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Effects of Some Priming Applications on Quality Parameters of Melon (*Cucumis melo* L.) Seeds Under KNO_3 Stress

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Abstract

Adverse environmental conditions reduce seed germination and prolong germination period. Pre-applications of the seeds to increase the germination are important. Some of the priming applications increasing germination are the process of keeping the seeds in pure water and sage extract for a certain period of time. This study conducted to determine the effects of priming and KNO_3 applications on some seed quality parameters in melon obtained from melon producers in Çanakkale region. Melon seeds were subjected to control (no priming and KNO_3), different priming (pure water, sage) and salt stress (KNO_3) treatments. As a result of the measurements made on the average germination time, average germination rate, average hypocotyl length, average radicle length and average radicle thickness parameters in the study, it was observed that the quality parameters that showed good improvement with priming applications decreased with KNO_3 stress. Priming of both sage and distilled water significantly increased the mean germination rate under KNO_3 stress. The most positive effect was the sage application, the least effect was the control (no priming) application.

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Bazı Priming Uygulamalarının KNO_3 Stresi Altındaki Kavun (*Cucumis melo* L.) Tohumlarının Kalite Parametrelerine Etkileri

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Öz

Olumsuz çevre koşulları tohumlarda çimlenmeyi azaltmakta ve çimlenme süresinin uzamasına sebep olmaktadır. Bu nedenle tohumlarda çimlenmeyi artırmaya yönelik ön uygulamalar önem teşkil etmektedir. Tohumlarda çimlenmeyi artıran priming uygulamalarından bazıları, tohumların saf su ve adaçayı ekstraktında belirli bir süre bekletilmesi işlemidir. Bu çalışma, Çanakkale bölgesindeki kavun üreticilerinden temin edilen kavun tohumlarında priming ve KNO_3 stres uygulamalarının bazı tohum kalite parametreleri üzerine etkilerini belirlemek amacıyla yapılmıştır. Kavun tohumları kontrol (priming ve KNO_3 uygulanmayan), farklı priming (saf su ve adaçayı) ve tuz stresi (KNO_3) uygulamalarına tabi tutulmuştur. Çalışmada ortalama çimlenme süresi, ortalama çimlenme hızı, ortalama hipokotil uzunluğu, ortalama radikula uzunluğu ve ortalama radikula kalınlığı parametreleri üzerinde yapılan ölçümler sonucunda, priming uygulamaları ile iyi gelişme gösteren kalite parametrelerinin KNO_3 stresi ile azaldığı gözlemlenmiştir. Özellikle hem adaçayı hem de saf su priming uygulamaları, KNO_3 stresi altında ortalama çimlenme oranını önemli ölçüde artırmıştır. En olumlu etki adaçayı uygulaması, en az etkiyi ise kontrol (priming yapılmayan) uygulaması göstermiştir.

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Introduction

The rapid increase in the world population and the shrinking of agricultural areas day by day for various reasons bring with it inadequate and poor quality nutrition, which is one of the biggest problems of today. This situation; increases the importance of obtaining abundant and high quality products. Thus, new varieties with high yield and quality it reveals the necessity of increasing the yield from the unit area, protecting and using the natural agricultural areas efficiently, avoiding methods that will endanger human and environmental health, as well as the development of agricultural products (Parera et al., 1994).

Some vegetable seeds, which are difficult to germinate and take a long time, germinate late and irregularly or not germinate at all due to environmental stress factors and negative reasons arising from seed quality in the environment in which they are planted. In such adverse conditions, the germination rate of the seeds sown is low, and the plant development and the yield from that plant decrease. In particular, seeds with small embryos and heterogeneous germination, such as melon, tomato, pepper and eggplant, which are produced by direct sowing, are adversely affected by technical and ecological conditions during the germination and seedling emergence stages. Weeds, diseases and pests caused by late and irregular germination slow down plant growth and cause great losses in yield and quality, thus limiting production significantly. For this reason, even in irregular and adverse conditions, the seeds; it is very important to ensure that it can germinate quickly and homogeneously. This situation increases the importance of studies to increase seed viability and vigor before planting (Ashraf & Foolad, 2005). With various physical, chemical and technological applications in the cultivation of cultivated vegetables, fast and homogeneous emergence can be obtained in some vegetable seeds that are difficult and irregular to germinate. One of the most important technological applications to increase seed viability and strength before planting is keeping seeds in osmotic solutions. The basis of this technique, called priming; It is based on the fact that the seeds can be kept for a long time without germination by taking them to high humidity scopes in the osmotic potential adjusted liquids. Physiological improvement of seeds is provided by priming technique (Özkaynak et al., 2020).

