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Research Article

# Different Priming Treatments Effects on The Germination of Peanut under Salinity Conditions

Feride ÖNCAN SÜMER[1*], Hatice Kübra GÖREN[1], Öner CANAVAR[1]
[1]Aydın Adnan Menderes University, Faculty of Agriculture, Department of Field Crops, Aydin
*Corresponding author: fsumer@adu.edu.tr

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**Abstract**
Peanuts, which are in the legume family, have various uses. The aim of this study is to determine the effects of different priming methods on the germination characteristics of peanut seeds under salinity and non-salinity conditions. The study was conducted under laboratory conditions at Adnan Menderes University, Faculty of Agriculture, Department of Field Crops. In the study, the effects of four different treatments on the germination characteristics of peanut seeds under salinity and non-salinity conditions were investigated. According to the results of the study, it was observed that the values of the examined characteristics decreased in the seeds exposed to salinity. It has been determined that the applications are positively effective in salinity conditions. The highest values for the highest germination percentage, length of roots, and length of hypocotyl properties were obtained from the application of graphene oxide NPs under non-salinity conditions.
**Keywords:** Peanut, priming, salinity, germination

## 1. Introduction

Peanuts are grown as an important source of oil and protein. It is also an important source of income for producers in the countries where it grows. This plant, which belongs to the legume family, is grown in many countries between 40° North and 40° South latitudes (Liao and Holbrook 2007). The African continent is the second largest peanut production region after the Asian continent. In this region, Nigeria is 2.4 miles and 1.6 miles from Sudan. They are important producers in the region. The African continent is followed by the American continent in terms of production amount. They are the important peanut producing countries of the region with production values (FAO, 2019). Peanut seeds contain 48-50% oil and 26-28% protein. In addition, they are also rich in minerals, vitamins and fibre. Its seeds can be consumed raw, roasted or boiled; Peanut butter can be used as a topping or in the preparation of many types of confectionery. After the oil is extracted, the remaining pulp is used in the feed industry. Their shells can be used as fuel, as a filler in the feed industry, and as an additive in box making. Since it is a plant from the legume family, it fixes nitrogen into the soil with its roots. It is a source of both income and food for small farm businesses (Nigam and Aruna 2008). It has been stated that peanuts have positive effects on human health and can also be used in child nutrition thanks to their high nutritional values (Briend, 2001). Therefore, this plant can be a strategic plant in the fight against hunger in underdeveloped and developing countries. Genetic advances play a critical role in cultivar development in peanut. Nanoparticles are developing day by day and are taking their place in the world as an indispensable part of our lives. With nanotechnological studies operating in all areas of life, interest in nanostructures has begun to increase day by day, and new products and materials have been developed by placing these structures into large material components and systems (Dave and Chopda, 2014). Nanoparticles are particles smaller than 100 nm in size and have high surface energy (Gur et al., 2022). Kaya et al. (2010) stated that hydro-priming applications reduced the effects of heat stress and improved enzyme activity in pepper (*Capsicum annuum* L.). Ghiyasi et al. (2014), in their study where they examined the effect of hydro-priming applications on black cumin plants with germination problems; The seeds were first kept in an environment with 100% relative humidity for 96 hours and then primed in pure water for 6 hours. As a result of the study, it was stated that hydro-priming application showed positive results in average germination time, germination index, final germination rate, seedling length, seedling dry weight and seedling vigor index compared to control seeds. Patel et al. (2017) stated that hydropriming applications contributed to the development of the characters of the germination process compared to seeds without priming. Damalas et al. (2019) stated that hydropriming applications improved the germination characteristics of summer grown broad beans (*Vicia faba*), but the effect showed significant variability depending on environmental conditions. The purposes of Priming are; to eliminate the problems encountered in the period between seed sowing and seedling emergence, to shorten the time between sowing and emergence, and to ensure homogeneous seedling emergence. In this study, it was aimed to examine the germination characteristics of peanut seeds by priming under salinity conditions.

