International Journal of Science Academic Research
Vol. 05, Issue 06, pp.7659-7662, June, 2024
Available online at http://www.scienceijsar.com

ISSN: 2582-6425

Research Article

EFFECT OF DIFFERENT DOSES OF GAMMA IRRADIATION ON SOME MORPHOLOGICAL CHARACTERS OF *OCIMUM BASILICUM* L.

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Received 20th April 2024; **Accepted** 25th May 2024; **Published online** 28th June 2024

Abstract

Gamma irradiation is important agent used to improve the productivity and quality of many plants. The present study was carried out to evaluate the effectiveness of different doses of gamma rays (0, 25, 50, 100, 125, 150 and 200Gy) on vegetative growth of *Ocimum basilicum* L. the germination seeds was completed within 10 days, after about 45 days of growth the morphological parameters of the plants were taken in three time periods, and the difference between each period was 14 days. Results showed that 125Gy dose of gamma irradiation significantly increased for all character per plant, but Increasing gamma rays doses of high dose 150 due to significantly reduced germination percentage, vegetative growth characters, but the 200Gy treatment it led to no germination of seeds at all (killer dose). The parameters used were morphological studies (plant height, stem diameter, number of leaves, leaves area, number of brunches). The study suggested 125Gy dose as seeds treatment for increasing basil plants production through enhancing germination percentage, vegetative growth and another the components.

Keywords: Basil, Gamma ray, Morphology.

INTRODUCTION

Gamma radiation has been recognized as a fast and reliable means for the alteration of physiological and biochemical processes in plants. It is one of the important physical agents used to improve the characters and productivity of many plants. Using of gamma radiation technique represented a significant role in plant breeding programs and genetic studies aimed to improve yield and produce desirable traits in many crops under both normal and stress conditions (Borzouei *et al.,* 2013). Gamma radiation, more energetic than X-rays, is implemented from sources of radioactive isotopes, cesium-137 or cobalt-60, and it is specified by the World Health Organization as a food preservation technique that enhances food safety without modifying the toxicological, biological or nutritional quality of the food (Diehl, 2002; Datta, 2009; Farkas and Mohacsi-Farkas, 2011). *Ocimum* belongs to the family Lamiaceae (often called Labiatae, the traditional name.), it's a large family, comprising about 200 genera and 3,200 species. *Ocimum* is one of the most important genera of the family Lamiaceae. There are about 150 species of Ocimum (Nassar *et al.,* 2013). Commonly known as basil or sweet basil (Bravo *et al.,* 2021).

MATERIALS AND METHODS

Plant materials

Seeds of basil (*Ocimum basilicum* L) were provided from General Babylon market, later, 40 gm of seeds were put in petridishes for each individual irradiation treatment .Irradiated at doses (25 Gy, 50 Gy, 100 Gy,125 Gy, 150 Gy, and 200Gy), as proposed by (Hanafy and Akladious, 2018) at average of 18 Gy/hour using Cobalt 60 as irradiation source was acomplished at department of Physics/ College of Science/ Baghdad university. Seeds were sown in loamy clay soil. Seeds of the control were not irradiated. Where a decrease in germination rate and growth parameters was observed above the dose of 150 Gy. Each treatment was replicated three times with 20g seeds in each replicate and the seeds allowed to germinate in soil sections (1 m×1m in diameter) containing equal amounts of homogeneous clay soil. The seeds were sown at 4-5 cm depth in each section and after the emergence was complete (after 10 days) the density was reduced plants per section until reduce the compersion between them. After 6 weeks from sowing were the first period measure to determine some growth parameters (shoot length, root length, fresh and dry weights of shoots and roots), after 8 weeks collacted of second period and finally collected the third period after 10 weeks. observations on various quantitative traits were recorded on plants of each treatment in the same above mentioned criteria as in the following: For coducting studies for period from 1/3/2023 till 15/5 /2023 to obtain vegetative parts of plant.

Determination of plant height (cm)

Plant height was measured by using a metric tape, starting from the soil surface to the top of the plant, during three time periods.

Stem diameter (*Mm)*

The stem diameter of the plants was measured the area near the soil surface using a device of digital vernier caliper (Chinese origin),during three time periods.

Leaves number(leafe.plant^{-1})

The number of leaves was calculated for three replications for each treatment during three time periods.

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Branches number(branch.plant^{-1})

The number of branches was calculated for three replications for each treatment during three time periods.

Leaf area (cm^2.leaf^{-1})

The leaf area was calculated by three replicates for each treatment according to a special program for measuring the leaf area.