In order to increase the yield taken from the unit area in plant production and to obtain a quality cultivation, the seed, which is the starting material, must also be of high quality. In the cultivation of cultivated vegetables, the health of the seed, its short time germination and good performance are related to the quality of the seed. Seed sowing and germination, which is the first stage of cultivated vegetables, is the most sensitive period in terms of early seedling development and cultivation in many plant species (Pandita et al., 2007).

Achieving the desired plant density and high yield in a successful agricultural production depends, first of all, on the rapid, homogeneous and complete germination of the planted seed. In order to eliminate all the negativities that may occur during germination and emergence, to obtain sufficient number of seedlings and yield, the seeds are subjected to various applications called priming (pre-germination) before planting (Ellis & Roberts, 1980). Priming is defined as the controlled water intake at a level that will initiate the metabolic activity required for germination in the seed, but will not allow root emergence. Priming applications activate the enzymes that break down the storage materials in the seed and ensure optimum use of the storage materials (Demir et al., 1994; Elkoca, 2007).

Priming, by absorbing water before planting, has effect on germination, emergence and growth and yield of the plant in the later stages. Depending on the amount of water in the atmosphere, the seeds take the water either by absorption from the humid environment or by direct wetting. The physiological basis of priming is based on the treatment of the seeds with an osmotic solution or directly with water, allowing the biochemical activation to start by providing a balance in the osmotic potential of the seed, but stopping the application at the border of the rootstock exiting the bark (Heydecker & Gibbins, 1978).

The applied seeds should be washed and dried after completing the first stage of germination. After the seeds have been dried to their original moisture content, they can be stored or sown using conventional techniques. Depending on the priming technique, species and even variety, even if they are planted after a certain period of storage, they can show faster and more uniform growth than unprimed ones (Kaya et al., 2010).

The aims of priming; to eliminate the problems encountered in the period between seed sowing and seedling emergence, to shorten the time between sowing and emergence, to ensure seedling emergence uniformly. In addition, it is to increase resistance to various stress conditions such as low and high temperatures, salinity and drought, to slow down the aging process during storage and to extend the storage period (Basu, 1994; Heydecker & Gibbins, 1978; Mc Donald, 1999). Pandita et al. (2007), found that the germination rate of the pepper seeds of Chilli cv. Pusa Jwala cultivar increased as a result of priming with 30 mM KNO_3 solution for 24 hours. In a different study conducted to examine the effects of priming applications with different priming agents of Hot Queen pepper seeds on seed strength, it was determined that the applications made with KNO_3 were superior to all other applications (Amjad et al., 2007). In the study, it was determined that the applications made with KNO_3 were superior to all other applications. KNO_3; It shortened germination time by 50%, increased radicle and stem length, and was more effective on seedling weight and strength compared to other agents. In the present study, it was aimed to determine the effects of different priming applications on seed quality characteristics of melon seeds affected by different levels of KNO_3 stress.

Material and Method

In this research, melon (*Cucumis melo* L.) seeds (İpsala variety) obtained from the producers producing melons in the Çanakkale region were used. The seeds harvested 50 days after full flowering were washed with distilled water for 2 minutes for the purpose of seed surface and then sterilized by immersing them in 3% sodium hypochlorite solution for 10 seconds. The seeds were subjected to priming [pure water, sage (*Salvia officinalis* L.)] and KNO_3 (0, 150, 200 mM) applications in the trial, which consisted of 3 replications, with 30 seeds from each replication established according to the randomized block design. The seeds in the control group were germinated under the same conditions without priming and KNO_3 applications. Priming was applied to melon seeds for 24 hours using sage extraction. 10 g of dried sage was weighed and placed in 500 ml of water. 500 ml of the mixture was boiled and cooled (25°C±2). 25 ml of the cooled solution was taken and the mixture was prepared by adding 175 ml of water (Özkaynak et al. 2015). Before the priming application, the seeds were weighed, and after the priming application, the seeds were dried in the shade and ventilated environment until they reached the weight before the priming application (Khan, 1992). After the drying process, the seeds arranged between 40x40 cm filter papers were watered with 0 mM, 150 mM and 200 mM KNO_3-containing distilled water in equal amounts on the first day and on the 7th day, and germinated in plastic bags at 25°C in the dark for 14 days (Heydecker and Gibbins, 1978).