## 2. Materials and Methods

The study was carried out in the randomized complete plot design with three replications. In the study, soybean seeds were carried out under 23±1 $^{0}$C temperature and 50% air humidity conditions before germination. Peanut genotype (NC 7) was used as a plant material. The seeds were obtained from Ece Tarim/Aydin. The initial seed moisture contents were 8.0 % (on dry weight basis). Four priming were made under two different conditions: salinity (3.0 dS $m^{-1}$ NaCl) and non-salinity. These are four applications: for the treatments of control, iron oxide, graphene oxide, and potassium humate. Control peanut seeds were soaked in distilled water ($dH_2O$) (Basra et al., 2004). A solution containing iron oxide (Fe2O3NPs) and graphene oxide (GONPs) were seperately prepared with 10 mg of the application material in 100 mL of water. K humate: A solution of 0.3 g per 1 liter was prepared. For each application, 100 grams of seeds were weighed in three replicates. The amount of solution was 1.5 times fold the amount of the seeds in the box. The seeds were covered in the solution(250 ml for each solution) for 8 hours, submerged at a level that covered the seeds, and then the seeds were dried. Seeds were placed in 15*12 cm plastic box with blotting paper inside. After begining of the germination 24 hours, 9 ml of the solution was added for each replicate. The germination rate, hypocotyl length, root length, root fresh weight, root dry weight, hypocotyl fresh weight, and hypocotyl dry weight values were measured for the treatments of control, iron oxide, graphene oxide, and potassium humate under two salinity conditions. Germination percentage (GP) was estimated at (9th day) according to the formula GP = (seeds germinated / total seeds) x 100. Fresh weight of the hypocotyl (FHW) was determined by weighing the wet weight of the hypocotyl on a precision scale at the end of the 9th day. Dry cotyledon weight (DCW), after determining the fresh cotyledon weight, was dried at 105°C for 24 hours and weighed on a precision scale to determine the root dry weight. In each plastic box, the length of roots (RL), in 20 germinated seed was measured at the end of the 9th day. Subsequently, the length of roots (RL) for each variety was measured with a ruler and then the average was taken. Relative water content $(RWC)$= (Fresh Weight−Dry Weight) (Turgid Weight−Dry Weight)]×10 JMP statistical package program was used for variance analysis of the data of the features examined in the experiment and the differences between the averages were determined with the LSD (5% and 1%) test.

**Table 1**. Analysis of variance for the effect of different priming treatments (control, $Fe_2O_3$NPs, graphene oxit, potassium humate) on some morphological and germination parameters of peanut seeds under two conditions (non-salinity and salinity)

| **Source of Variance** | **Calculated F Value** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **df** | **GP** | **RL** | **HL** | **FHW** | **DHW** | **RWC** |
| **Conditions (C)** | 1 | 2.1448 | 12.358*** | 9.785*** | 30.56*** | 6.26* | 20.502*** |
| **Treatments (T)** | 3 | 1.517 | 4.524*** | 3.426* | 0.87 | 0.373 | 4.421* |
| **CxT** | 3 | 4.557** | 1.82 | 1.961 | 1.785 | 1.866 | 8.133** |
| **Error** | 14 | 2.67 | 4.90 | 3.02 | 4.53 | 1.59 | 6.488 |
| $LSD_{0,05\ (C)}$ | | ns | 2.18 | 4.32 | 2.5252 | 1.53 | 10.59 |
| $LSD_{0,05\ (T)}$ | | ns | 3.087 | 6.12 | ns | ns | 14.98 |
| $LSD_{0,05\ (CxT)}$ | | 14.72 | ns | 9.785*** | ns | ns | 21.1 |

GP: Germination percentage, FHW: Fresh weight of hypocotyl, DHW: Dry weight of hypocotyl, FRW: Fresh weight of roots, DRW: Dry weight of roots, RL: Length of roots, RWC: Relative water content, HL:length of hypocotyl. Treatments; Graphene oxide, Disteled water, K-humate, Iron oxide. (The mean square of error was given) ***, **, * = significant at $P \leq 0.001$, $P \leq 0.01$ and 0.05, respectively; ns = nonsignificant.

