23), maximum pods per plant were found for BARIdherosh-1 and BARIdherosh-2. For BARIdherosh-1 maximum number of seeds per plant (590.17) was observed at 150 Gy and for BARIdherosh-2 (542.33) it was 450 Gy.

Keywords: Gamma, irradiation, okra, mutation.

INTRODUCTION: Okra (*Abelmoschus esculentus* L.) also known as 'Ladies finger, Bhindi, Bamia, Ochro or Gumbo' is one of the most important vegetable crops grown for its green tender fruit in the peri-urban and rural areas of Bangladesh (Kabir and Khanzada, 2018). It is a flowering plant in the Malvaceae family and originated in Africa. Okra is a vegetable crop with low calories and consists of many nutrients involving vitamins B and C, fiber, calcium, and folic acid. Okra pods are variable in colors (white, red, green and purple).The immature fruit of okra is eaten green either fresh or prepared by boiling, frying and also used in making soups and stews. The nutritional value lies in its higher amount of calcium and phosphorus. Okra also contains carbohydrate, protein and fats (Majd *et al.*, 2018).

Mutation is a sudden heritable change in an organism. It may be structural or functional, but generally, structure changes occur. It can be spontaneously or artificially introduced in seeds and vegetatively propagated crops. Seed is commonly used in mutational studies because it can tolerate the physical condition. In the improvement of crops, an induced mutation in the plant is an effective tool. Radiations are the best tools to induce genetic variability within a very short span of time. Induced mutation has high effects in enhancing and it has been used in the development of improved cultivars of cereals, fruits, and crops (Lee *et al.*, 2002). One of the important physical agents is the gamma radiation which is used to improve the characters and productivity of many plants (e.g. rice, maize, cowpea, potato, and bean (Hanafy and Akladious, 2018). Mishra *et al.* (2007) have discovered some beneficial radiation induced mutant types in okra, like increase in number of fruits per plant, fruit length and yield of fruit per plant.

OBJECTIVES: The present study is carried out to detect the genetic variation induced by gamma and study the effect of gamma rays on morphological parameters of okra.

MATERIAL AND METHODS: Gamma irradiation: Gamma ray was conducted using gamma Cobalt-60 source in Bangladesh Institute of Nuclear Agriculture (BINA). Total four doses of rays (150, 300, 450 and 600 Gy) were applied to treat the seed.

Field experiment: A field experiment was carried out at Experimental field, Department of Horticulture, Bangladesh Institute of Nuclear Agriculture (BINA) from 2019 to 2020. Seeds were sown in pots; all pots were equally spaced with equal soil contents in each pot. The experimental design was completely random with each dose having 3 replicates. The equal number of seeds were sown in all pots. The pots were checked regularly for water requirements.

Parameters: The following parameters were studied during this experiment:

Plant height: Plant height of five plant per pot was measured randomly at the maturity.

Leaves per plant: Leaves per plant of five plant per pot was measured at the maturity.

Pods per plant: Total number of pods of five plant were recorded after harvest and convert it for the single plant.

Length of pod: Length of five pods were recorded from each replication after harvest.

Seed per pod: Total number of seeds of five pod were recorded after harvest and convert it for the single pod.

Statistical analysis: The experiment was set up in a randomized complete block design with three replications per treatments. Data were statistically analyzed to find out the coefficient of variation for each parameter. Two tests were performed i.e., analysis of variation (ANOVA) and least significant difference (LSD) at $\alpha = 0.05$ using Statistix 10.0.

RESULTS AND DISCUSSIONS: The analysis of variance of this experimental data showed significant differences in all the characters under study. The analysis of variance of different irradiation treatments on BARI Dherosh-1 and BARI Dherosh-2 for some characters was shown in table 1 & table 2. For BARI

Dharosh 1, The highest mean square of treatment was obtained from seed per plant (34610.77) followed by plant height (596.73) and the lowest mean sum of square of treatment was obtained from the primary length of pod (22.5193). For BARI Dharosh 2, the highest mean square was observed in seeds per plant (34992.3) followed by plant height (1750.51). The lowest mean square observed was pods per plant (19.5513).

Plant height: For BARI Dherosh-1, plant height was maximum at 600 Gy (133.6cm) followed by 450 Gy (128.6cm) as compared to control (115.27 cm), while the height was decreased significantly at 150 Gy (99.53cm). Maximum plant height was observed at 150 Gy (155.2cm) followed by at 600Gy (115.63cm) for BARI Dherosh-2 (figure 1). All the parameters were presented in figures 1 and 2.

