The Effect of Gamma irradiation on Agromorphological Traits of Okra [*Abelmoschus esculentus* (L.) Monech]

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Abstract
Okra is a common Vegetable crop with numerous beneficial properties ranging from medicinal, therapeutic, food, nutritional, financial, and Industrial benefits. Seed of two okra varieties (Yarballa and Yarkaka) were exposed to four different gamma irradiation doses (0Gy, 200Gy, 300Gy, and 400Gy). The experiment was laid in a Completely Randomized Block Design (CRBD) with four replicates. The irradiated seeds and the control seeds were grown till maturity. The morphological and yield Parameters were taken. The effects of gamma irradiation at high doses decreased significantly ($P \leq 0.05$). The highest plant height (47.53 cm), number of leaves (15.88) and leaf surface area (618.79cm^2) were observed in control and 200 Gy in Yarkaka and Yarballa. respectively, while number of nodes (13.00) was observed at 200gy in Yarballa and Yarkaka. Similarly, the okra varieties exhibited variation in vegetative traits. The highest weight of pod (19.47g) and length of pod (6.93cm) were observed in control and 200Gy in Yarballa respectively. The highest number of seeds (66.67) was observed at 200Gy in Yarballa. Yarballa revealed the highest weight of seeds (0.11g) and seed index (0.19g) at control. The results show that gamma irradiation significantly affects the morphological and yield traits of okra as they showed decreased in the parameters with increasing irradiation doses as compared to the control. Therefore, 200Gy performed better in terms of morphological and yield parameters as compared to the other doses. Further experiment should be conducted on this okra crop especially on the Yarballa variety which was the most responsive to the irradiation doses to ascertain the stability of the traits and to ensure a continued improvement of the variety.

Keywords: Gamma irradiation, Okra, Agromorphological, Trait

Introduction

Okra is a multipurpose vegetable crop whose whole parts; leaves, flowers, stem, fruit, and seeds can be used effectively for different purpose such as vegetable, fruit, medicine, beauty and cosmetics, fibre industry. Okra is a very effective reagent in medical sector as it can perform as an antispasmatic, antidiuretic, emollient, stimulant, demulcent, diaphoretic agents and useful in the treatment of ulcer disease (Basnet et al., 2023). It is a good source of many nutrients including carbohydrates, proteins (rich in lysine and tryptophan), vitamins A, B and C, dietary fibre, calcium, zinc, folic acid and iodine (Cook, 2000; Holser, 2004). As a significant economic vegetable crop, there is a decline in the production of okra due to certain factors such as climatic, soil or edaphic factors, diseases and pests and the scarcity of improved okra varieties with important desirable traits or characters also contributes to the low yield of the crop (Asare et al.,2017).

Gamma irradiation is a suitable alternative in plant breeding for the creation of desired characters in cultivated plants. It can penetrate very deep into host tissues and is capable of genetic reshuffling with possible healthy mutations (Majeed et al., 2017). Gamma irradiation is used to produce biotic and abiotic

stress tolerance plant production from the seeds and improves the growth and yield traits such as plant height, number of leaves, branches, seeds, and seed yield per plant showing moderate to high level with increased doses of gamma irradiation (Gobinath and Pavadai, 2015).

Materials and Methods

Two local varieties of okra seeds were collected from Kure market (Godabe), a popular market in Minna. The names of the varieties are Yarballa, a 40days variety and Yarkaka, a 90days variety. The two varieties of okra seeds were irradiated at the Centre for Energy Research and Training (CERT), Ahmadu Bello University, Zaria, Kaduna State. The seeds were irradiated using gamma rays of Cobalt-60 source with doses of 0Gy, 200Gy, 300Gy and 400Gy for each variety.

Results and Discussion

Plant height at 4th week in Yarballa 200Gy had the height (17.66cm) at 6th & 8th week 0Gy had the highest (35.25cm) and (47.53cm) respectively, these values were not significantly different from 200Gy (Table 1a). In Yarkaka at 4th and 6th, 0Gy recorded the highest (10.79cm) and (20.38cm) respectively, these values were not statistically different from 200Gy. At 8th week, 200Gy had the highest with 21.83cm (Table 1a). Generally, it was observed Plant height decreases significantly with increasing doses of gamma irradiation this is in line with the findings of Norfadzrin et al.(2007) who noticed that higher gamma ray doses had negative effect on the morphological characteristics of tomato and okra seedlings derived from irradiated seeds. The reduction in plant height in this study may be attributed to high gamma irradiation doses which deleterious effects such as damage to the process of cell division and cell elongation leading to the reduction in mitotic activity of meristematic tissues The number of nodes at maturity, number of leaves and leave surface area in both Yarballa and Yarkaka, 200Gy had the highest and these values were significantly different from all other doses at $P \geq 0.05$ (Table 1b). Dubey et al. (2007) showed an increase in plant height, number of leaves and branches per plant when okra seeds were irradiated with different low doses of gamma rays. Production of the growth regulator, kinetin might have been stimulated which may be responsible for the increased number of leaves. Lower doses of gamma rays had stimulatory effects on average surface area while higher doses had inhibitory effects. It has been reported that increase in plant sensitivity after gamma irradiation may probably be due to reduced level of endogenous growth regulators such as cytokinins, as a result of breakdown or lack of synthesis (Kiong et al. 2008).

