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# The Effect Of Γ -Irradiationon Vigor Of *Origanumonites* And Hyssopus officinalis Seeds

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**Abstract**
Medicinal and aromatic herbs and spices have been widely used for different medical and domestic purposes. Most of the medicinal and aromatic plant seeds have dormancy properties. Researchers are trying to change these properties of aromatic plants by using different methods.This study was performed, in the year 2010, to determine the effects of γ -irradiation germination velocity, germination rate and emergence ratios of the Thyme (*Origanumonites*) and Hyssop (*Hyssopus officinalis*) seeds. The seeds used in the research were supplied from plants grown in Cumra Vocational High School. 2.5 kGy, 4 kGy, 5.5 kGy and 7 kGy (except the control group) doses of γ -irradiation were applied on Thyme and Hyssop seeds. As a result of the experiments, germination and emergence ratios decreased inversely by increasing dose of γ -irradiation. For 7 kGy exposure dose, there was no germination observed in both of the seeds. Additionally, starting germination for both of the seeds delayed by increasing dose of γ -irradiation. Emergence rate for both of the seeds delayed by increasing dose of γ -irradiation.

**Keywords:** γ –irradiation, Vigor, Germination velocity, Germination rate, Medicinal and Aromatic plants

## INTRODUCTION

It is currently observed that seed, as the most important income of the agricultural production, has had a technological product feature. The value that seed has both promotes the research and development studies about seed growing and increases the investments in that area. Production, development, proliferation, treatment and commercial marketing of seed are know-how required profession [1].

There is a strongly parallel correlation between the agricultural states of countries and their success in agriculture. In the countries having developed economy and agriculture, seed industry is also developed. Seed corporations, born and grown in the last 100 years, were initially organized as family corporations. In the globalization period, they have changed their structures due to the effects of genetic and biotechnological advancements.

Yield and quality potentials of plants hide inside the seed, in its genetic structure. All the techniques and technologies performed in the agricultural production process are conducted in order to let the genetic and physiological potential in the seed come up. None of the applications such as irrigation, dressing, fight against disease causing factors, greenhouse cultivation, air conditioning, etc. can make contribution to the production improvement beyond the genetic borders of the plant. They can only help them come up.

Agricultural production starts, first of all, with a good seed or seedling. Therefore, quality concept, depicted as the standard of perfection, is crucial for seed. The concepts designating quality in a seed are identity (genetic purity, physical purity, homogeneity, and seed weight), performance (germination, vigor, humidity content, emergence, storability) and hygiene (seed health, fungus, weed, insect, red spider, etc.) [2].

In agricultural production, first step of farming is seeding and germination of the seeds under appropriate conditions. There are three necessities in order for germination to happen. These are, respectively, for embryo to be alive and having the ability to germinate, the must for embryo to be found in suitable environmental circumstances and disappearance of the internal and external factors inhibiting germination.

In addition, starting of germination and its continuance depend on the feature and special need of different plant seeds. On the other hand, germination rate can be affected by the other factors which are not related to viability. For example, some seeds in a seed group can geminate naturally faster than the others. In some conditions, germination rate depends on resting degree of the seed. Environmental conditions affect the rate of germination as well. Both the power of germination and the rate of germination are related to time factor. Germination power indicates the number of seeds germinating in a specific time. On the other hand, germination rate indicates the time needed for germinated seeds to reach a specific percentage. This time is designated as date [3].

Turkey has a rich flora in terms of medicinal plants. *Labiatae* is one of families constituting this flora. The family of *Labiatae* is represented with 220 genus and 3200 species in the world and with 45 genus and 546 species in Turkey. This family widely spreads over Mediterranean region. *Thymus L.* plant grows generally in stony areas and through the cracks of stones. Also, it is known as thyme or stone thyme. Thyme has different genotypes in the flora of Turkey, and it is one of the mostly exported medicinal plants of Turkey. 80% of the exported thyme is *Origanum* genus, i.e. the thyme of Izmir (*O. onites Syn. O smyrnaeum*). It is a medicinal and aromatic plant, of which usage and production areas have been increasing day by day. Also, many of its features come to light every passing day. Izmir thyme is the only cultivated thyme type. Most of the other types are used before collected from nature [4].