Source of variance	Mean sum of square				
	Plant height	Leaves per plant	Pods per plant	Length of pods	Seed per pod
Replication (2)	8.744	4.021	2.4527	2.9647	85.6
Treatment (4)	596.731*	393.882*	22.7452*	22.5193*	65275.9*
Error (8)	0.101	0.142	0.0389	0.0188	1.9

Table 1: The analysis of variance of different irradiation treatment on BARI dherosh-1. '*' = Significant at 5% level.

Source of variance	Mean sum of square				
	Plant height	Leaves per plant	Pods per plant	Length of pods	Seed per pod
Replication(2)	17.38	4.752	5.4529	6.614	24.7
Treatment (4)	1750.91*	264.081*	19.5513*	24.679*	34992.3*
Error (8)	1.01	1.118	0.0559	0.0365	1.5

Table 2: The analysis of variance of different irradiation treatment on BARI dherosh-2. '*' = Significant at 5% level.

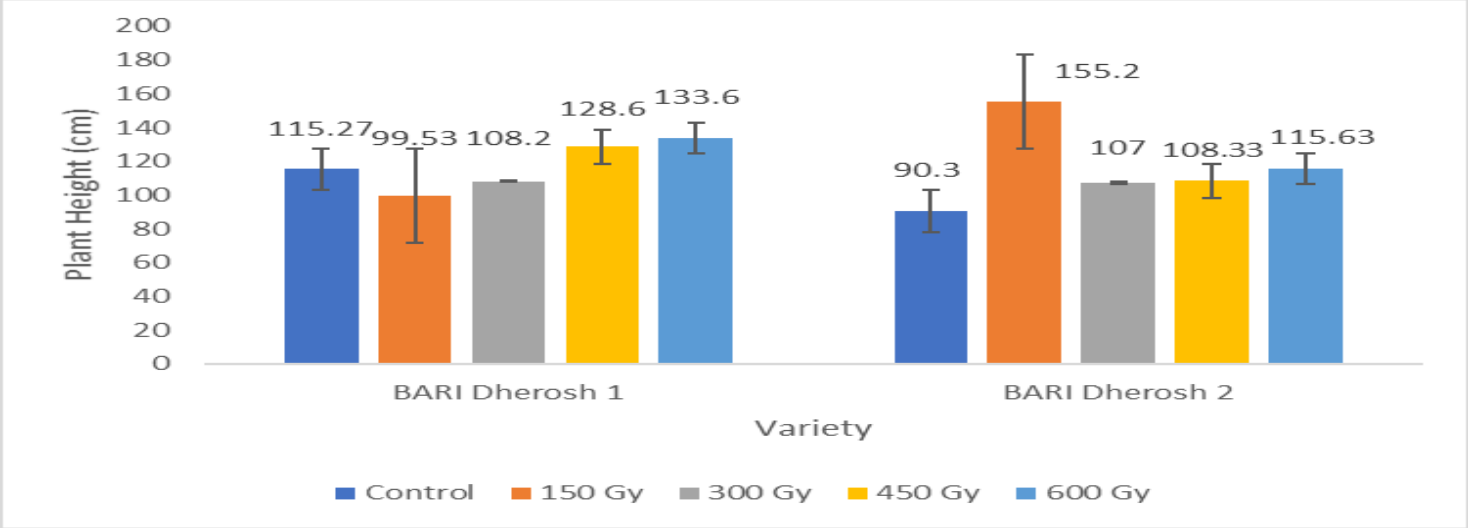

Figure 1: Effect of gamma irradiation on plant height of two okea variety (BARIdheros1 and BARIdherosh2).

