

Research Article

Estimation of Induced Variability of Yield Contributing Traits in M₁gamma Irradiated Germplasm of Okra (*Abulmoschus Esculentus* L.)

Hamid Ullah¹, Rehman Ullah Khan¹, Saad ullah khan¹, Sultan Mehmood¹, Sikandar Khan Sherwani^{2*}, Asim Muhammad¹, Syed Aneel Gilani³, Hidayat Ullah¹, Yar Muhammad⁴

¹Department of Botany, University of Science and Technology, Bannu; ²Department of Microbiology, Federal Urdu University of Arts, Science and Technology; ³Botanical Sciences Division, Pakistan Museum of Natural History, Islamabad Pakistan; ⁴Department of Chemistry, University of Science and Technology, Bannu

*Corresponding author: sikander_biology@hotmail.com

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ABSTRACT

The effect of gamma irradiation was worked out on two okra varieties namely Puhja and Nutech, which were cultivated in the experimental area of Green House, UST, Bannu in the crop season, 2010. Germplasm of the mentioned varieties were exposed to different doses of gamma rays, i.e., 10, 15, 20, 25 krad, at Nuclear Institute of Food and Agriculture, Peshawar. The mean values observed for the traits like number of pods per plant and the length of pod in response to interaction between varieties and doses were observed as highly significant. As far as the number of seeds per plant and 1000 seeds weight for the interaction between varieties and doses are concerned, highly significant values were obtained. So far as the conclusion of the result of this study is concerned, it is noticed that the two varieties of okra responded differently to radiation doses for some of the plant characters likes¹ plant height, number of leaves plant⁻¹, number of pods plant⁻¹ length of the pods and seeds plant⁻¹.

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INTRODUCTION

Okra (*Abelmoschus esculentus* L.) is one of the most important vegetable crops grown for its green tender fruit Okra is a flowering plant. It is also called lady's finger or gumbo. Its scientific name is. It is an annual or perennial species, grows to about the height of 2 m. Its leaves are about 10 to 20 cm long and broad. The fruit is a capsule up to 18 cm long, containing numerous seeds. Okra is more popular in southern part of the United States. Here it is available year round there. Okra has unique mucilaginous juice. Okra is full of valuable nutrients. Nearly half of which is soluble fiber in the form of gums and pectin's. Soluble fibers help to lowers serum of cholesterol, and thus reducing the risk of heart disease. The other half is insoluble fiber which helps to keep the intestinal tract healthy and reducing the risk of some forms of cancer, especially colorectal cancer.

It is cultivated once throughout the tropical and warm temperate regions of the world for its fibrous fruits or pods containing round, white seeds. It is among the most heat and drought tolerant vegetable species in the world. It can tolerate poor soils with heavy clay and intermittent moisture. In cultivation, the seeds are sown to a depth of about 1-2cm. Germination occurs between 6 days to three weeks. Seedling requires ample water. Amongst the diverse media mutation breeding has opened new out ways for genetic development of plants in Pakistan. To attain the objective of food, self-sufficiency efforts should be made to raise the yield of food per unit area. The additions of new varieties to the genetic pool are

simply possible through mutation. The mutation breeding experiments have been performed on numerous crop species including rice, peanuts, barley etc. Swedish scientists have exposed the possible applications of radiations for the development of crop plants. They have discovered mutants in barley. The new varieties so produced are better to their mother varieties in certain characteristics like high protein contents etc. Mishra *et al.*, (2007) have discovered some beneficial radiation induced mutant types in okra, like increase in number of fruit plant⁻¹, fruit length and yield of fruit plant⁻¹ etc. In sight of the mentioned rational of gamma radiations the effects of diverse doses of gamma radiations in okra to evaluate the possibility of using this agent as a source of some new hereditary changes concerning the improvement in yield components as well as with quality.