Statistical analysis

Data were analyzed by investigation the change of (ANOVA)table .noteworthy contrast between medications were considered by SSPSS measurable program was utilized to calculate measurable investigations .level of importance utilizing Fishers ensured slightest critical contrasts (LSD) Test.

RESULTS AND DISCUSSION

Effect of Gamma rays doses on plant height (cm) of *O. basilicum*

In table (1) results showed that, dose 125 gave highest value for plant height 41.78cm compared to control (untreated) and other treatments. While lowest value 22.78cm in 150Gy and significant differences between radiation doses is 3.167 ($P \leq 0.05$). The third period of growth gave highest value for plant height 49.50cm compared to first and second period and significant differences between periods are 2.239 ($P \leq 0.05$). While the interaction between dose and period appear in its higher value in 125Gy in period 3 it was 64.33cm. Increasing gamma irradiation doses significantly to 150Gy in all periods to decreased plant height, These remarks were in accordance with (Bhosale and More, 2014) who noticed a gradual decrease in *Withania somnifera* seedling height when gamma rays increased from 10 to 40kR, (Khan *et al.,* 2014) treated seeds of *Brassica napus* L. by gamma rays doses (0, 10, 15, 20, 25 and 30kR) and exhibited that elevated doses of radiation markedly reduced plant height compared with control.

Table 1 .Effect of γ-ray doses, periods and their interaction on plant height in cm of *O.basilicum*

Doses	Periods			Mean of Doses
	1	2	3	
Control	14.67	26.33	46.67	29.22
25	15.67	32.00	48.33	32.00
50	18.00	35.33	54.00	35.78
100	18.67	29.33	48.33	32.11
125	18.67	42.33	*64.33	*41.78
150	10.67	22.33	35.33	22.78
Mean of Periods	16.06	31.28	*49.50	
L.S.D. 0.05 Doses = 3.167, Periods = 2.239, Interactions = 5.485				

Effect of Gamma rays doses on stem diameter(mm) of *O. basilicum*

Results in table (2) showed that, dose 125 gave highest value for stem diameter 2.211mm compared to control (untreated) and other treatments, while lowest value in 50Gy 1.178mm and significant differences between radiation dose is 0.1829 ($P \leq 0.05$). The third period of growth gave highest value for stem diameter 2.322mm compared to first and second period and significant differences between periods are 0.1293 ($P \leq 0.05$). The interaction between doses and periods appear in125Gy its gave highest value 3.433mm in period 3. result also corresponds with the result of (Songsri *et al.,* 2011) wherein the highest dosage of gamma radiation resulted the shortest height, germination, and stem diameter of physic nut and also in the study of (Alvarez-Holguin, 2019) which observed that seeds with high radiation doses cannot germinate, or their seedlings cannot survive beyond a few days after 4 kGy dose. As reported by (Berry, 2012), shorter plants have its advantages with seed establishment, which also prevents lodging and yield loss. Increased gamma radiation doses also increase free radicals' production, leading to diminished growth and sometimes to a shortened lifespan of plants (Marcu *et al.,* 2013).

Table 2. Effect of γ-ray doses, periods and their interaction on stem diameter mm of *O.basilicum*

Doses	Periods			Mean of Doses
	1	2	3	
Control	1.067	1.200	1.467	1.244
25	0.333	1.467	1.733	1.178
50	0.867	1.800	2.333	1.667
100	0.667	1.433	2.833	1.644
125	0.900	2.300	*3.433	*2.211
150	0.833	1.467	2.133	1.478
Mean of Periods	0.778	1.611	*2.322	

Effect of Gamma rays doses on leaves number /plant of *O. basilicum*

In table (3) results showed that, dose 125 gave highest value for leaves number 116.0 leaf.plant^{-1} compared to control (untreated) and other treatments. While lowest value 58.4 leaf.plant^{-1} in 100Gy and significant differences between radiation doses is 12.93leaf.plant^{-1} ($P \leq 0.05$). The third period of growth gave highest value for leaves number 147.1 leaf.plant^{-1} compared to first and second period and significant differences between periods are 9.14leave.pant^{-1} ($P \leq 0.05$). While the interaction between dose and period appear in its higher value in 125Gy in period 3 it was 260.0 leaf.plant^{-1}.Gamma radiation generally, improved plant growth and in turn, number of leaves since all used doses gave number of leaves higher than its corresponding control and than normal control, (Hussein *et al.,* 1995) studied the effect of γ- radiation 0, 1, 5, 10 and 15K r and manganese application on growth and chemical constituents of *Datura metal* L. found that irradiation treatments, especially lower doses, had stimulatory effect on plant height and number of leaves.

