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Effect of different doses of X-rays on Seed germination and seedling growth of barley plant *Hordeum vulgare* L

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Abstract

This study was carried out in the Department of Botany at the University of Benghazi, Faculty of Arts and Sciences, Tokara Branch. To study the effect of different doses of X- rays on germination and seedling growth of *Hordeum vulgare* L plant, seeds were irradiated with three doses of x-ray (0, 10, 15, 20 Gr) Linear accelerator. The results of the study showed no significant differences in the effect of the three doses of X-ray on the rate and speed of germination of the plant, while the doses had a positive effect in stimulating the increase in the length of seedling after 10 days of cultivation, the length of seedling was increased directly with the increase in dose concentration compared to control, Control and other dull doses indicate seedling response to radiation therapy.

Keywords: *barley* plant, X- rays.

Introduction

Barley plant *Hordeum vulgare* L belongs to the Poaceae family (Graminae). Barley crops are grown in Libya under the rainfed and irrigated systems. Rainfed agriculture is in the semi-arid regions, which extend along the Mediterranean coast north by a width of 20-100 km, The irrigated agriculture is in the arid regions, which represent most of the central and southern parts of Libya, where rainfall is rare and characterized by drought and high temperature (Al-Habaki and Ashour,2006). Despite the severe consequences caused by ionizing radiation if misused or lost control, it has many uses and applications in various fields of vital development and community service such as medicine, industry, agriculture and others. The use of radiation technology and radiotherapy plays a significant role in preserving the clean environment as well as serving humanity, progress and progress. There are three types of radiation widely used in various peaceful applications that serve society and the environment. They are Gamma rays from cobalt 60 units, beta rays from electronic accelerators with a total capacity of less than 0.1 million electron volts, x-ray machines Generation of x-rays, which do not exceed 0.5 million electron volts. The most radioactive sources used in medical, industrial and agricultural development are gamma rays from cobalt units 60(Hammad,2002). X-rays are a type of electromagnetic radiation that includes visible light, radio waves and gamma rays. X-rays and visible light share many properties. For example, x-rays travel at 299.792 km / s, and X-rays and visible light move in straight lines in the form of electrical energy and magnetic energy linked to some of the electromagnetic waves together. X-rays and light differ in wavelength, the distance between two peaks of an electromagnetic wave. X-rays wavelength is shorter than the wavelength of light, and for this reason x-rays can penetrate many substances without light. X-rays cause biological, chemical and physical changes in the material. If a plant or animal absorbs these rays, living tissue may be damaged, and for this reason it can be dangerous. An overdose of x-rays may cause cancer, skin burns or other serious conditions (Ibrahim, 2015). Many researchers point out that gamma rays and chemical mutants are important methods used to induce genetic changes in vegetable and crop plants. Their research has examined the positive effects of these mutants on morphological traits, production indices, and damage to growth (dwarf plants, Plants, etc.) that appear as a result of the use of certain doses or inappropriate concentrations. Different from x-rays resulting from x-ray less permeability and energy. Gamma rays are also known as field-based artificial matrix mutants and are widely used in plant breeding, one of the biotechnological methods, as well as tissue culture, monoclonal production and pollen cultivation. They are used as a means of improving crop genetics and access to economically viable strains, The coagulating gamma rays from cobalt are 60 of the physical mutants updated for field mutations, the General Authority for Agricultural Research of Syria. Studies have shown that gamma rays are able to directly influence the chromosome and its components, especially DNA, which is responsible for the stability of the transmission of traits from one generation to another. It is also capable of forming new genetic structures with desirable economic characteristics using the synthetic physical mutations. In the plant is a constant source of contrast and devotes this variation by the election to obtain new strains, and one of the most important features of artificial mutations is the change of one or several factors that use this method when The genetic makeup of a