MATERIALS AND METHODS

The present study was conducted in 2010 to ascertain the effective levels of gamma radiations, on the two okra (*Abelmoschus esculentus* L.) cultivars viz. Puhja and Nutech in the green house research area of main campus UST, Bannu, Pakistan. The seeds of two cultivars were obtained from Bannu Model Farm. Later on the seeds were treated with 10, 15, 20 and 25 krad doses of gamma radiations in CO₆₀ Gamma source working at NIFA (Nuclear institute for food and agriculture Peshawar). Data was recorded for five treatments of each variety with keeping control treatment too. The experimental field was arranged in four replications with Randomized

Complete Block Design. The measurement of experimental field was kept as 9 × 2.4 and was split out in to four rows with row to row distance 70 cm while plant to plant distance 30 cm. Each replication was composed of four sub plots. Each sub plot contained 80 plants, i.e. 20 plants in each row. In this way the total area along with 4 replications was 15 m × 11.20 m. Total sub plots were 16 and each plot of 3 m × 2.4 m and thus the total number of plants were 1280,320 of each variety. All the plots were irrigated thoroughly and adequately from well. Similar and equal dose of NP fertilizer was maintained in all the varieties to evaluate their actual performance against the prevailing condition. The fertilizer was used in three splits in Top-Dressing method.

Statistical Analysis

The data so collected for each parameter were averaged and was subjected to statistical analysis as proposed by Steel and Terrie (1980).

When significant results were obtained for all parameters then L S D tests were applied for comparison among the means of treatment. All the results were compared at 5% probability level.

RESULTS AND DISCUSSION

Plant Height

It is evident from Table I that the differences in the mean values due to gamma radiation doses were non significant. The data revealed that the range of mean values for radiation doses were 51.7 to 63.6 for plant height. The differences recorded in mean values due to varieties for plant height were observed as non-significant and the values were in the range of 57.9 for Puhja to 58.7 for Nutech. The effect of interaction between doses of gamma rays and varieties was also noted as non-significant. The value recorded in Table I for interaction ranged from 49.8 to 66.9 and 45.5 to 77.5 for Puhja and Nutech respectively. The increase in the mean value due to 25 krad dose was recorded as 15.5% for Puhja as compared to its control. Similarly an increase in the mean value due to 10 krad dose was calculated as 70.3% for Nutech as compared to its control. So far as the competition of Puhja and Nutech varieties against different doses of radiation is concerned, Nutech variety responded well of all and reached at the climax at 10 krad dose as shown (figure 1a and 1b). However Puhja variety responded negatively at 10 Krad doses of gamma radiation and thus lying at the bottom. The findings of Hegazi and N. Hamideldin (2010), Borzouei *et al.*, (2010), Ellyfa Kon *et al.*, (2007) and Norfadzrin *et al.*, (2007) contradict with the present result of Plant height. This type of controversy might be due either to differences in genetic materials or agro climatic conditions under which the experiment was performed.

Table I: Effect of gamma radiations on plant height in okra varieties.

Varieties			
Radiation Doses Kr	Puhja	Nutech	Mean
(T1)00	57.9 b c d	45.5 d	51.7 E
(T2)10	49.8 c d	77.5 a	63.6 A
(T3)15	54.3 b c d	53.5 b c d	53.9 D
(T4)20	64.4 a b c	54.9 b c d	59.7 C
(T5)25	66.9 a b	58.0 b c d	62.5 B
Mean	58.7	57.9	

Any two means sharing the same letters are not significantly different according to Duncan's New Multiple Range Test. Capital letters indicate significance at 5% probability level.

Number of Leaves Plant⁻¹

It is evident from Table II that the difference in the mean values due to gamma doses was non-significant. The data revealed that the range of mean values for radiation doses was 31.6 to 44.5 for the number of leaves per plant. The differences recorded in mean values due to varieties for number of leaves per plant were observed as significant and values were in the range of 34.5 for Nutech and 41.4 for Puhja. It was observed that increase in mean values of Puhja for number of leaves per plant was 6.9 as compared to the mean value of Nutech for the number of leaves per plant. The effect of interaction between doses of gamma rays and varieties were non-significant Table II. The values recorded for interaction ranged from 30.5 to 47.5 and from 26.9 to 41.6 for Puhja and likewise in case of Nutech. The increase in the mean values due to 10 krad was calculated as 1.9% and 8.9% for Puhja and Nutech respectively as compared to their respective controls.