**Table 2**. The effects of different priming treatments (control, $Fe_2O_3$NPs, graphene oxit, potassium humate) on some morphological and germination parameters of peanut seeds under two conditions (non-salinity and salinity)

| Priming Treatments | Control (non-salinity) | | | | | | NaCl (salinity 3 dS $m^{-1}$) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GP (%) | RL (mm) | HL (mm) | FHW (g) | DHW (g) | RWC (%) | GP (%) | RL (mm) | HL (mm) | FHW (g) | DHW (g) | RWC (%) |
| Control | 75.833 | 9.555 | 14.333 | 9.043 | 11.367 | 33.971 | 22.083 | 8.683 | 7.024 | 8.553 | 6.633 | 35.096 |
| Graphene oxide NPs | 82.917 | 17.268 | 26.735 | 16.343 | 12.947 | 38.939 | 70.000 | 10.138 | 15.207 | 13.660 | 12.033 | 38.854 |
| K-humate | 78.917 | 11.574 | 24.361 | 16.713 | 13.497 | 31.557 | 81.250 | 12.116 | 13.674 | 14.487 | 12.220 | 36.117 |
| Iron oxide NPs | 55.833 | 9.555 | 22.333 | 14.043 | 11.367 | 33.971 | 72.500 | 12.541 | 12.812 | 13.267 | 11.627 | 43.841 |

Conditions (C), Priming Treatments (T)

## 3. Results and Discussions

The results of variance analysis are presented in Table 1, according to these results, the interaction of environment and priming was found significant in Germination percentage and Relative water content traits. The effect of conditions on Fresh weight of hypocotyl, Dry weight of hypocotyl, Fresh weight of roots, Dry weight of roots, Length of roots, Relative water content and length of hypocotyl were statistically significant. The effect of treatment factor on germination percentage and relative content weight was found statistically significant. Germination percentage values were observed to vary between 22.08-82.91 % (Table 2). The lowest value was obtained from Graphene oxide NPs treatment under salinity conditions, while the highest value (82.91 %) was obtained from graphene oxide NPs treatment under non-salinity conditions. In salinity conditions, the lowest germination percentage was obtained in the control, i.e. seeds kept in pure water. It was observed that salinity caused stress in seeds and significantly affected germination. However, priming treatments significantly and positively affected the germination rate under salinity conditions. In previous studies, priming treatments increased the germination rate (Bailly et al., 1998; Hsu et al., 2003; Afzal et al., 2008). However, the fact that the seed used in the study was perennial caused the germination percentage averages to be low. Length of roots (mm) values varied between 8.68-17.26 mm (Table 2). The lowest value was obtained from the control treatment under salinity conditions, while the highest value was obtained from Graphene oxide NPs treatment. In similar studies, it was determined that priming application increased root length (Jeammuangpuk et al., 2020). Length of hypocotyl values were found to vary between 7.67-26.73 mm. Fresh weight of hypocotyl values varied between 3.26-11.34 g. The lowest value was obtained from K-humate treatment under saline conditions, while the highest value was obtained from Graphene oxide NPs treatment under non-saline conditions. It was observed that priming treatments under saline conditions gave positive results and increased traits such as fresh weight of hypocotyl. The data obtained from dry weight of hypocotyl were found to vary between 1.62-4.94 g (Table 2). The lowest value was obtained from iron oxide NPs while the highest value was obtained from graphene oxide NPs. It is observed that the pretreatment results are higher in salt-free conditions. Relative water content values were determined to vary between 36.11-38.93 %. The lowest value for this property was obtained from K-humate application, while the highest value was obtained from graphene oxide NPs. Similar to previous studies, priming treatments increased salt tolerance (Sahin et al. 2011; Bakht et al. 2011). Under salinity conditions, priming treatments resulted in good seed germination in some plants (Cayuela et al. 1996; Iqbal and Ashraf 2007). The positive effect of iron oxide NPs was observed in drought-related trials (Tran et al., 2022; Daler 2023; Özdemir 2023).

## 4. Conclusion

In this study, the aim was to enhance germination characteristics by utilizing priming applications to address the escalating salinity problem. The averages of the examined traits decreased under saline conditions. On the other hand, applications of iron oxide nanoparticles, potassium humate, and graphene oxide NPs applications gave positive results under saline conditions. These results will be useful for future studies. It is predicted that seed priming applications will contribute positively to good emergence and uniform plant production.

## Declaration of Author Contributions

The authors declare that they have contributed equally to the article. All authors declare that they have seen/read and approved the final version of the article ready for publication.

## Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

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