Research Topics Examined in the Study

Control (no priming and KNO_3) seeds+pure water treatment, Control (without priming and KNO_3)+150 mM KNO_3 treatment, Control (without priming and KNO_3)+200 mM KNO_3 treatment, Sage priming+pure water treatment, Sage priming+150 mM KNO_3 treatment, Sage priming+200 mM KNO_3 treatment, Pure water priming+pure water treatment, Pure water priming+150 mM KNO_3 treatment, Pure water priming+200 mM KNO_3 treatment.

Seed Quality Tests

Germination ratio (%): The seeds were counted at the same time every day, and the seeds whose radicle reached 2 mm in length were determined as germinated (Ellis & Roberts, 1980).

Average germination time (day): Average germination time was determined using the formula given in Equation 1 (Ellis & Roberts, 1980).

$$\sum(n*D)/(\sum n) \quad (1)$$

n: Number of seeds germinated in n days

D: Number of days from the start of germination

∑n: Total number of germinated seeds

Hypocotyl length (mm): It was determined by measuring the length from the radicle collar to the hypocotyl leaves (Ellis & Roberts, 1980).

Radicle length (mm): It was determined by measuring the length from radicle collar to radicle tip. The data obtained in the research S.A.S. 9.1.3. It was subjected to variance analysis with a portable computer package program, and the LSD ($p<0.05$) test was used to compare the differences among the means.

Radicle thickness (mm): It was measured with the help of a caliper at the junction of the radicle collar and hypocotyl (Ellis & Roberts, 1980).

Results and Discussion

After a good melon variety is developed, the seed used in the production of that variety must also have a superior germination power and a good seedling growth capacity. Because vegetative production starts with seed and a good seedling to be developed from seed means a good plant and good production. It may be necessary to make different applications for good seed capacity. At this stage, the first step is to obtain seeds of high genetic potential, sufficient maturity and superior quality, and the application of priming (pre-germination) to increase the germination level and quality is the second step. This study was carried out to determine the effects of priming and KNO_3 stress applications on some seed quality parameters in melon seeds obtained from melon producers in Çanakkale region.

Average Germination Time (day) & Average Germination Rate (%)

Germination rates in the study are as in Table 2. In the study, it was observed that the melon seeds germinated better than the control in the priming applications. There was an overall increase in mean germination times as salt stress increased. This is an indication that the presence of KNO_3 has a negative effect on the germination time of melon seeds in general. With the priming applications, the germination time of the seeds under salt stress is reduced. The highest average germination rate was 96.03% (sage priming+control-0 mM KNO_3) and the lowest average germination rate was 39.41% (control-unprimed seeds+200 mM KNO_3).

In Table 2, it is seen that the highest germination rate of sage application and the lowest germination rate in control were obtained at different KNO_3 stress levels. As shown in Table 1, the highest mean germination time was 7.58 days (sage priming+200 mM KNO_3) and the lowest mean germination time was 4.32 days (pure water priming+control-0 mM KNO_3). When Table 1 and Table 2 are examined, it has been determined that there are statistical differences between the priming applications determined in the study on the basis of average germination time and average germination rate. In a similar study conducted by Özkaynak et al. (2020), they determined that the priming applications increased the average seed germination rate. According to Kaya et al. (2010), it was stated that the priming application of pepper had a positive effect on the germination rate and duration at stress temperatures.