So far as the competition of Puhja and Nutech is concerned Puhja variety responded well of all and reached to the climax at 20 krad dose of gamma rays as shown in the figure II a and II b. However it responded negatively at all other doses of gamma rays. Nutech variety responded well at 20 Kr doses of gamma rays only. It respond most negatively and lying at the bottom on 15 kR dose of gamma rays. Thus Puhja surpass all the varieties. The findings of Abdul Majeed and Zahir Muhammad (2010) have showed highly significant reduction by gamma rays dose in number of leaves per plant.

These findings contradict with present findings. It may be due either to differences in the genetic materials used or agro climatic conditions under which the experiment was conducted.

Table II: Effect of gamma rays on leaves per plant in okra varieties.

VARIETIES			
Doses KR	Puhja	Nutech	Mean
T1(00)	46.6 a	38.2 a	42.4 B
T2(10)	30.5 a	35.6 a	33.0 D
T3(15)	36.4 a	26.9 a	31.6 E
T4(20)	47.5 a	41.6 a	44.5 A
T5(25)	46.3 a	30.20 a	38.2 C
Mean	41.4	34.5	

Any two means sharing same letters are not significantly different according to Duncan's New Multiple Range Test. Capital letters indicate significance at 5% probability level.

Number of Pods Plant⁻¹

It is evident from Table III that the difference in the mean values due to gamma doses was non-significant. The data revealed that the range of mean values for radiation doses was 6.6 to 10.2 in case of number of pods per plant. The differences recorded in mean values due to varieties for number of pods per plant were also noted as non significant and values were in the range of 8.3 for Puhja and 8.3 for Nutech. The effect of interaction between doses of gamma rays and varieties were highly significant Table III. The mean values for number of pods per plant ranged between 4.25 to 11.5 for Puhja and 4.2 to 11.7 for Nutech in response to variance radiation doses. The decrease in the mean values due to 15 krad dose was calculated as 170.5% and increase in the mean values due to 20 krad dose was computed as 30% for Puhja and Nutech respectively as compared to their respective controls Table III.

So far as the competition of puhja and Nutech varieties against different doses of radiation is concerned, Nutech variety responded well of all at 20 krad doses of gamma rays and reached at the climax as shown in the figures 3a and 3b. Nutech have also responded negatively of all at 15 krad dose and lying at

the bottom. In case of Puhja response is well at 15 krad dose of gamma rays and reached to the highest. According to Arulbalachandran *et al.*, (2010) a wide range of variation was recorded at 60 krad gamma rays for number of pods per plant. These results are not in agreement with the present findings. Similarly according to Sophia John *et al.*, (2001) a wide range of variation was recorded at 20 krad gamma rays dose for number of fruits per plant. These findings are also not in agreement with the present findings. The differences in data might reflect the differences in germplasm used along with the agronomical practices under which the experiment was conducted.

Table III: Effect of gamma radiations on the number of pods per plant in okra varieties.

Varieties			
Radiations doses KR	Puhja	Nutech	Mean
T1(00)	4.25 e	9 c d	6.6 E
T2(10)	9.7 a b c	9.5 b c	9.6 B
T3(15)	11.5 a b	4.25 e	7.8 D
T4(20)	8.7 c d	11.7 a	10.2 A
T5(25)	7.2 d	9.2 c d	8.2 C
Mean	8.3	8.7	
T1(00)	4.25 e	9 c d	6.6 E

Any two means sharing same letters are not significantly different according to Duncan; s New Multiple Range Test. Capital letters indicate significance at 5% probability level.

Varieties			
Radiations doses KR	Puhja	Nutech	Mean
T1(00)	7.3 d	13.5 b	10.4 D
T2(10)	13.6 a b	14.9 a	14.2 A
T3(15)	13.9 a b	7.5 d	10.7 D
T4(20)	11.3 c	13.8 a b	12.5 C
T5(25)	13.20 b	13.5 b	13.4 B
Mean	11.8	12.6	

