

Effects of X-ray Irradiation on Growth and Yield of Pepper (*Capsicum annuum* L.)

¹Danfulloh, T. B. *, ¹Mairiga, A. G., ¹Abdul, I. D., ¹Obioha, M., ¹Hashim A., ¹Tanko, M. M. & ²Ahmed, I. G.

¹Department of Biological Sciences, Federal University of Wukari Taraba State

²Department of Biological Sciences, Federal University of Kashere, Gombe State.

*Corresponding author: danfullohtundeno@gmail.com

ABSTRACT

X-ray irradiation is a known physical mutagen capable of inducing heritable genetic variations in plants. This study investigated the effect of X-ray irradiation on the growth and yield performance of pepper (*Capsicum annuum* L., variety Yolo Wonder 254 F₁). Pepper seeds were exposed to three irradiation doses (3, 6, and 9 mGy) using a Philips medical X-ray system at the Radiology Unit, Federal Teaching Hospital, Gombe. The experiment was conducted during the 2021 rainy season at the research farm of the Department of Agronomy, Federal University Kashere, using a Randomized Complete Block Design (RCBD) with three replications. Growth and yield parameters were measured using standard procedures, and the data were analyzed using one-way ANOVA, Pearson's correlation, and Duncan's Multiple Range Test (DMRT) at $p < 0.05$. Results indicated evidence of hormesis, where low-dose X-ray exposure stimulated plant growth and yield performance. The 3 MGy dose significantly ($p < 0.05$) enhanced plant height, stem girth, number of leaves and branches, as well as fruit length, diameter, seed weight, and total fruit yield. A positive and significant correlation was observed between crop growth rate (1.08 ± 0.29 g/mg/day) and fruit yield (22.60 ± 4.83 g/plant). Overall, X-ray irradiation notably affected phenotypic and agronomic traits, with the 3 mGy dose showing the most favorable growth and yield improvements. This suggests that low-dose X-ray exposure can be an effective mutagenic tool for generating beneficial variants in pepper breeding.

Keywords: X-ray irradiation, Pepper, Growth, Yield, Mutagenesis, Hormesis

INTRODUCTION

Capsicum annuum (L.) popularly known as pepper, is one of the most extensively consumed foods and the world's most widely cultivated spice crop (Kim *et al.*, 2014). It is the third most important vegetable crop in the world, after tomato and onion (Peet, 2006), and is said to be the first spice used by humans (Hill *et al.*, 2013). *C. annuum* was domesticated in Mexico more than 6,000 years ago, according to recent archaeological, genetic, and ecological evidence. Northeastern and central-eastern Mexico have been identified as important early domestication centres (Kraft *et al.*, 2014).

Pepper is a rich source of several bioactive classes of phytochemicals including carotenoids, polyphenolic compounds including phenolic acids and flavonoids, saponins, capsaicinoids, vitamins C, E, and A, and volatile compounds (De Sá Mendes & de Andrade Gonçalves, 2020; Jardim). Several reports demonstrate that pepper has anticancer activity against a variety of cancers including bladder cancers such as malignant human glioblastoma, melanoma, esophagus epidermoid carcinoma, human oral tumor, gastric adenocarcinoma and (Baenas *et al.*, 2019, Adami *et al.*, 2018 Liu *et al.*, 2021), (Khandel *et al.*, 2018), (Kim *et al.*, 2016 and Chilczuk *et al.*, 2020).

Pepper promotes the passage of saliva and stomach juice, raises body warmth, relieves cramps, improves complexion, and soothes gout, according to Nakato *et al.*, (2017). Pepper

