Original Article

Horticultural Biotechnology Research 2015, 1: 35-38
http://scienceflora.org/journals/index.php/hbr/
doi: 10.19071/jhcbt.2015.v1.2916

Effect of gamma rays on germination, morphological and yield characters of bhendi (*Abelmoschus esculentus* [L.] Moench)

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Received: 21.09.2015
Revised: 08.10.2015
Accepted: 22.10.2015
Published: 22.10.2015

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ABSTRACT

Bhendi (*Abelmoschus esculentus* [L.] Moench) is the most common vegetable crop of the world. The genus *Abelmoschus* belongs to family Malvaceae is represented by 12 species. This investigation was carried out to the study of different doses of gamma irradiation on bhendi seeds of varieties arka anamika. Gamma irradiation treatment at 10, 20, 30, 40, 50, and 60 KR levels. The main objective of the present study is to determine the effect gamma irradiation on different morpho-agronomic characteristics. Agronomic traits were analyzed such as days of first flower, height of plants, number of fruits per plant, fruit length, seed yield per plant, fresh weight per plant, dry weight per plant, 100 seed weight. The seed pre-soaked in distilled water for 6 h before the sown in the field. The results showed that the positive shift with respect to all parameters. High doses of gamma irradiation (40 and 50 KR) observed in moderate to high values.

KEY WORDS: Bhendi, gamma rays, irradiation, treatment

INTRODUCTION

Bhendi is a multipurpose vegetable crop and a good source of many nutrients including vitamins B and C, fiber, calcium, and folic acid. Okra is the sixth important popular vegetable crop widely grown under varying climatic conditions in almost all parts of India throughout the year except in the mountainous region. It is estimated that world okra production is about 5-6 million tons per year. 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). Immature green fruits are cooked in curry and soups. High iodine content of fruits helps to control goiter. However, the widespread incidence of yellow vein mosaic disease in this crop has affected its successful cultivation.

Mutation breeding in crop plants is an effective approach in the improvement of crop having a narrow genetic base such as bhendi. The role of mutation breeding increases the genetic variability for the desired traits in various crop plants and have been proved beyond doubt by a number of scientists (Tah, 2006; Adamu and Aliyu, 2007; Khan and Goyal, 2009; Kozgar *et al.,* 2011; Mostafa, 2011). Several factors such as properties of mutagens, duration of treatment, pH – pre- and post-treatment, and temperature and oxygen concentration.

Gamma irradiation was found to increase plant productivity. In this connection, Jawardena and Peiris (1988) reported that gamma rays represent one of the important physical agents, used to improve the yield of many plants (e.g., rice, maize, bean, cowpea, and potato). Gamma irradiation has been found to be very useful for both sterilizations and for the preservation of foods (Mokobia and Anomohanran, 2005). The present study has been intended to investigate the response of the bhendi varieties arka anamika to different doses of gamma irradiation (10, 20, 30, 40, 50, and 60 KR) with control, growth, yield, and quality were also to be studied.

MATERIALS AND METHODS

The seeds of bhendi (*Abelmoschus esculentus* [L.] Moench) were irradiated at six different doses such as 10, 20, 30, 40, 50, and 60 KR. These doses were delivered from CO^{60} gamma cell installed at ICAR, Tamil Nadu Agricultural

University, Coimbatore, Tamil Nadu. 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 Randomized Block Design, with seven treatments (including control) and three replications. The 100 seeds of each of the seven treatments were sown on the 3rd day of treatment at the rate of 20 progeny rows per treatment with proper randomization. The seeds were soaked overnight to facilitate uniform pre-soaking. Data on qualitative and quantitative characters of M_1 generation were gathered from 25 plants per treatment. The seeds of M_1 generation were collected and raised in M_2 generation and followed by M_3 generation.

Measurements

Growth characters

After 10 weeks from sowing, the following growth parameters were recorded, using 10 random plants from each treatment; days to first flower (days), plant height (cm), number of branches per plant, fresh weight per plant (g), and dry weight per plant (g).

Yield characters

At harvest stage, ten random plants from each treatment were used to record the following parameters, a number of fruits per plant, fruit length, fruit yield per plant, and 100 seed weight.

RESULTS AND DISCUSSION

M_1 Generation

The result of gamma ray treatment, there was a proportionate reduction in germination of bhendi with increase dosage of gamma rays treatment, similar results were reported in black gram (Ramasamy, 1973), soybean (Balakrishnan 1991; Pavadai *et al*., 2010) rice, and Cowpea (Gnanamurthy *et al*., 2012). The seedling survival reduced with an increase in dose of gamma rays. Similar results have been obtained in soybean; Balakrishnan, 1991). Packiaraj (1988) studied the effect of gamma rays on cowpea varieties and hybrid was reported a progressive decrease in germination, survival seed yield per plant, number of fruit per plant, fruit length per plant with increasing dosage of gamma rays. In the present study, germination percentage, number of fruits per plant, fruit length per plant, seed yield per plant and fresh weight per plant, dry weight per plant, 100 seeds showed a decreasing trend when compared to the control (Table 1) and days to first flower increased with increase in dose of gamma rays (Table 1).