The other member of *Lamiaceae* family naturally spreading over Turkey is hyssop. It is found mostly in strongly heated sunny places, calcareous soils and rocky places of Thrace and Anatolia in wild form. It is a bush-like and taproot perennial plant. It can grow up to 100 cm and divaricated into many branches. Approximate kernel thousand weight of a seed, maintaining its ability of germination for 3-4 years, is 1.1g. Purity and germination power of the seedling to be used in production is needed to be high. Average germination time is about 14 days [5].

Gamma ray exposure is an energy income that does not cause radioactivity. Its unit is rad (1 rad = 100 erg $g^{-1}$), or gray (1 gray = 100 rad). 1 rad is for anirradiation to leave 100 erg of energy in one gram of substance [6], [7]. 1Gy is defined as 1 joule of energy given to 1kg of a homogenous substance being under the effect of ionized radiation. The units are described 1 krad = 1 000 rad, 1 mrad = 1 000 000 rad, 1 Gy = 100 rad, 1 kGy = 100 000 rad [8]; [9], [10]; [11].

Gamma rays are the irradiation produced from the sources of Cobalt 60 (60 Co) and Cesium 137 (137 Cs). 60 Co is produced in nuclear reactor by the neutron bombardment of 59 Co. The sources of 60 Co are the most frequently used source in spite of their insufficiency [6], [12], [10]. The irradiation released by radioactive substances, such as alpha, beta and gamma or X, cause the formation of charged ions on the material that they hit. Therefore, these irradiations are called as ionizing irradiation[9]. Ionizing radiation has much more energy than non-ionizing light, microwave and radio waves [13].

It is known that different irradiation methods are used for breeding purposes. In recent years, irradiation has been used to prevent microbial activity in the storage of seeds. The effects of irradiation on vitality in different seeds are not fully known.Therefore, determining the effects of different radiation doses on the viability of seeds is a new study.

In this research, it was aimed to determine the radiation dose that can be applied without damaging the seed viability of some medicinal and aromatic plants. In addition, the rates of Izmir thyme and hyssop seeds vigor were determined.

In this study, the effects of gamma rays, as an ionizing irradiation frequently used in the preservation of foods, on the germination and viability of Izmir thymes and hyssop seeds were studied.

## MATERIALS AND METHODS

### Materials

Hyssop (*Hyssopus officinalis*) and Izmir thyme (*Origanumonites*) samples were supplied from the plants grown in the test field of Cumra Vocational High School. Some part of the supplied seeds was stored for control and the rest was sent for irradiation exposure.

### Methods

2.5; 4.0; 5.5 and 7 kGy doses of gamma rays were applied to four groups (except the control group) by Gamma Pak Corporation, found in Tekirdag – Cerkezkoy Organized Industry Zone.

All the papers used in germination medium were porous, and they were thin-textured so that it can prevent the development of grass roots inside the paper. For germination of the seeds, blotting paper, sponge paper or paper towel were used. Seeds were ordered alternatively as monolayer on a paper, multilayer or in between two paper layers. Germination, emergence power and germination rate of the seeds in optimum conditions were performed according to ISTA rules[14].

## RESULTS AND DISCUSSION

Currently, ionizing γ –irradiation have a widespread usage especially in the preservation of foods. By this technique, for some food products, contamination is prevented and durability is increased. Also, by this technique, quality values of foods are aimed to be prevented using appropriate doses of γ –irradiation. In this study, the effects of γ –irradiation applications on the germination and emergence of Izmir thymes and hyssop seeds were studied. The results concerning various doses of γ -irradiation applications on Izmir thymes (*Origanumonites)* and hyssop (*Hyssopus officinalis*) seeds were given in Table 1 - 2 as the number of days lasting for germination, the day germination stops and germination ratios. First day of the emergence, the

day emergence stops and emerging plant ratio were given in Table 3 - 4.

When Table-1 (the effects of various doses of γ – irradiation applications on hyssop seeds as the number of days lasting for first germination, the day germination stops and germination ratios) is considered, it is understood that germination stops by increasing dose of γ –irradiation application. The number of days for first germination and germination stopped and became stable by increasing γ - irradiation dose. On the other hand, in 2.5 kGy dose, germination ratio increased a bit and then it decreased.

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When Table 2 (the effects of various doses of γ - irradiation applications on Izmir Thymes (*Origanumonites)* seeds as the number of days lasting for first germination, the day germination stops and germination ratios) is considered, it is understood that all doses of γ -irradiation applications inhibit germination.