pungency have attracted great attention, according to Zhao *et al.*, (2022), due to the concentration of the alkaloid capsaicinoid, which makes pepper a major ingredient used for spice commodities all over the world. It is used in many families for a variety of purposes, including improving the intake of bland diets, preserving grains, and as a mild medication. It is also used in stew and some local dishes across the country, however, the varieties and quantities vary by region. Pepper production has set a new world record over the years. According to FAO statistics (2003), world Capsicum pepper production in 2001 was 21.3 million tons from a harvested area of 1.6 million ha (average yield of 13.4 t/ha); China was the top producer with 10 million tons, followed by Mexico (1.9 million t) and Turkey (1.4 million t) (1.5 million t). Nigeria (715,000 t from 90,000 ha) and Ghana (270,000 t from 75,000 ha) are the top producers in tropical Africa, with a total production of one million tons (Adesina *et al.*, 2014). According to a 2011 estimate, peppers were grown on 3.8 million hectares, with 3.3 million hectares in Asia (2.5 million ha) and Africa (0.8 million ha) in developing and less developed countries (FAOSTAT, 2013). Nigeria accounts for over half of Africa's entire production (Adesina *et al.*, 2014). Bird peppers-atawere (*C. frutescens*), Cayenne pepper or red pepper- Sombo (*C. frutescens*), Atarodo (*C. Chinenses*), Tatase (*C. annum*), and Nsukka yellow pepper are among the varieties grown in Nigeria. The widespread use of pepper in households in Nigeria indicates that it is an important agricultural produce with high economic value. Udegbe *et. al.* (2012) reveals the economic value chain of pepper production as the producer, assembler, wholesaler, retailer and finally the consumer. This chain represents a viable economic enterprise in the production, storage and distribution of pepper. In recent times the supply of pepper across the southern part of the Nigeria has declined remarkably due to several disruptions in the production and distribution channels and local production seems inadequate to feed the large demand by households (Alawa *et al.*, 2021)

Many crops have continued to develop dramatically through the use of induced-mutation breeding techniques, such as chemical mutagens or gamma irradiation, which have enhanced yields, stress tolerance, and trait variety in both horticultural and staple species (Ali, and Suryakant, 2024). Mutation technology has been used to produce many cultivars with improved economic value and to advance the study of plant genetics and development (Renalli, 2012). Crops like *Oryza sativa* (Elsherbiny *et al.*, 2024; Lekha *et al.*, 2024), *Hordeum vulgare* (Yao *et al.*, 2025), *Triticum durum* (Hassine *et al.*, 2023), *Cicer arietinum* (Ilyas *et al.*, 2024), *Vigna mungo* (Nair *et al.*, 2024), *Sesamum indicum* (Rauf *et al.*, 2024), and *Guizotia abyssinica* (Suvarna, 2020). By combining classical mutagenesis with modern genomic tools, breeders can accelerate the identification of desirable alleles and develop enhanced varieties more efficiently. These studies suggest that mutagenesis could be a useful strategy for crop improvement.

Mutagenesis is the process by which a chemical, physical, or biological agent causes rapid heritable changes in an organism's genetic information that are not triggered through genetic segregation or genetic recombination (Roychowdhury, 2013). Inducing mutations in pepper is important in the plants breeding and crop improvement (Bosland and Votava, 2012). Plant breeding, or the creation of new cultivars, is supported by a number of approaches in plant biotechnology (cultivated varieties of crop plant). Mutation induction is a technique for producing new alleles of genes in elite contemporary breed materials (Yali and Mitiku, 2022). Plant mutant breeding is therefore a type of rapid plant breeding (Shu *et al.*, 2012). In rural, pre-urban, and urban settings, the pepper crop is a source of income for resource- poor households. The study aimed at inducing mutagenesis using x-ray irradiation to stimulate variation resulting in improved growth and yield of *Capsicum annum* L.

MATERIALS AND METHODS

Study Area

Field experiment was conducted at the Agronomy Department's research farm at the Federal University of Kashere (FUK) in Gombe State. Kashere (Figure 1) is located in Akko Local Government Area, Gombe State, during the 2021 cropping season.