Table 1. Average Germination Time (day)

	Control (0 mM KNO_3)	150 mM KNO_3	200 mM KNO_3
Control (Unprimed seeds)	4.39 ^{d}	6.60 ^{ab}	5.27 ^{cd}
Sage priming	4.43 ^{d}	5.08 ^{cd}	7.58 ^{a}
Pure water priming	4.32 ^{d}	5.71 ^{bc}	5.31 ^{cd}

* $p<0.05$; LSD: 1.0172

Table 2. Average Germination Rate (%)

	Control (0 mM KNO_3)	150 mM KNO_3	200 mM KNO_3
Control (Unprimed seeds)	87.00 ^{b}	49.90 ^{e}	39.41 ^{f}
Sage priming	93.91 ^{a}	82.50 ^{b}	87.00 ^{b}
Pure water priming	96.03 ^{a}	76.55 ^{c}	70.55 ^{d}

* $p<0.05$; LSD: 5.4762

Average Hypocotyl Length (mm)

Hypocotyl length was measured in seedlings grown on filter paper on the 14th day of germination. Average hypocotyl length values are as shown in Table 3. In all three applications [Control (no priming), pure water and sage priming], there was a decrease in radicular lengths as salt stress increased. The highest mean radicular length was 126.70 mm (sage priming+control-0 mM KNO_3), and the lowest mean radicular length was 15.69 mm (pure water priming+200 mM KNO_3).

When the table 3 is examined, an improvement is observed in hypocotyl lengths in the presence of KNO_3 stress in sage and pure water priming applications. Table 3 shows that that there are statistical differences in terms of average hypocotyl lengths between the priming applications determined in the study. In a study conducted by Armin et al. (2010), they declared that the priming application of watermelon using potassium nitrate had a positive effect on the length of the hypocotyl.

Table 3. Average Hypocotyl Length (mm)

	Control (0 mM KNO_3)	150 mM KNO_3	200 mM KNO_3
Control (Unprimed seeds)	107.56 ^{c}	34.02 ^{f}	23.05 ^{g}
Sage priming	126.70 ^{a}	48.86 ^{d}	17.03 ^{h}
Pure water priming	120.10 ^{b}	42.61 ^{e}	15.62 ^{h}

* $p<0.05$; LSD: 2.8461

Average Radicle Length (mm)

As shown in Table 4, an overall reduction in radicle length was determined as the salt stress level increased. The highest average radicle length was 93.70 mm (control-unprimed seeds+control-0 mM KNO_3), and the lowest average radicle length was 15.69 mm (pure water priming+200 mM KNO_3). When radicle length values in melon were examined, it was determined that there were statistically significant differences. In a similar study conducted by Sarıyer & Kuzucu (2019), they stated that there was a significant decrease in radicle lengths as the stress level increased in priming applications applied to watermelon seeds under NaCl stress.

Table 4. Average Radicle Length (mm)

	Control (0 mM KNO_3)	150 mM KNO_3	200 mM KNO_3
Control (Unprimed seeds)	93.700 ^{a}	27.460 ^{e}	21.237 ^{f}
Sage priming	86.117 ^{b}	59.957 ^{c}	18.043 ^{fg}
Pure water priming	89.657 ^{ab}	39.527 ^{d}	15.693 ^{g}

* $p<0.05$; LSD: 5.3557

Average Radicle Thickness (mm)

As shown in Table 5, an overall increase in radicle thickness was detected as KNO_3 stress levels increased. The highest average radicle thickness was determined as 2.61 mm (sage priming+200 mM KNO_3), and the lowest average radicle thickness was determined as 1.96 mm (control-unprimed seeds+control-0 mM KNO_3). It has been determined that there is a statistically small difference in terms of average radicle thickness between the priming applications applied in the study.

Table 5. Average Radicle Thickness (mm)

	Control (0 mM KNO_3)	150 mM KNO_3	200 mM KNO_3
Control (Unprimed seeds)	1.960 ^{d}	2.223 ^{c}	2.336 ^{bc}
Sage priming	2.330 ^{bc}	2.463 ^{ab}	2.610 ^{a}
Pure water priming	1.970 ^{d}	2.440 ^{b}	2.483 ^{ab}

* $p<0.05$; LSD: 0.1633

Conclusions

In priming applications, pure water and sage can be used successfully in other priming applications. The important advantages are that the herbal materials used are natural, easily available, and the cost is very low compared to priming chemicals. Priming products are also very important in terms of having a positive effect on the seed germination rate, providing homogeneous standard seedling development, and not having any known negative effects on the seed and seedling. It has been concluded that it can be used effectively in different species such as melon and watermelon, and at the same time, it is a priming material that can be used effectively in the production of commercial vegetable seedlings in practice. In future studies, we suggest trying different combinations of these priming applications to further illuminate the subject.

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