When Table 3 (the effects of various doses of γ - irradiation applications on sowed hyssop sprouts as the number of days lasting for first emergence, the day emergence stops and emergence ratios) is considered, the number of days for first emergence increased by increasing doses of γ -irradiation exposure. Additionally, the number of days lasting when emergence became stable increased, but the ratio of emergence decreased.

When Table 4 (the effects of various doses of γ - irradiation applications on sowed Izmir Thyme sprouts as the number of days lasting for first emergence, the day emergence stops and emergence ratios) is considered, the number of days lasting for first emergence increased by increasing γ -irradiation doses. Additionally, the number of days lasting when emergence became stable increased, but the ratio of emergence decreased.

Today, there are many radiation and chemical mutagens causing mutation. These mutagens may frequently cause negative results such as prevention of germination, development deficiency, pigment loss, retardation of flowering, delicacy against diseases and cold, cytological abnormalities and imbalance, infertility and yield decrease [15]; [16]; [17]. In a study performed by applying γ -irradiation s on 2 types of cotton seeds, sprouts died in $M_2$ generation during growing period. Sprout mortality percentage changed from 16.1 to 40.0 % when the dose applied to Calland type increased. Maximum sprout dye happened in 400 Gray doses of both the two types [18]. In another study concerning the soy bean seeds applied different γ -irradiation doses, mortality ratio increased by increasing γ - irradiationdose. Maximum survival ratio in 10 krad of application is 31 %; minimum survival ratio in 30 krad of application is 18 %. In the study, survival ratio decreased by increasing dose. That is, it was observed that seeds were damaged further because of the γ -irradiations; therefore, physiological damage in plants increased. Similar results were reported by [19], [20]and [21] as well.

Flavoring features of spices and aromatic plants are due to volatile oils that they contain. They are exposed to microbial contamination during drying under sun, storing and shipping. That is why it is needed that they be sterilized by steam, ethylene oxide and radiation before sale [22]. However, these applications affect seed viability, especially when they are performed for the plants of which seed is used. In radiations for sterilization purpose, it should be tried to estimate the appropriate dose for each of the plants.

**REFERENCES**

[1]. EserB., SaygılıH., GokcolA., IlkerE.Seed Scientific and Technologies.Ege Univ. Seed TechnologiesResearch Center.Bornova-İzmir (2005).
[2]. Amarjit, S., Routledge B. Seed Quality: Basic Mechanisms and Agricultural implications 389 (1995).
[3]. Sehirali, S. Seed Technologies. Trakya Univ. Faculty of Agriculture. Field Crops Department. 3. Press. Istanbul (2002).
[4]. Tulukcu E., Saglam C., Celebi M. Importance of Thymes Species in Konya. 9. Field Crops Congress. Bursa (2011).
[5]. Tulukcu E. Cordukotu. Doga&Saglık. Year: 3Volume: 13. Pp:20-23. Istanbul (2008).
[6]. Lagunas-Solar Mc. Radiation Processing Of Foods: An Overviewof Scientific Principles and Current Status. J. Food Prot. 58, 186-192 (1995).
[7]. Anonymous. Food Irradiation Regulations. Official Newspaper 23868, Ankara (1999).
[8]. Kayaardı S., Gok V. Using of Ionized Radiation on Food Industry. Y.Y.U. Veterinary Faculty Journal. 10, 104-108 (1999).

[9]. Unluturk A., Turantas F., Acar J., Karapınar M., Temiz A., Gonul S. A., Tuncel G.FoodMicrobiology, 2.Press, Mengi Tan Basimevi, Izmir (1999).

[10]. Anonymous. Nuclear Agricultural and Animal Research Center Food Irradiation and Sterilization department. Course of Food Irradiation. Turkey Atom Energy Agency, Ankara (2002).

[11]. Colak A. F. Effect of Irradiation on Black Cumin (*Nigella Sativa* L.) Determination Phsicochemical, Mikrobiyolojik Properties andFattty Acid Composition. Trakya Univ. Institute of Science. Food Engineering. PhD Thesis (2006).

[12]. Monk J. D., Beuchat L. R., Doyle M. P. Irradiation Inactivation of Food Borne Microorganisms. J. Food Prot., 58, 197-208 (1995).

[13]. Radomyski T., Murano E A., Olson D G., Murano Ps. Elimination of Pathogens of Significance in Food by Low-Dose Irradiation, A Review. J. Food Prot. 52, 73-86 (1995).