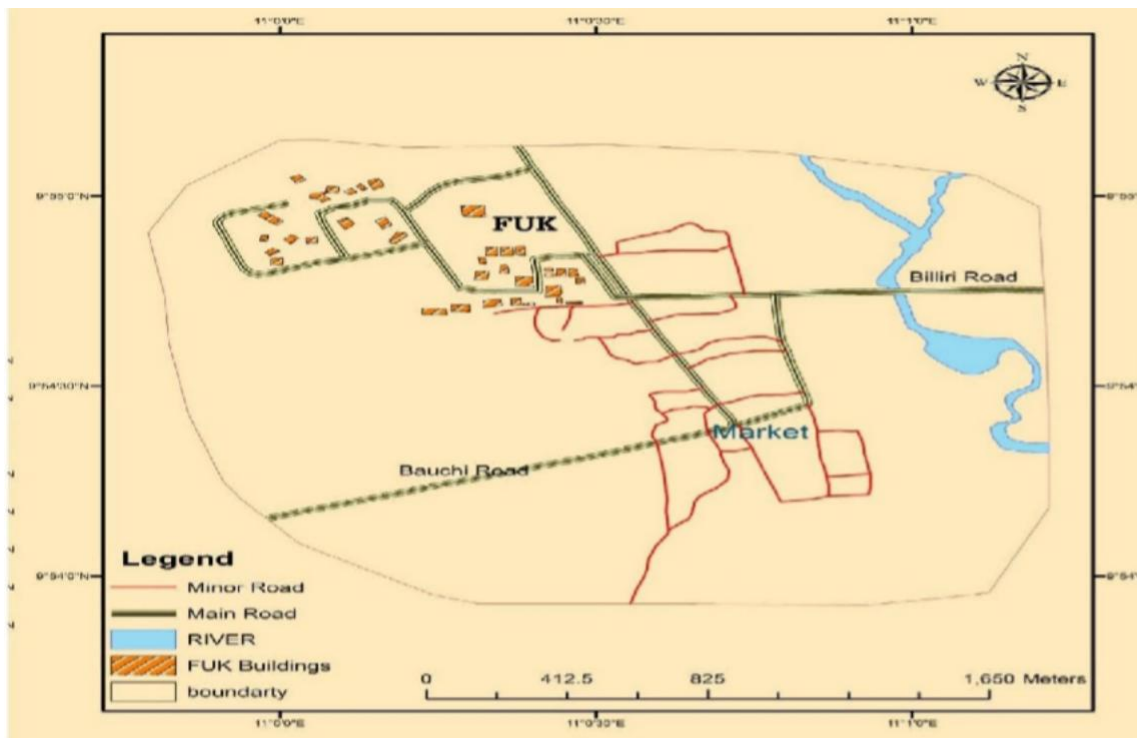


Fig 1. Map of Kashere showing the location of FUK (Source GOGIS)

Preparation of the seeds treatments

The Agricultural Research Institute in Zaria provided a certified hybrid pepper seed (Yolo Wonder) with variety number 254-F1 for this experiment. ABC Best Seeds, Nigeria Limited produced the seeds, which were then kept at room temperature on a sheet of moist tissue paper soaked in the distilled water in an opaque container (petri dish). This procedure is employed to ensure seed viability. The seeds were divided into four groups and stored in a 20g white nylon bag. The first group received no irradiation and served as a control, while each of the remaining three groups received doses of 3.0, 6.0, and 9.0 Milli Grey (mGy). The irradiation was carried out in the Radiology Unit, Federal Teaching Hospital, Gombe, using a Philips medical system (model-0989000085271, February 2010, Hamburg, Germany). To achieve pepper seed irradiation, the X-ray machine was set to 52, 66, and 81 Kilovoltage (kvp), 40, 50, and 50 milliamperes per second (mA), and 60, Focal to target distance (cm) [FTD (cm)] for 10 seconds (S-1) to obtain 3.0, 6.0, and 9.0mGy dosages, respectively (Bado *et al.*, 2016). Nursery Preparation Seedlings were raised in nursery beds by spraying, lightly covering with topsoil, mulching with dry grass, and watering on a daily basis until they emerged 6 days after sowing (6 DAS). To conserve moisture, the dry grass was cut and put across the rows of seedlings that had developed. The seedlings were handled according to the approach outlined by Yahaya *et al.* (2010), which meant permitting them develop for 35 days following seeding before transplanting them to the field. The hand-weeding was carried out while the sprouts were young, and hoe weeding began two weeks after transplantation. Fertiliser was treated twice as a baseline dressing using N.P.K 15:15:15 and urea for fourteen days after transplantation. Harvested fruit were collected per plant and plot starting 96 days after planting (Toungos and Yahya 2018).

Growth parameters

The following data were measured as growth parameters:

Plant height (cm): A metre rule was used to measure the height of ten selected seedlings from each net plot at 6, 9, and 12 weeks shortly after transplanting (WAT). The average was calculated and reported as the mean height described by Toungos and Yahya (2018).