Length of the Pod

It is evident from Table IV that the mean values due to gamma rays doses for length of pod was significant. The mean values for gamma radiation doses were 10.4 to 14.2 for length of the pod. The lowest length of the pod (10.4) was recorded for control and the highest length of pod (14.2) was recorded for 10 Krad dose. The differences found in values due to varieties effect were non-significant and the values recorded for length of pods due to varieties were 11.8 and 12.6 for Puhja and Nutech respectively. Effect of interaction between varieties and gamma rays doses Table IV were highly significant. The values for length of pod ranged between 7.3 to 13.9 for Puhja and 7.5 to 14.9 for Nutech in response to various radiation doses. Increase in the values due to 15 krad dose was recorded as 90.4% for Puhja as compared to the control. Similarly an increase in the value due 10 krad dose was calculated as 10.3% for Nutech as compared to its respective control. Also a decrease in the value due to 15 k rad dose was calculated as 44.4% as compared to its respective control Table IV.

So far as the competition of Puhja and Nutech varieties against different doses of gamma radiations is concerned Puhja variety responded well and reached to the climax at 15 krad dose as shown in the figures IVa and IVb. In case of Nutech response is well of all at 10 krad dose and lying at the climax. However Nutech have responded negatively at 15 krad dose of gamma rays and thus lying at the bottom. These results are in agreement to those reported by Sophia John *et al.*, (2001) who advocated that there was significant change in length of fruits due to higher radiation doses. The present findings are also in

close agreement with those found by Mishra *et al.*, (2007) in which some of the gamma doses had significantly increased the length of the pod as compared to control.

Table IV: Effect of gamma radiations on length of the pods in okra varieties. Any two means sharing same letters are not significantly different according to the Duncan's New Multiple Range Test. Capital letters indicate significance at 5% probability.

Seeds Plant-1

It is evident from the Table V that the difference in the mean values due to gamma rays were non significant. The data revealed that the range of mean values for radiation doses was 178.5 to 414.3 for number of seeds per plant. The lowest number of seeds per plant (178.5) was recorded for control and highest number of seeds per plant (414.3) was recorded for 10 krad. The differences recorded in mean values due to varieties for number of seeds per plant. The values recorded for interaction ranged from 64 to 454.2 and 212.5 to 416.2 Puhja and Nutech respectively. The increase in the mean values due to 10k R dose was computed as 609.6% for Puhja as compared to its control. The increase in the mean values due to 20 krad dose was computed as 42 % as compared to its respective control.

So far as the competition of Puhja and Nutech variety against different doses of gamma radiation is concerned Puhja variety have responded well of all and reached to the climax at 10 krad dose as shown in the figures 4.5a and 4.5b. However its response is lowest at 20 krad dose of gamma rays and reached to the bottom. In case of Nutech the response is highest at 15 krad dose of gamma rays but its response is more negative at 20 krad dose of gamma radiations. The results put forward by Arulbalachandran *et al.*, (2010) contradict with present results. 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 difference in genetic materials.

Table V Effect of gamma radiations on number of seeds per plant in okra varieties

Any two means sharing same letters are not significantly different according to Duncan's New Multiple Range Test. Capital letters indicate significance at 5% probability.

Varieties			
Radiations	Puhja	Nutech	Mean
T1(00)	64.0 e	293.0 b c	178.5 E
T2(10)	454.2 a	374.5 a b	414.3 A
T3(15)	427.7 a	212.5 c d	320.1 B
T4(20)	129.0 d e	416.2 a	272.6 C
T5(25)	230.7 c	260.7 c	245.7 D
Mean	261.1	311.4	

CONCLUSION

A highly significant effect was observed in the number of pods per plant and seeds per plant for interaction between doses of gamma rays and varieties effect. The highest mean value for number of pods per plant was recorded in the 15 krad dose of gamma rays for Puhja and in the 20 krad dose of gamma rays for Nutech. The highest mean values for the number of seeds per plant were recorded in 20 Krad doses of gamma rays for Punjab and in the 20 Krad doses of gamma rays for Nutech. In Puhja variety the values for interaction between doses of gamma rays and varieties effect for number of seeds per plant has increased differently in response to different interaction. However in case of Nutech variety the values for interaction between doses of gamma rays and varieties effect has both increasing and decreasing effect in response to different interaction for number of seeds per plant. In case of the number of pod per plant all the

values have increased in Puhja variety for interaction between different doses of gamma rays and varieties effect.

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