species is increased, except for one or several genes. The mutation deals with the morphological, physiological and biochemical characteristics of the plant (plant height, yield, maturity, plant color, protein ratio and other characteristics). The mutation is a new hereditary structure that may distinguish the plant with important economic characteristics. This new structure results from an artificial change in the physical or chemical structure of the nucleotides of the genes or as a result of the re-synthesis of the chromosomes again after fractures due to the effect of radiation on the chromosomes and then re-docking Chromosomes are new forms (Research Center Scientific Agricultural in Tartous,2001). In many studies, the positive results of seed exposure prior to transplantation to low doses of ionizing radiation have been found (Al-Ouda *et al.*, 2004) that low-dose radiation irradiation (10 Gy) resulted in improved plant character traits and yield components. Radiation induction increased the efficiency of distribution and transfer of representative products Which led to an increase in the number of ears and weight of the grain compared to control, which confirms the importance of the use of radiation induction to increase the yield. The study of (Charbaji *et al*., 2007) showed that the dose of 7 non-gamma rays has an effect in increasing the percentage of rooting compared with the witness in all the assets and varieties of apple plants used in the research (Salihy *et al*.,2006) showed that the response of four varieties of potato for radiation doses differed according to the variety and dose dose. The mean of most of the traits was significantly increased by the dose significantly over all the varieties in height and the irradiation dose was 30 Gy. The average number of branches, and the results showed a decrease in the average number of leaves at the radioactive dose 40 Gy. The studies (Research Center Scientific Agricultural in Tartous, 2009) showed the possibility of using two-dose gamma rays (15-20 Gy) on hard and soft wheat to obtain morphological, physiological and technological mutations and to elect these changes resulting from genetic changes that have new genetic structures that improve productivity Soft and hard wheat in the unit area in the areas of low rainfall and less water need to ensure the activation of rainfed agriculture and the mitigation of irrigated agriculture, especially in areas where there is little groundwater. The results of (Tawileh *et al.*, 2010) showed that the two doses (12, 16) Gy of gamma rays had a positive effect compared to control in some traits and the effect of spleen in other traits compared to the control of soybean plant. The study of the study of (Abdallah *et al.*,2018) indicated that the dose of 10 non-gamma rays negatively affected the speed of germination of the cells, led to the death of the plant after 60 days of cultivation and can be considered a lethal dose. Had a positive positive effect in the characteristics of the vegetative total.

Due to the widespread use of radiation and radiotherapy technology in our time to effect positive and genetic changes in crop plants. In an attempt to improve the barley plant, different doses of X-rays were used in seed irradiation. The aim was to:

1-Study the effect of different doses of X-ray in the growth and development of barley plant seedlings

2-Determine the optimal dose of X-rays that contribute to stimulate the growth and development of barley plant seedlings.

Materials and methods

The study was conducted in the Environment Lab Botany Department, Environment Lab Faculty Arts and Science-Tocra, Unviersty of Benghazy-Libya.

Plant materials: The seeds of the *barley* plant *Bromus*, which is widely cultivated in the western part of Benghazi (El Makroun), 80 km away from Benghazi, were used in the research.

Seed Viability Test: Seed vitality was tested by taking 50 seeds of *barley* seeds. It was placed in a Petri dish containing two filter sheets and 15 cm3 of distilled water was added. The percentage of germination was 94% after 3 days of planting

Experimental design and treatments: The healthy and symmetric seeds were selected in size and irradiated at the National Center of Oncology, Benghazi, by means of a linear accelerator. The samples were placed at a distance of 100 cm from the device. The type of radiation produced by X-ray and the type of energy used (MV 6) And in doses (0, 10,15, 20) according to the following:

10Gy =1000 CGY=1000MU

15 Gy=1500 CGY=1500 MU

20Gy = 2000CGY= 2000MU

Seeds were sterilized once by 70% ethanol for 1 min. then rinsed once for 10 min by10% commercial bleach (final concentration 4.8% of sodium hypochlorite) for 10 min and washed extensively with sterile distilled water(El Gumi,2014). The germination of barley seeds is achieved in Petri dishes (10 seeds /dishes and 2dishes by treatment and accession). Each Petri dishes was covered with two Whatman No. 1 filter papers moistened with distilled water and were placed in an incubator**.** under controlled conditions (23±1°C in dark). was applied in each petri dish of respective. 10 cm^3 of distilled water was added to each petri dish(Fig 1). The seedling were grown in the pots(sand soil) for Ten days.

Measurements: Seeds were considered as being germinated when the radicle had protruded through the seed coat. The germination percentage was determined by counting the number of geminated seeds. The daily record of germinated seed was taken up to Three days from setting up of the test. After final count, germination percentage (GP) was calculated by using the GP = (Number of total germinated seeds /Number of total seeds) x100
The germination rate GR: is the number of grains that germinate for each 24 h during Three days. and germination (Number of total germinated seeds / Number of Days).

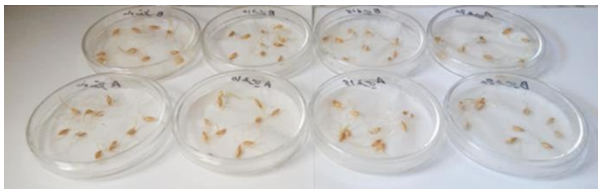
Seedling length(cm): was recorded at Ten days after planting.The uprooted seedlings were washed with tap water and excess water was soaked with tissue paper. Seedling length was measured with a ruler (Fig. 4). fresh weights and Dry weight(mg) were recorded by an electronic balance. Dry weight of Seedling was measured after keeping fresh plant sample in an oven at 60 C^{o} for 48hours.

Statistical analysis:The data were subjected to statistical analysis and significance of differences between treatments was determined by ANOVA ONE –WAY,using Minitab version 16.