Then, ten plants were chosen at random out of each net plot at 6, 9, and 12 WAT; their leaves were counted, and the average number of leaves per plant was calculated. Furthermore, ten plants were picked at random from each net plot, and the number of branches per plant was counted at 6, 9, and 12 weeks after transplantation, with means recorded. Plant stem girths were measured from the ground using a Vernier calliper.

Using a Vernier calliper, the diameter (in centimetres) of five randomly chosen plants from each net plot was measured, and the mean was noted. A 30-cm ruler was used to measure the fruit length of five randomly chosen plants from each net plot, and the average was noted. Each plot's mean was calculated by counting the quantity of fruits produced by 15 randomly chosen plants at 12 WAT. Days to 50% flowering was calculated by measuring the number of days between transplanting and the point at which half of the plants in each plot had begun to flower. Ten fresh fruits selected randomly from each plot were taken and the mean was computed as mean fresh fruit yield (kg/ha) while total plant weight (g) at harvest was recorded with the aid of a sensitive weighing balance.

Fruit yield determination

They include fruit length (cm), fruit diameter (cm) weight of seed per fruit (g), and fruit yield (t/ha). **Fruit length (cm):** Fruit length was determined with a meter rule as the distance from the base of the fruit to its tip. While **Fruit diameter (cm)** was determined using a Vernier calliper to measure the diameter of the fruit's base, middle, and tip, and the mean was recorded (Toungos and Yahya 2018). **The weight of the seeds (g)** was calculated by carefully separating the seeds from the fruit mentioned above, drying them to remove any remaining moisture, weighing them on a sensitive measuring scale, and calculating the mean. The total fruit yield (Mt/ha) was calculated using the net plots of each experimental plot. Fruit yield per hectare was computed after the fruit was weighed and dried to eliminate moisture. (Toungos and Yahya 2018).

RESULTS AND DISCUSSION

Table 1. showed the effect of X-ray irradiation on certified pepper seed (*Capsicum annum* L) as seen in 3.0mGy treatment which showed a relatively higher increase in growth and yield development ($P < 0.05$) compared with all other treatments. Plant heights and number of leaves measured in field experiments of pepper seed induced with different doses of x-ray irradiation exhibited significant variations.

At 12 weeks after transplanting (table 1), the seed that received 3.0mGy had the tallest plant height, with mean values of 34.60 ± 10.11 cm, while the untreated seed with zero exposure had the shortest plant height. These agrees with the findings of Omeke (2021), who observed small dose of mutagen (sodium azide) was effective in causing significant morphological variation in some varieties of pepper. Monica and Seetharaman (2016) also reported that the germination percentage of garden bean was improved at low concentration/ dose of gamma rays and EMS and decreased at high concentration. Bind *et al.*, (2016) also reported that low concentration of mutagen improved biological parameters. this implies that lower does of x-ray irradiation could have positive effect on pepper growth and production. Table 2 revealed at 9 WAT, 3.0mGy resulted in a greater number of leaves per plant having 38.30 ± 10.45 . The highest stem girth diameter and number of branches per plant was 1.64 ± 0.24 and 7.27 ± 2.24 at 12 WAT respectively, all recorded on 3.0mGy as shown in table 3 and 4 respectively. The findings are consistent with those of other researchers, such as Tomlekova *et al.*, (2014), who found out that when cotton, okra (Rao and Rao, 1978), and maize (Sheppard *et al.*, 1987; Sheppard and Chubey, 1990), *Jatropha curcas* when exposed to 5 Kr of gamma radiation showed greater increase. Aliyu *et al.*, (2018) also reported best improvement of agronomic traits of sesame at low concentration of sodium azide. This suggests that x-ray irradiation of hybrid pepper seed at lower doses may have positive effect on pepper vegetative growth as x-ray irradiation is capable of inducing mutation on CaGRF1, CaGRF3 and CaGRF5 gene which

might have altered the plant growth. It's also evidence that Fast Neutron Irradiation (FNI) can cause significant changes in pepper plant agronomic traits and yield parameters, as reported by (Daudu and Falusi 2011).