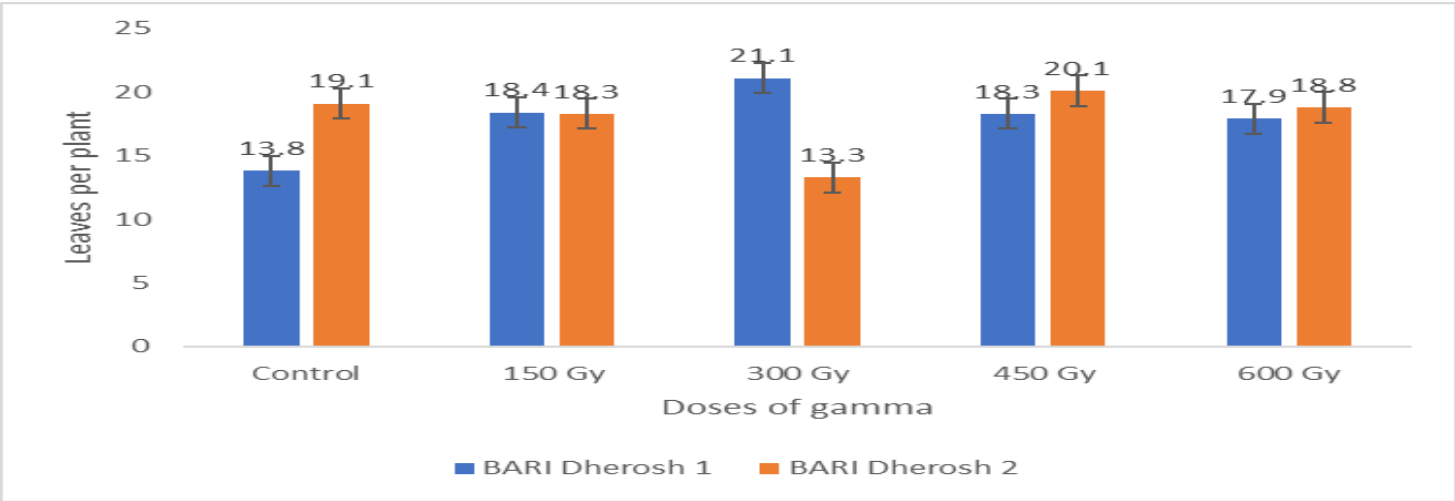

Figure 2: Effect of gamma irradiation on number of leaves per plant of two okea variety (BARIdheros1 and BARIdherosh2).

Plant height was decreased with the increase of gamma irradiation dose. Similar results were obtained by Minisi *et al.* (2013) on Gomphrena globosa, Choudhary and Dnyansagar (1980) reported the dose dependent decrease in plant height in

gamma irradiated plants of *Allium sativum* L. and three cultivars of *Oryza sativa* L. respectively. Gamma rays decreased the plant height may be due to destruction or damage to apical meristem (Saha and Sultana, 2008), hampered respiratory enzyme synthesis and reduction in the level of amylase activity (Aney, 2013) and to the temporary suspension of cell division or delay in mitosis, Machaiah, and Vakil, mentioned that ionizing radiation causes inactivation of growth regulators leading to retarded plant growth. Plant height may be decreased due to an increase in the production of active radicals that are responsible for lethality or due to increase in radiation-induced gross structural chromosomal changes (Khan *et al.*, 2018).

Number of leaves per plant: The number of leaves was maximum at 300Gy (21.1) followed by 150 Gy (18.4), 450 Gy (18.3) and minimum at control (13.8) for BARI Dherosh-1 (figure 2). In case of BARI Dherosh-2 (figure 2), maximum leaves per plant was observed at 450 Gy (20.1) followed by control (19.1) and minimum leaves was observed at 300Gy (13.3). Abdul Majeed *et al.,* (2010) observed highly significant reduction in number of leaves per plant by gamma irradiation dose.

Pods per plant: Maximum pods per plant was observed in 300Gy (16.35) followed by 150Gy (14.483) at BARI Dherosh-1, while maximum pods per plant was observed in 450Gy (16.23) followed by 150Gy (14.347) at BARI Dherosh-2 (figure 3). Minimum pods per plant was observed in control (9.03) and 300GY (9.297) at BARI Dherosh-1 and BARI Dherosh-2 respectively. John *et al.* (2006) and Amir *et al.* (2018) found wide range of variation at different gamma irradiation dose for the number of pods per plant.

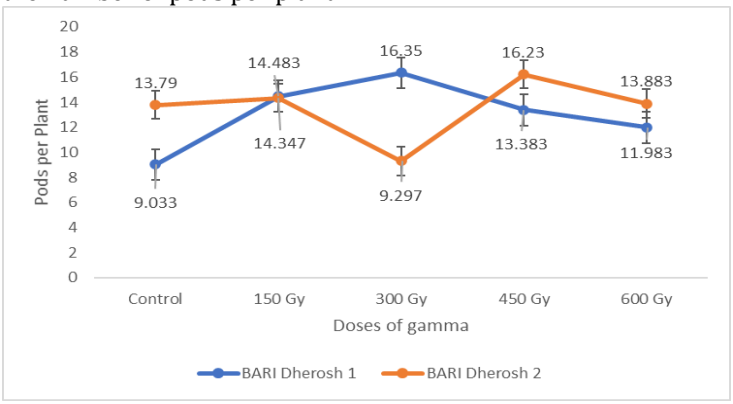

Figure 3: Effect of gamma irradiation on number of pods per plant of two okea variety (BARIdheros1 and BARIdherosh2).