Table 1a: Effects of gamma irradiation on the Morphological trait of Okra

Variety	Doses	Plant height 4 WAP	Plant height 6 WAP	Plant height 8 WAP
Yarballa	0Gy	16.35±0.96^{b}	35.25±3.84^{b}	47.53±6.17^{b}
	200Gy	17.66±2.06^{b}	34.54±4.61^{b}	40.03±5.74^{b}
	300Gy	12.73±2.86^{ab}	25.24±6.14^{ab}	30.49±7.94^{ab}
	400Gy	8.31±2.45^{a}	14.98±4.42^{a}	16.00±4.78^{a}
Yarkaka	0Gy	10.79±0.60^{a}	20.38±1.35^{a}	21.69±1.31^{a}
	200Gy	10.49±1.20^{a}	20.03±1.24^{a}	21.83±1.73^{a}
	300Gy	7.20±2.37^{a}	14.38±4.23^{a}	16.55±4.92^{a}
	400Gy	5.94±2.48^{a}	12.03±4.86^{a}	13.62±5.49^{a}

Values are mean ± SE of mean. Values(s) followed by the same letter(s) along the column are not significantly different at P≥0.05

For the yield parameters 0Gy had the highest weight of pod in both varieties with (0.33g) and (49.47g) respectively. In terms of length of pod and number of seeds 200Gy had the highest in both Yarballa and Yarkaka (Table 2).

Table 1b : Effects of gamma irradiation on the Morphological trait of Okra

Variety	Doses	No of leaves Maturity	No of nodes Maturity	Leave surface area
Yarballa	0Gy	11.23±1.24^{ab}	12.63±1.32^{b}	579.00±28.20^{ab}
	200Gy	14.38±1.61^{b}	13.00±1.75^{b}	618.79±29.82^{b}
	300Gy	10.88±2.60^{ab}	8.25±1.92^{ab}	492.98±14.81^{ab}
	400Gy	6.75±2.19^{a}	6.25±1.90^{a}	343.68±10.62^{a}
Yarkaka	0Gy	13.00±0.86^{ab}	12.88±1.21^{a}	434.89±23.97^{a}
	200Gy	15.88±1.07^{b}	13.00±1.06^{a}	448.95±27.47^{a}
	300Gy	10.63±4.02^{ab}	9.00±2.85^{a}	329.52±10.99^{a}
	400Gy	6.63±2.50^{a}	6.50±2.53^{a}	300.84±11.06^{a}

Values are mean ± SE of mean. Values(s) followed by the same letter(s) along the column are not significantly different at P≥0.05

For weight of seed and seed index 0Gy had the highest in Yarballa while in Yarkaka 200Gy had the highest (0.08g) weight of seed and 0Gy had the highest seed index (0.12g) (Table 2). There was increase in yield of crops treated with mutagens as it was observed in this study that 200Gy exposure was found to increase fruit characters such as length and number of seeds per fruit. Jagajanntham *et al.* (2012) observed a proportionate reduction or decrease in fresh weight of okra variety with increasing level of gamma irradiation. Norfadzrin *et* al. (2007) indicated that low doses of gamma irradiation have profound effect on plant height, dry weights of tomato and okra. Increased number of okra fruit per plant and fruit length as a result of gamma irradiation was observed by many researchers (Dubey *et al*., 2007; Mishra *et al*.,2007; Sharma and Mishra, 2007). Increased number of fruits per plant reflected positively on seed yield.

Conclusion

The results show that gamma irradiation significantly affects the morphological and yield traits of okra as they showed decreased in these parameters with increasing irradiation doses as compared to the control. Okra varieties that were exposed to 200Gy irradiation performed better in terms of morphological and yield parameters as compared to the other irradiated dose

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Table 2: Effects of gamma irradiation on the yield trait of Okra

Variety	Weight of pod (g)	Length of pod (cm)	Number of seeds	Weight of seeds (g)	Seed index (g)
Yarballa	19.47±3.79^{b}	6.90±2.88^{a}	59.33±2.96^{a}	0.11±0.02^{a}	0.19±0.08^{a}
	12.30±1.75^{ab}	6.93±0.37^{a}	66.67±12.34^{a}	0.08±0.03^{a}	0.16±0.05^{a}
	12.07±2.86^{ab}	6.53±1.03^{a}	42.00±11.15^{a}	0.08±0.01^{a}	0.11±0.08^{a}
	7.93±0.42^{a}	6.07±0.42^{a}	38.67±3.76^{a}	0.07±0.02^{a}	0.11±0.08^{a}
Yarkaka	0.33±0.14^{a}	4.47±0.17^{a}	35.67±4.05^{a}	0.05±0.00^{a}	0.12±0.05^{b}
	0.31±0.06^{a}	5.00±1.06^{a}	40.33±4.33^{a}	0.08±0.01^{a}	0.11±0.05^{ab}
	0.15±0.08^{a}	4.37±0.24^{a}	34.67±2.96^{a}	0.10±0.00^{a}	0.09±0.03^{a}
	0.21±0.12^{a}	4.33±0.88^{a}	34.00±2.64^{a}	0.08±0.03^{a}	0.09±0.01^{a}

Values(s) followed by the same letter(s) along the column are not significantly different at P≥0.05. Values are mean ± SE of mean.

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