Similar effects of ionizing radiation on reproductive and other yield parameters have been reported for tomatoes treated with sodium azide at concentrations ranging from 1 to 4 m by Adamu and Aliyu (2007), as well as Okra exposed to Gamma irradiation doses ranging from 300 to 500 Gray (Hegazi and Hamideldin, 2010). Our results corroborate with those of Yoshida *et al.* (1999), Din *et al.*, (2004), Borzouei *et al.*, (2010), and Tabasum *et al.*, (2011), who found that crop sensitivity to radiation is influenced by a variety of factors such as radiation form and dose, crop physiological status, age, and genotype. The results from this study, on the other hand, contradict the findings of Asmahan and Nada (2006) and Hegazi and Hamideldin (2010), who found that increasing the irradiation dose increased certain morphological traits including plant height.

The total biomass of pepper (root dry weight, shoot dry weight, and total dry weight of pepper) revealed no significant difference ($p > 0.05$) as shown in table 5, with 3.0mGy of x-ray exposure resulted in a better effect in all variables (root dry weight 3.28 ± 0.03^c , shoot dry weight 18.27 ± 0.03^c , and total dry weight 15.41 ± 0.04^c). Furthermore, crop growth rate (CGR) showed 1.08 ± 0.29 g/mg/day, relative growth rate (RGR) 0.59 ± 0.29 g/mg/day, and absolute growth rate (AGR) 0.72 ± 0.25 g/cm/day which were all higher at the lower dose. This may suggest that continuing to apply higher amounts of x-ray irradiation to the seeds may have a negative reaction, affecting the pepper plant's performance. These results are in agreement with those of Pakorn *et al.* (2009), who demonstrated that as the intensity of irradiation increased, some crop growth features in *Anubias congensis* decreased due to the destruction of genetic material and reduced cell division, resulting in growth retardation. It also agrees with the findings of Omeke *et al* (2021), who observed that small doses of sodium azide were effective in inducing significant genetic variability in some pepper traits, resulting in variation in morphological features and yield of Shombo and Tatase.

Table 6 and 7 revealed lower X-ray irradiation (3.0mGy) altered pepper yield and yield components, as revealed by fruit length 5.96 ± 1.44^b , fruit diameter 4.48 ± 0.80^a and fruit weight 22.60 ± 4.83^b . While number of fruits per plant 5.20 ± 1.30^a and weight of dry seed 3.76 ± 0.85^b where observed in 6mGy. The above finding is in tandem with Krausse (1989) using gamma irradiation with a lower dose of 10 kR of gamma rays, developed 6 mutant lines, with Dorado being the best mutant line with higher yields (1320 to 1560 kg/ha as compared to the control line 1205 kg/ha). Furthermore, positive heterosis was observed in five hybrids, with the highest heterosis found in Mutant 181 x Mutant 224 (20.74%), Mutant 274 x Mutant 699 (19.85%), and Mutant 224 x Mutant 699 (17.81%). (Madhusudan *et al.*, 2009). Furthermore, as reported by Tomlekova *et al.* (2014), several reports by Zaka *et al.*, 2004 provide evidence of a stimulating effect on cereal growth and crop yield when seeds or seedlings are subjected to low dose ionizing radiation. Pavadai and Dhanavel (2005) also reported that as the dose of gamma rays was increased, the weight of 100 seeds and the yield per plant decreased. All of the cited reports' findings are consistent with this study using x-ray irradiation, which revealed a rise in pepper yield and yield component. Low exposure of x-ray irradiation could have positively affected CaOVATE, CaCLV3 and CaFW2.2 gene that is responsible for yield trait thereby given more yield when compared with the control and higher exposures.

The current study showed that *Capsicum annuum* yield characteristics and vegetative development were greatly improved by low-dose X-ray irradiation (3.0 mGy) ($P < 0.05$). In particular, plant height, leaf count, stem girth, and branch count all peaked at 3.0 mGy, which is in line with Omeke's (2021) findings that tiny doses of sodium azide caused notable morphological variation in pepper cultivars. It also agrees with Danfulloh *et al.*, (2022) who reported higher increase in phytochemical content of *C. annuum* when exposed to 3mGy X-ray irradiation. This suggests that lower concentrations of ionizing radiation or mutagens can promote growth by bringing about advantageous genetic alterations without seriously harming cells.

