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Research Article

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The Effect of Different Gamma Radiation Applied on Tokak-157/37 Barley (*Hordeum vulgare*) and Karahan-99 Wheat (*Triticum aestivum*) on M1 Generation

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Abstract: In this research study, the dose of gamma radiation on seed germination of two *Hordeum vulgare* Tokak-157/37 barley kind and Karahan-99 wheat *Triticum aestivum*, and the mechanisms of the dose required to maximizing the rate and percentage of germination and seedling, growth of root TAEK was conducted in Ankara. The moisture rate has been %11, the barley and wheat seeds whose germination per cent is 98 % has been irradiated with 9 different doses between 0-600Gy in the centre of ^{60}Co which has 1.92 kGy/h powers. At the laboratory experiment it has been seen that the percentage of germination of rising radiation doses has no effect on M1 generation, but after diminishing of root length and seedling height with rising radiation doses it has been determined that the growth of the first leaf has stopped on the 14th day and this event has been given importance statistically for Tokak-157/37 barley kind, 50 % efficient dose has been determined as ED_{50} 485 Gy, for Karahan-99 wheat kind , 50 % efficient dose has been determined as ED_{50} 370 Gy.

Keywords: Gamma rays, Root length, Seedling height, Physiological effects, Germination, Wheat, Barley

1. Introduction

Physiological and biochemical processes in plants are significantly affected by gamma-irradiation stress. The irradiation of seeds with high doses of gamma rays disturbs the synthesis of protein, hormone balance, leaf gas-exchange**,** and water exchange and enzyme activity (Xiuzher, 1994).

Gamma rays, X-rays, visible light, and UV are all of electromagnetic radiation (Rabie et al., 1996) .Gamma rays belong to ionizing radiation and interact to atoms or molecules to produce free radicals in cells. These radicals can damage or modify important components of plant cells and have been reported to affect differentially the morphology, anatomy, biochemistry and physiology of plants depending on the irradiation level. The first developmental stage of the plant is germination, a critical stage in the life cycle of plants and a key process seedling emergence (Stoeva et al., 2001). The second developmental stage of the plant is germination plants this growth stage is strongly influenced by environmental factors, especially temperature and soil moisture (*Kovács* and *Keresztes*, 2002). The plant will be able to end its development period before early fall stresses (Basra et al., 2004; Subedi and Ma, 2005). The results show that emergence and established of uniform power plant achieved using power levels to rapidly seed germination. Increasing agricultural production is possible in two ways: increasing acreage and yield per unit area. Due to limited natural resources it should be forced to increase the yield per unit area that is the main farming procedures. Low dose of gamma irradiation stimulates

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cell division and high- dose inhibits cell division due to free radicals and DNA system damage (Afzal et al., 2002; Ashraf and Foolad, 2005; Farooq et al., 2006; Zaka et al., 2004). High doses of gamma radiation cause DNA damage and expression of genes related to callus. Physiological symptoms in large range of plants exposed to gamma rays have been described by many researchers**.** A number of radio biological parameters are commonly used in early assessment of effectiveness of irradiation to induce mutations. Seed germination, seedling survival and pollen and ovule sterility have been used extensively. Depending on the gamma radiation dose between 15 and 300 Gy the height of pea seedlings was found shorter and parallel with this peroxides activities were higher than in the nonirradiated controls. After doses of gamma irradiation has also been reported in corn *Zea mays* L. (Patade et al., 2008; Kim et al., 2004; Wi et al., 2005**).** The present study was designed with following object: To observe the effects of morphological and physiological characters of different doses of gamma rays on seed germination, seedling growth on Tokak-157/37 Barley and Karahan-99 Wheat.

2. Materials and Methods

2.1. Experimental

Our researches were been TAEK (Turkish Atomic Energy Authority) laboratories. As materials Tokak-157/35 malt kind and Karahan-99 bread wheat seeds have been used. The necessary sand for the laboratory study has been taken from the 0-20 cm. deep land. At the test 2-1-1 range land shed manure and sand mixture have been used. All experiments were repeated three times. The irradiated seeds were sowed 20 seeds three times per dose according to chance event plot test design in the strongboxes were taken to the growing rooms of which heat, light and humidity rates can be controlled. After fourteen days of germination seedling height and root length were measured when the growing of the first leave stopped. Seeds were treated using ^{60}Co gamma rays in TAEK with the following characteristics.

2.2. Statistical Analysis

The statistical analyses of test results were done according to student t-test. For Tokak-157/37 malt kind ED_{50}=370 Gy was determined and for Karahan-99 wheat kind ED_{50}=370 Gy was determined.