M_2 and M_3 Generation

Morphological parameters

The details of various morphology and yield characters, such as days of first flower, height of plants, number of fruits per plant, fruit length, seed yield per plant, fresh weight per plant, dry weight per plant, and 100 seed weight, are presented separately.

The results presented in Tables 1 and 2 show an increase in most vegetative characters seeds of okra (*A. esculentus* [L.] Moench) as a result of soaking seeds in water or irradiation with gamma rays before sowing. In the second and third generation were a significant difference between in plant height and a number of branches per plant, fresh and dry weights per plant. These results also demonstrated by Norfadzrin *et al*. (2007) who noticed that higher gamma ray doses particularly 600 and 800 Gy had a negative effect on the morphological characteristics of tomato and okra seedlings derived from irradiated seeds. In this connection, Dubey *et al.* (2007) showed an increase in plant height, number of leaves, and branches per plant when okra seeds were irradiated with different doses of gamma rays. Dhankhar and Dhankhar (2003) noticed that seeds of a purple stem line of okra when subjected to gamma irradiation at 0.6 or 0.7 KR some plants exhibited flat and Y-shaped branching.

Seed yield parameters

The results obtained in the present study (Table 2) demonstrated that the significant differences between the seed yield parameters such as a number of pods per plant, pod length, weight of seeds per plant, and seed yield per plant.

Similar reports increased number fruit per plant and fruit length as a result of gamma irradiation was recorded by many authors (Dubey *et al*., 2007; Mishra *et al*., 2007; Sharma and Mishra, 2007). In this connection, the seed yield was recorded by Sundaravadivelu *et al*. (2006) in cotton and Das *et al*. (2007) in mung bean, Singh and Singh (2003) in okra. Soehendi *et al*. (2007) stated that modification obtained by gamma ray irradiation of mung bean leaflet type could affect leaf and seed yield.

CONCLUSIONS

In M_1 generation, seed germination, seedlings survival, days of first flower, plants height, number of fruits per plant, fruit length, seed yield per plant, fresh weight per plant, dry weight per plant, and 100 seed weight, gradually reduced with increasing doses of gamma rays treatment, except days to first flower. In M_2 and M_3 generation, all

Table 1: Effect of gamma rays on growth and yield parameters in bhendi (*Abelmoschus escuelntus* (L.). Moench) in M_1 generation

Treatment	Germination (%)	7th day seedling survival (%)	30th day shoot length (cm)	Root length (cm)	Days to first flowering (days)	Number of fruits per plant	Fruit length (cm)	Seed yield per plant (g)	Fruit weight per plant (g)	100 seed weight (g)
Control	98.00	95.33	33.51	19.08	35.0	28.2	12.2	16.043	550.21	5.860
Gamma rays 10 KR	90.23	88.24	31.25	17.24	36.1	26.6	12.0	15.321	510.36	5.324
20 KR	82.34	79.65	29.36	16.87	36.5	24.3	11.6	14.587	475.32	5.108
30 KR	74.94	71.36	25.26	15.81	37.5	21.2	11.4	14.320	421.78	4.578
40 KR	62.01	59.47	22.49	14.38	38.0	20.5	10.5	13.847	365.78	4.205
50 KR	40.23	36.87	18.54	12.46	37.8	20.1	10.1	13.542	342.19	4.006
60 KR	32.45	30.58	15.32	10.21	39.1	15.9	8.6	11.256	318.91	4.027

Table 2: Effect of gamma rays on growth and yield parameters in M_2 and M_3 generation

Treatment (conc.)	Days to first flowering (days)	Plant height (cm)	Number of fruits per plant	Fruit length (cm)	Seed yield per plant (g)	Fresh weight per plant (g)	Dry weight per plant (g)	100 seed weight (g)
M_2 generation								
Control	36.1	69.54	22.24	12.22	26.32	118.72	21.70	6.08
Gamma rays 10 KR	38.2	71.72	21.58	11.98	26.30	116.35	20.56	6.01
20 KR	35.3	70.38	23.36	12.47	27.12	121.54	21.32	6.13
30 KR	36.7	72.32	25.12	12.65	28.50	125.40	22.05	6.24
40 KR	35.7	75.14	25.87	12.91	31.28	130.35	22.90	6.42
50 KR	35.2	75.67	24.31	13.33	33.08	132.58	23.57	6.58
60 KR	37.8	68.95	20.18	11.05	27.56	121.08	20.16	5.97
M_3 generation								
Control	37.4	68.35	23.22	10.67	25.24	117.65	21.32	6.44
Gamma rays 10 KR	37.2	70.27	22.41	11.74	25.88	115.36	21.20	6.81
20 KR	38.1	71.40	23.56	10.31	24.10	110.47	20.35	6.58
30 KR	36.4	72.31	24.10	12.08	26.35	116.28	22.44	6.99
40 KR	36.1	73.65	24.08	13.23	25.88	120.48	21.89	7.12
50 KR	35.8	75.10	26.24	15.17	27.19	124.39	25.72	7.55
60 KR	38.4	69.55	23.18	10.98	24.31	118.07	22.06	6.04

parameters were recorded in moderate and high value. The highest mean value for all parameters was recorded in 50 KR gamma rays treatment compare to control and other treatment.

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