Table 3. Effect of γ-ray doses, periods and their interaction on number of leaves/ plant of *O.basilicum*

Dose	Periods			Mean of Doses
	1	2	3	
Control	7.3	60.7	122.7	63.6
25	7.3	69.3	141.3	72.7
50	9.3	75.3	132.0	72.2
100	9.3	55.3	110.7	58.4
125	12.7	75.3	*260.0	*116.0
150	7.3	53.3	116.0	58.9
Mean of Periods	8.9	64.9	*147.1	
L.S.D. 0.05 Doses = 12.93, Periods = 9.14, Interactions = 22.40				

Effect of Gamma rays doses on branches number/plant of *O. basilicum* L.

As showd in table (4) the data obtained showd that there was no significant difference between 125Gy that gave 8.22

branches/plant and control that gave 7.33 branches/plant by exposure of gamma rays and significant differences between radiation doses is 1.765 brunch/plant ($P \leq 0.05$), while in the 3 period the 125 Gy treatment scored the highest value of brunch number 11.67 branches / plant compared to first and second period and significant differences between periods are 1.248 brunch/plant ($P \leq 0.05$), While the interaction between dose and period appear its no significant differences between 125Gy and control in period 3 it was 16.00 and 13.33branches/plant in($P<0.05$)=3.057. These outcomes were in harmony with the observation of (Hamideldin and Eliwa, 2015) in which branches number of mustard plants were progressively increased with rising gamma irradiation doses from 10 to 50Gy. Moreover, branches number were significantly diminished with raising gamma rays doses therefore, the least branches number was recorded for irradiated basil plants with 150Gy. A reduction in branches number for several crops that were subjected to elevated gamma-ray doses had been previously reported (Khan *et al.,* 2014 and Verma *et al.,* 2017).

Table 4 .Effect of γ-ray doses, periods and their interaction on number of branch/plant of *O. basilicum*

Dose	Periods			Mean of Doses
	1	2	3	
Control	0.00	8.67	*13.33	*7.33
25	0.00	8.00	9.33	5.78
50	0.00	5.33	10.00	5.11
100	0.00	6.00	12.00	6.00
125	0.00	8.67	*16.00	*8.22
150	0.00	6.00	9.33	5.11
Mean of Periods	0.00	7.11	*11.67	
L.S.D. 0.05 Doses = 1.765, Periods = 1.248, Interactions = 3.057				

Effect of Gamma rays doses on leaf area (cm^2) of *Ocimium basilicum* L.

In figure (5) showed the increase in the level of radiation doses caused changes in the leaf area, where the highest value of leaf area in 125 Gy was 32.947cm^2 and the lowest value was 13.626cm^2 in 25Gy treatment. The results were significantly different between the doses (L.S.D. = 3.455) within a significant level ($P<0.05$). Higher doses of gamma rays were not lethal and they caused very little visual damage to the plants. Presence of significant differences between total biomass would suggest change in the rate of fixed C. Our study exhibited that radiation resulted in decrease in leaf area at higher doses of gamma rays, while showing negative relationship to photosynthesis and a strong positive relationship to leaf density. Similar results have been observed in sunflower plants exposed to variable doses of gamma rays (Thiede *et al.,* 1995).

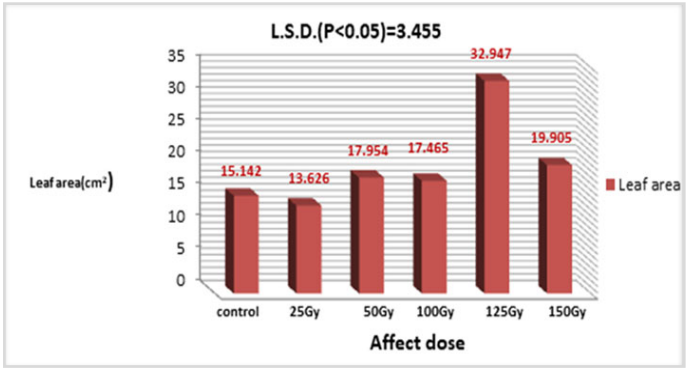

Figure 1. The effect of Gamma doses on leafarea / plant in cm^2

Conclusion

In conclusion, the present data suggest that relatively low doses of gamma rays increase morphological growth of basil plants. Gamma irradiation at 125 Gy was superior in enhancement of these parameters, whereas, high dose of gamma irradiation (150 Gy) caused decrease in these contents. In addition, (200Gy dose) could be considered as an killer dose, which led to the complete non-germination of seeds during the three growth periods.

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