3. Results

The results of variance analysis shows that among cultivars for all traits, there were significant differences in traits expect stem diameter that it is a fix character and has been affected by radiation. As seen in the table at different doses for all traits expect percentage and germination rate, there are significant differences for other traits. This indicates that radiation levels have a direct effect on cell division and intracellular metabolism, length and diameter of the cells, but it has no effect on the rate of intracellular activity.

3.1. At the plantation after irradiation

Germination Percentage (%)

The effects of Tokak-157/37 malt and Karahan-99 wheat kinds on the percentage of germination have been given in Table 1. As it may be understood from the Table 1, it has been determined that there is no effect of rising radiation doses in wheat and barley on germination percentage.

Table 1. The effects of gamma radiation on Tokak-157/37 malt and Karahan-99 wheat germination percentage

Doses (Gy)	Germination Per. Tokak-157/37 barley (%)	Germination Per. Karahan-99 wheat (%)
Control	100	100
50	100	103,5
100	101,7	94,6
150	100	96,5
200	101,7	89,3
300	100	96,8
400	100	96,5
500	94,6	96,5
600	96,6	89,3

Seedling Height

The effect of Tokak-157/37 barley Karahan-99 wheat kinds on seedling height has been stated in Table 2. In barley, although rising radiation doses according to control with the fall in seedling height has been seen, while control was 100, the seedling height at 600 Gy fall to 32,55. For this kind, ED_{50} value has been found as 485 Gy. According to the variation analyses, it has been stated that the difference between the doses is important and according to control, a big difference ($p<0,05$) has been determined.

For the wheat, with the rise of radiation doses, the seedling height has diminished and while control was 100, it has declined to 5,45 at 600 gray. ED_{50} valve has been determined as 370 gray ($p<0,001$) As a result, storage period and seedling height have declined.

Table 2. The effects of gamma radiation on seedling height of Tokak-157/37 barley and Karahan-99 wheat kinds

Doses (Gy)	Tokak-157/37 barley		Karahan-99 wheat	
	Average	Fide heights	Average	Fide heights
Control	17,57	100	19,28	100
50	17,05	97,04	17,69	91,75
100	16,47	93,74	18,01	93,41
150	15,68	89,24	14,94	77,49
200	15,40	87,65	15,43	80,03
300	15,36	87,42	11,05	57,31
400	12,56	71,48	9,02	46,78
500	8,14	46,33	2,76	14,31
600	5,72	32,55	1,05	5,45

Root Length

In Tokak-157/37 barley and Karahan-99 wheat when searched about the effects on root length, it has been determined that according to control, with the rise of radiation doses, the root length has declined. Tokak-157/37 barley and Karahan-99 wheat have been given at Table 3. We see that with the rise of radiation doses, the root length declines and according to variation analyses there is an important difference between the doses ($p<0,01$).

As a result, with the help of mutation techniques in the world 2252 mutants have been grown so far and 158 of these have been direct mutant and 667 of these have been formed by crossbreeding In the lately researches the effects of gamma radiation on lentil kinds have been determined. In our research, we have seen that rising radiation doses has no effect on germination percentage, but with rise of radiation doses seedling height and root length declines and it has been found out statistically. In our country, at the centre with many studies and this technique many variations are developed and it has been presented for the use of Turkish agriculture and new mutant variations researches have been going on intensively.

Table3. Tokak-157/37 barley and Karahan-99 wheat root lengths

Doses (gray)	Tokak-157/37 barley		Karahan-99 wheat	
	Average	Root lengths	Average	Root lengths
Control	8,35	100	6,97	100
50	10,02	120	7,58	97,75
100	9,44	113,05	7,62	96,32
150	8,63	103,35	12,6	90,77
200	8,5	97,6	5,85	83,93
300	8,11	97,12	5,43	77,9
400	8,15	97,6	5,59	80,2
500	8,29	99,28	4,26	61,12
600	8,62	103,23	4,03	57,82

4. Discussion

The results showed that different doses of gamma rays and their interaction on the number of seeds germinated (Hamid.et al., 2012). Gamma irradiation is one kind of processing methods, which could affect the germination of grain. Cells of rice and wheat could be destroyed by gamma irradiation (Yu and Wang, 2005, 2006), this is the reason that irradiation affect the germination of rice and wheat seed. There are many surveys describing inhibition of germination by treatment by ionizing radiation, for example, the effects of gamma irradiation on the germination of wheat seeds and gamma germination inhibits the germination of wheat seeds (Borros et al., 2002; Wang and You, 2000).