Results and Discussion
Seed Germination: Final seeds germination "G%" The results of (Table 1) showed that there was no effect on the ratio and speed of germination of barley plant seeds compared to control, indicating that the enzymes of the X-rays were not affected by the process of germination (Fig. 1). These results differed with the results of (Abdallah *et al.*,1018), which indicated that the dose (10 Gy) had a negative effect on the length of the cloves' germination period of *Allium sativum* L , leading to the death of all the plants after 60 days of planting, this could be considered lethal dose (LD100).

Table 1: Effect of X-rays Gy on final germination . percentage, germination rate of *barley*

doses of X-rays 20 Gy	Germination% (GP)	Germination rate(GR) seed/day
0	100	0.02± 4.77
10	100	0.01±4.94
15	0.001±96	0.03±4.72
20	100	0.01 ±4.44



0 10 15 20 Gy
Figure 1: Germination of the seeds at the 3th day

Seedling growth of Barley : (Figure 3, Figure 4) shows that the doses of X-ray have a stimulating effect on the vegetative growth of the plants. The plant height increased gradually by increasing the dose of X-rays compared to the control. The seedling of the irradiated seeds was increased by 20 Gy on the control and the other doses (10, 15 Gy). The positive effect of low doses of x-rays on vegetative growth of plants is attributed to increased cell length and rapid division, as well as a change in favor of photosynthesis versus demolition . Dull indicates the seedling response to the radiation treatment. These results, in concordance with those of(Al-Ouda *et al.*, 2004) The radiostimulation with low doses (10 GY) improved yield and growth parameters**,** also The high doses (15, 20 GY) caused a significant deterioration in growth and development of *Triticum durum*, as well as yield components of the two varieties of *Triticum durum*. And (Salihy *et al*.,2006) which indicated that The dose 30 Gy caused an increase in the average number of plant branches of *Solanum tuberosum* L. These results differed with the results of(Tawileh et al., 2010) which indicated that The doses (12, 16 Gy) of gamma irradiation has negative effect on first pod height and plant Glycine max L height traits which decreased against control.

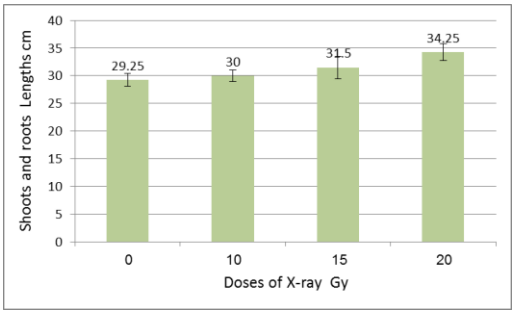


Figure2: Effect of X-ray Gy on roots and shoots lengths

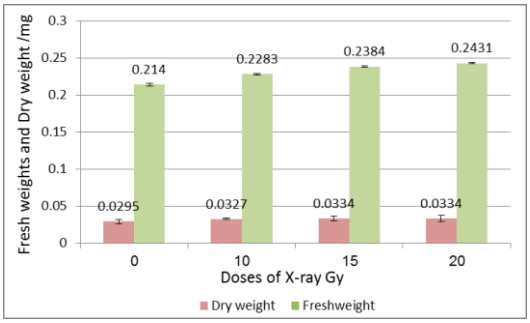
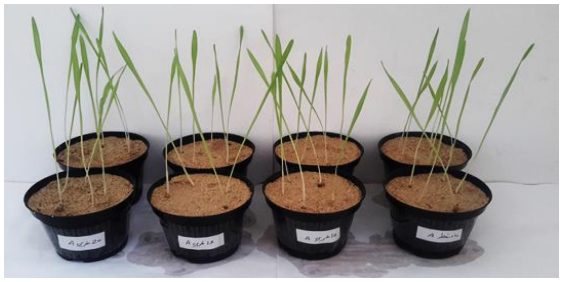


Figure3: Effect of X-ray Gy on the fresh and Dry weight



10 0
20 15

Figure 4 Effect of doses of X-rays on the lengths of the roots and the shoots *of Barley*

Conclusion

This study was conducted to determine the effects of different doses of X- rays on germination and seedling growth of *Hordeum vulgare* L plant, seeds were irradiated with three doses of x-ray (0, 10, 15, 20 Gy) Linear accelerator. The results of the study showed no significant differences in the effect of the three doses of X-ray on the rate and speed of germination of the plant, while the doses had a positive effect in stimulating the increase in the length of seedling after 10 days of cultivation, the length of seedling was increased directly with the increase in dose concentration compared to control, Control and other dull doses indicate seedling response to radiation therapy. It is recommended to apply the continuation of scientific research in this field and apply the dose 20 Gy -varieties of barley to the superiority of the plant height on the rest of the doses

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