Length of pods: The value for length of pod ranged from 10.133cm to 16.667cm for BARI Dherosh-1 and 10.43cm to 17.7cm for BARI Dherosh-2 (figure 4). The 300Gy was observed maximum length of pods while control was observed minimum 10.133cm. For BARI Dherosh-2 maximum length of pod was in 150Gy (17.7cm) followed by control (16.3cm) and minimum length of pod was observed in 300Gy(10.433cm). John *et al.* (2006) was found significant change in length of Pods due to higher radiation doses. Mishra *et al.* (2007) observed that, gamma irradiation doses had significantly increased the length of the pod as compared to control. S observed the stimulatory effect of gamma irradiation in lower doses on a number of capsules per plant in *Sesamum indicum*. Avinash (2013) observed the stimulatory effect of gamma irradiation in lower doses on a number of capsules per plant in Sesamum indicum.

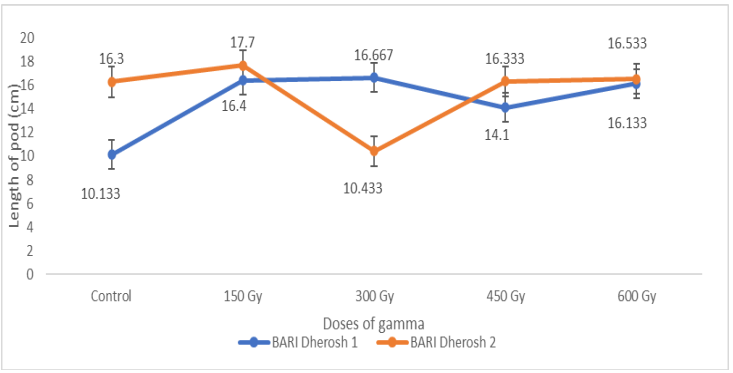

Figure 4: Effect of gamma irradiation on length of pod of two okea variety (BARIdheros1 and BARIdherosh2).

Seeds per plant: The highest number of seed per plant was observed at 150Gy (590.17) and at 300Gy (555.67) for BARI Dherosh-1 (figure 5), while the lowest was observed at 450Gy (265.9). In case of BARI Dherosh-2, the highest number of seeds per plant was observed at 450Gy (542.33) and the lowest number was at 300Gy (278.50). Amir *et al.* (2018) observed that the number of seeds per plant decreased significantly at 200 Gy (12.5) and it was increased in 100 Gy (16.5) and in control. This type of controversy might be due to different agro-climatic conditions and topographic effects on which the experiment was performed. It may be also due to different genetic materials.

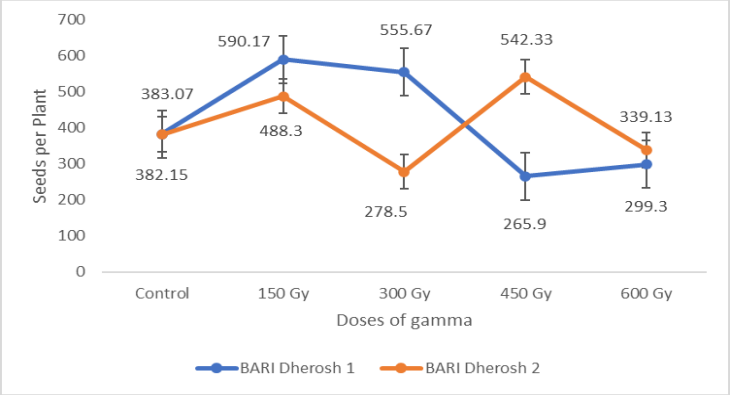

Figure 5: Effect of gamma irradiation on seeds per pod of two okea variety (BARIdheros1 and BARIdherosh2).

CONCLUSION: Different doses of gamma irradiation showed significant difference for plant height, number of leaves per plant, number of pods per plant, length of pod and number of seed per plant. A highly significant effect was observed in the number of seeds per plant for gamma rays for both genotypes. BARI Dherosh-1 had the most pods per plant at 300Gy, while BARI Dherosh-2 had 450Gy. Mass seed was collected and will be cultivated for the next season for selection based on yield

CONFLICT OF INTEREST: Author has no conflict of interest.

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