For the determination of the efficient dose of Tokak-157/37 malt kind and Karahan-99 wheat kind control form the irradiated seeds with the dose of 50, 100, 150, 200, 300, 400, 500 and 600 Gy to the plants which have been grown at the laboratory conditions, the mutagenic effects of gamma radiation (germination %, fide height and root length) and the determination of the effects of planting’s results are given below.

5. Conclusions

In this research study, the dose of gamma radiation on seed germination of two Tokak 157/37 barley kind and Karahan-99 wheat, and the mechanisms of the dose required to maximize the rate and percentage of germination and seedling, growth of root TAEK was conducted in Ankara. The moisture rate has been %11, the barley and wheat seeds whose germination per cent is 98 % has been irradiated with 9 different doses between 0-600Gy in the centre of ^{60}Co which has 1.92 kGy/h powers.

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6. References

Xiuzher, L., (1994). Effect of irradiation on protein content of wheat crop. *J. Nucl. Agricul. Sci.,* 15: p.53

Rabie K., Shenata S., Bondok M., (1996). *Analysis of agric. science.* Cairo, 41, Univ. Egypt, pp.551-566.

Stoeva N. and Bineva Z., (2001). Physiological response of beans (*Phaseolus vulgaris* L.) to gamma-radiation contamination . II. Water- exchange, respiration and peroxidase activity. *J. Env. Prot. Eco*., 2: p.303

Kovács E. and Keresztes A., (2002). Effect of gamma and UV-B/C radiation on plant cells. *Micron,* 33 (2): p.210

Basra S.M.A., Ashraf M., Iqbal N., Khaliq A. and Ahmad R., (2004). Phsiological and biochemical aspects of pre-sowing heat stress on cottonseed. *Seed Sci and Technol*., 32: p. 774

Subedi KD. and Ma BL., (2005). Seed priming does not improven corn yield in a humid temperate environment. *Agron. J*., 97: p.218

Afzal A., N Aslam., Mahmood F., Hameed A., Irfan S., Ahmad G., (2002). Enhancement of germination and emergence of canola seeds by different priming techniques. *Garden depesqisa Bio*. 16 (1): p.34

Ashraf, M. and M.R. Foolad, (2005). Pre- sowing seed treatment a shotgun approach to improve germination growth and crop yield under salina and none-salina conditions. *Advan. Agron*., 88: p.271

Farooq, M., Basra S.M.A. and Hafeez-ur-Rehman, (2006). Seed priming enhances emergence, yield, and quality of direct-seeded rice. *Crop management & physiology*, 9: p.44

Zaka R., Chenal C., Misset M.T., (2004). Effects of low doses of short-term gamma irradiation on growth and development through two generations of Pisum sativum. Sci. Total Environ., 320: p.121-129

Patade Y., Suprasanna P., Bapat VA., (2008). Gamma irradiation of Embryonic Callus cultures and in vitro selection for salt tolerance in Sugarcane (*Saccharumofficinaram* L.). *Agricultural Sciences in China*., 7 (9): p.1152.

Kim J.H., Back M.H., Chung B.Y., Wi S.G., Kim J.S., (2004). Alterations in the photosynthic pigments and antioxidant machineries of red pepper (*Capsicum annuum* L.) seedlings from gamma- irradiated seeds. *J. Plant Biol.*, 47: p.321.

Wi S.G., Chung B.Y., Im J.H. Back M.H. Yang D.H., Lee J.W., Kim J.S., (2005). Ultrastructural changes of cell organelles in Arabidopsis stem after gamma irradariation. *J. Plant Biol.* 48 (2), p: 200

Bagi G.P., Pauspertl B. and Hidvegi E.J., (1998). Inverse correlation between growth and degrading enzyme activity of seedlings after gamma and neutron irradiation of seeds. *Int. J. Radiat. Biol. Relat. Stud. Phys. Chem. Med*., 53: p.519.

Marchenko M.M., Bloshko M.M., Kostyshin S.S., (1996).The accition of low doses of gamma irradiation on the function of the glutathione system in corn. *Ukr. Biokhim. Zh.,* 68: p.98.

Nouri H., Kiani D., Khani M.A., (2012), Investigation of mutagenic effects of various doses of gamma ray on seed germination traits of pinto bean cultivar of Khomein. *Annals of Biological Research*, 3 (10): p. 4977-4979.