On the other hand, at greater doses, some studies show opposite results. While higher X-ray doses (6.0 mGy) were less helpful or even inhibitory in the current study, Asmahan and Nada (2006) and Hegazi and Hamideldin (2010) reported that increasing irradiation dose increased some morphological features in okra. According to Pakorn *et al.*, (2009), high radiation may harm DNA, decrease cell division, and adversely affect growth and yield in *Anubias congensis*, suggesting a dose-dependent response. Zaka *et al.* (2004) reported stimulating effects of low-dose radiation on cereal growth and yield, while Pavadai and Dhanavel (2005) found that higher doses of gamma rays decreased seed weight and plant yield in various crops. Taken together, these findings suggest that the stimulating effects of low-dose ionizing radiation on pepper growth and yield observed in this study are consistent with broader trends in mutation breeding and radiobiology.

Table 1. Plant height of pepper at different ages as influenced by the level of x-ray radiation

X-ray dose (MGy)	Plant height (cm) Weeks after planting		
	6	9	12
0	13.27 ± 4.07 ^a	19.73 ± 5.97 ^a	23.83 ± 5.71 ^a
3	24.33 ± 10.91 ^b	32.47 ± 9.98 ^b	34.60 ± 10.11 ^b
6	20.30 ± 6.75 ^b	30.83 ± 7.39 ^b	34.37 ± 6.91 ^b
9	21.43 ± 7.29 ^b	30.43 ± 9.32 ^b	33.90 ± 6.78 ^b

Values are Mean ± SD (Standard Deviation). Means with different superscripts down the column are significantly different at $P < 0.05$ at 95% confidence level using Duncan Multiple Range Test (DMRT).

Table 2. Stem girth of pepper at different ages as influenced by the level of x-ray radiation

X-ray dose (MGy)	Stem girth (cm)		
	Weeks after planting		
	6	9	12
0	0.85 ± 0.23 ^a	1.17 ± 0.17 ^a	1.38 ± 0.17 ^a
3	1.07 ± 0.28 ^b	1.40 ± 0.26 ^{bc}	1.65 ± 0.26 ^b
6	1.02 ± 0.22 ^b	1.42 ± 0.26 ^c	1.58 ± 0.25 ^b
9	0.98 ± 0.30 ^{ab}	1.29 ± 0.24 ^b	1.64 ± 0.24 ^b

Values are Mean ± SD (Standard Deviation). Means with different superscripts down the column are significantly different at $P < 0.05$ at a 95% confidence level using Duncan Multiple Range Test (DMRT).

Table 3. Number of leaves of pepper at different ages as influenced by the level of x-ray radiation

X-ray dose (MGy)	Number of leaves/plants Weeks after planting		
	6	9	12
0	18.53 ± 7.68 ^a	30.10 ± 9.88 ^a	32.93 ± 8.06 ^a
3	23.77 ± 10.09 ^b	38.30 ± 10.45 ^b	37.60 ± 9.02 ^b
6	23.37 ± 8.76 ^b	36.93 ± 9.02 ^b	37.83 ± 7.62 ^b
9	24.27 ± 7.73 ^b	33.63 ± 7.35 ^{ab}	37.03 ± 7.22 ^b

Values are Mean ± SD (Standard Deviation). Means with different superscripts down the column are significantly different at $P < 0.05$ at a 95% confidence level using Duncan Multiple Range Test (DMRT).

Table 4. Number of branches of pepper at different ages as influenced by the level of x-ray radiation

Leave area index (cm)			
Weeks after planting			
X-ray dose (MGy)	6	9	12
0	3.10 ± 2.26 ^a	4.60 ± 1.98 ^a	6.13 ± 1.53 ^a
3	2.70 ± 2.42 ^a	5.50 ± 2.37 ^a	7.27 ± 2.24 ^b
6	2.20 ± 1.65 ^a	5.20 ± 1.94 ^a	6.90 ± 1.77 ^{ab}
9	3.07 ± 1.84 ^a	5.43 ± 2.14 ^a	6.90 ± 1.54 ^{ab}

Values are Mean ± SD (Standard Deviation). Means with different superscripts down the column are significantly different at $P < 0.05$ at a 95% confidence level using Duncan Multiple Range Test (DMRT).