[14]. Anonymous. ISTA Handbook of Seed Health Testing, Section 2, Working Sheets. International Seed Testing Association. 21-29, Zurich (1999).

[15] Sadykov P. T. Morphogenesis of G.*Hirsitum*L. After Treatment with Chemical Reagents. In VoprosyGenetikiSeleksiiSemenovodstvaMiopch atnika, İyutserny, 2. Taskent Uzbek, SSR. (1974).

[16] Tyaminov A R.Radiation-Induced Mutations forDwarmessin G.*Barbadense* L. And Their Role in Breeding. Se'skokhozyaistvennayaBiologiya. 8 (6) 860-864. InstitutSelektsiiKhlopehatnika, Taskent, Uzbek, SSR. (1978).

[17] Vetchinkana L. N., Zhalilov O, Z. H.,Syryanov Y.U.A, Pavlovskaya N.E. Expression Of Heterosis In Interspecific Cotton Hybrids Obtained Following Irradiation. Uzbekistan BioiogiyaZurnali. No: 6, 49-50 (1985).

[18] Sagel Z., Ilisulu K. Effect of Gamma Radiation on Some Properties Soybean Species M2 Generations. IV. National Nuclear Agriculture and Animal Congress (1996).

[19] Gaul H. Manual on Mutation Breeding, Technical Reports Series No:19. Sec. Edition IAEA, p: 87-98 (1977).

[20] Atila A. S., Peskircioglu H. Effect of Gamma Irradiation on Cukurova 1518 Species. Scientific Research and Examination. No: 22.T.A.E.K. Nuclear Agricultural Research Center. Ankara (1990).

[21] Kaynak M A.; Oglakcı M., Yolcu S. Harran Plain conditions Sayar 314 Cotton Species (G. *hirsutum L.)* Population of Gamma Radiation Determination of Effects of Mutation. III. National Nuclear Agriculture and Animal Congress. Ankara (1994).

[22] Farkas, J. Irradiation of Dry Food Ingredients. Crc. Press, Fl, 1-9, 25-36 (1988).

**APPENDIX**

**Table 1.** The Effects of Different Doses of γ –irradiation Applications on Sprout Germination Properties of *Hyssopus officinalis* Seeds

| | *Hyssopus officinalis* | | |
|---|---|---|---|
| | **The First Germination (Day)** | **The Day Germination Stops** | **Germination Rate (%)** |
| **0 kGy** | 2 | 7 | 52 |
| **2,5 kGy** | 7 | 10 | 65 |
| **4 kGy** | 8 | 27 | 35 |
| **5,5 kGy** | 0 | 0 | 0 |
| **7 kGy** | 0 | 0 | 0 |

**Table 2.**The Effects of Different Doses of γ –irradiation Applications on Sprout Germination Properties of *Origanumonites* Seeds.

| | *Origanumonites* | | |
|---|---|---|---|
| | **The First Germination (Day)** | **The Day Germination Stops** | **Germination Rate (%)** |
| **0 kGy** | 3 | 11 | 56 |
| **2,5 kGy** | 0 | 0 | 0 |
| **4 kGy** | 0 | 0 | 0 |
| **5,5 kGy** | 0 | 0 | 0 |
| **7 kGy** | 0 | 0 | 0 |

**Table 3.** The Effects of Different Doses of γ –irradiation Applications on Sprout Emergence Power of *Hyssopus officinalis* Seeds.

| | *Hyssopus officinalis* | | |
|---|---|---|---|
| | **First day of the emergence (Day)** | **The day emergence stops** | **Emergetion rate (%)** |
| **0 kGy** | 10 | 19 | 26 |
| **2,5 kGy** | 13 | 19 | 14 |
| **4 kGy** | 14 | 22 | 10 |
| **5,5 kGy** | 15 | 26 | 9 |
| **7 kGy** | 0 | 0 | 0 |

**Table 4.**The Effects of Different Doses of γ –irradiation Applications on Sprout Emergence Power of Izmir Thyme Seeds (*Origanumonites*).

| **IZMIR THYME** (*Origanumonites*) | | | |
|---|---|---|---|
| | **First day of the emergence (Day)** | **The day emergence stops** | **Emergetion rate (%)** |
| **0 kGy** | 15 | 26 | 32 |
| **2,5 kGy** | 16 | 26 | 5 |
| **4 kGy** | 18 | 21 | 4 |
| **5,5 kGy** | 20 | 23 | 3 |
| **7 kGy** | 0 | 0 | 0 |