Table 5. Total biomass (root dry weight, shoot dry weight, and total dry weight of pepper at 6 and 9 weeks after planting Root dry weight (RDW) (g) Shoot dry weight (SDW) (g)

X-raydose(MGy)	Total dry weight (TDW)(g)					
	6	9	6	9	6	9
0	1.09 ±0.04 ^b	2.78 ±0.02 ^b	10.02±5.66 ^a	15.03±0.02 ^a	3.58 ±0.03 ^a	3.44 ±0.00 ^a
3	1.40 ±0.04 ^a	3.28 ±0.03 ^c	12.55±1.52 ^c	18.27±0.03 ^c	15.41±0.04 ^c	13.51±0.00 ^c
6	0.96 ±0.06 ^c	2.00 ±0.06 ^a	10.40±1.21 ^b	16.39±0.07 ^b	12.24±0.03 ^b	10.04±0.00 ^b

Values are Mean ± SD (Standard Deviation). Means with different superscript down the column are significantly different at $P < 0.05$ at 95% confidence level using Duncan Multiple Range Test (DMRT).

Table 6. Crop growth rate, Relative growth rate, and Absolute growth rate of pepper at different ages as influenced by the level of x- ray radiation

	Crop growth rate (g/m/day)	Relative growth rate (g/g/day)	Absolute growth rate (cm/day)
X-ray dose (MGy)			
0	0.95 ± 0.24 ^a	0.21 ± 0.05 ^a	0.38 ± 0.07 ^a
3	1.09 ± 0.27 ^b	0.49 ± 0.19 ^b	0.61 ± 0.09 ^b
6	1.04 ± 0.23 ^b	0.22 ± 0.07 ^{ab}	0.57 ± 0.05 ^b
9	0.97 ± 0.31 ^{ab}	0.19 ± 0.03 ^{ab}	0.43 ± 0.03 ^{ab}

Values are Mean ± SD (Standard Deviation). Means with different superscript down the column are significantly different at $P < 0.05$ at 95% confidence level using Duncan Multiple Range Test (DMRT)

Table 7. Fruit yield of harvested pepper Plant fruit as influenced by level of x-ray radiation

X-ray dose (MGy)	Fruit Yield					
	FL	FD	WF	FN	WS	FY
0	4.42 ± 0.61 ^a	3.24 ± 1.58 ^{ab}	18.20 ± 3.83 ^{ab}	4.20 ± 1.30 ^a	2.50 ± 0.84 ^a	188.20 ± 3.21 ^{ab}
3	5.96 ± 1.44 ^b	4.48 ± 0.80 ^a	22.60 ± 4.83 ^b	4.80 ± 0.84 ^a	3.06 ± 0.85 ^{ab}	245.60 ± 4.76 ^b
6	5.14 ± 0.72 ^{ab}	2.98 ± 0.86 ^a	19.76 ± 1.91 ^{ab}	5.20 ± 1.30 ^a	3.76 ± 0.85 ^b	202.76 ± 1.83 ^{ab}
9	4.72 ± 1.13 ^{ab}	3.18 ± 0.65 ^{ab}	17.00 ± 4.18 ^a	3.80 ± 0.84 ^a	2.12 ± 0.70 ^a	155.00 ± 4.28 ^a

Values are Mean ± SD (Standard Deviation). Means with different superscript down the column are significantly different at $P < 0.05$ at 95% confidence level using Duncan Multiple Range Test (DMRT). FL= Fruit Length. FD = Fruit Diameter. WF = Weight of Fruit. FN = Fruit Number per Plant. WS = Weight of Seed FY=Fruit Yield

CONCLUSION

From the results of this study, there was hormesis in some traits of pepper when exposed lower dose of X-ray irradiation. The traits affected include plant height, number of leaves stem girth and number of branches. Positive increase was also observed in some yield attributes of pepper signifying that lower dose) of X-ray irradiation induced variation and improvement in needed agronomic traits. Fruit yield parameters such as fruit length, fruit diameter, weight of fruit, and total fruit yield were also affected by the lower dose (3.0MGy) of X-ray irradiation showing higher yield improvement than in the higher X-ray doses and the control. Nevertheless, number of fruit and weight of seeds differs as 6.0MGy obtained the highest values.

Therefore, the study concludes that the use of a low dose of X-ray on pepper may have significantly influenced variation not only on pepper growth and total biomass but also on yield. In addition, it is recommended that intense genetic studies be carried out to assessed the impact of X-ray irradiation on growth improvement and yield output of pepper.

CONFLICTS OF INTEREST

The Authors declare no conflict of Interest

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