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Effects of Doses and Different Applications of Salicylic Acid on Salinity Stress and Plant Growth in Broad Beans (*Vicia faba* L.)

Salisilik Asitin Farklı Uygulama Şekli ve Dozlarının Bakla (*Vicia faba* L.)'da Tuzluluk Stresi ve Bitki Gelişimi Üzerine Etkisi

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Abstract: This study was carried out to determine the effects of different application methods and doses of salicylic acid on the first developmental stages of broad beans grown under salt stress. The experiment was carried out in the plant growth cabinet at Siirt University, Faculty of Agriculture, Department of Field Crops laboratory. During the investigation, the temperature of the working environment was kept at 25±3 °C. Plants were grown in 16 hours of light and 8 hours in the dark period. Three salt concentrations (0, 75 and 150 mM NaCl) and three salicylic acid (SA) concentrations (0, 0.5 and 1.0 mM SA) were applied to the plants through soil and leaves. As a pre-application, 0.5 mM SA and hydropriming were used. According to the results, germination percentage, germination index, mean germination time, stem height, root lenght, stem fresh weight, stem dry weight, root fresh weight, root dry weight and total chlorophyll content varied between 63.33-86.67%, 0.97-2.51, 3.60-6.28 day, 36.11-39.47 cm, 27.50-30.57 cm, 4.404-6.623 g, 0.473-0.555 g, 2.813-3.400 g, 2.813-3.400 g, 0.300-0.396 g and 41.0-50.6%, respectively. While salinity levels did not have a significant impact on germination characteristics, hydropriming application improved germination characteristics, but salicylic acid application had a negative effect. However, it has been observed that salicylic acid applications increase seedling development and dry matter accumulation and promote plant growth under salinity stress. As a result, it has been observed that the application of 0.5 mM salicylic acid is a useful application to improve salinity stress and promote plant growth in broad bean.

Keywords: Growth promoter, Dry matter, Broad bean, Stress management, Salinity, Grain legumes

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Öz: Bu çalışma, salisilik asidin farklı uygulama şekli ve dozlarının tuz stresi altında yetiştirilen baklanın ilk gelişim dönemlerindeki etkilerinin belirlenmesi amacıyla yapılmıştır. Deneme Siirt Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü laboratuvarında bitki yetiştirme kabininde yürütülmüştür. Deneme süresince çalışma yapılan ortamın sıcaklığı 25±3 °C'de tutulmuştur. Bitkiler 16 saat boyunca aydınlık, 8 saat boyunca karanlık periyotta yetiştirilmiştir. Bitkilere 3 farklı tuz konsantrasyonu (0, 75 ve 150 mM NaCl) ve 3 farklı salisilik asit (SA) konsantrasyonu (0, 0.5 ve 1.0 mM SA) topraktan ve yapraktan olacak şekillerde uygulanmıştır. Ön uygulama olarak ise 0.5 mM SA ve hidropriming yapılmıştır. Çalışma sonuçlarına göre, çimlenme oranı, çimlenme indeksi, ortalama çimlenme süresi, gövde uzunluğu, kök uzunluğu, gövde yaş ağırlığı, gövde kuru ağırlığı, kök yaş ağırlığı, kök kuru ağırlığı ve toplam klorofil içeriği sırasıyla %63.33-86.67, 0.97-2.51, 3.60-6.28 gün, 36.11-39.47 cm, 27.50-30.57 cm, 4.404-6.623 g, 0.473-0.555 g, 2.813-3.400 g, 2.813-3.400 g, 0.300-0.396 g ve %41.0-50.6 aralığında değişim göstermiştir. Çimlenme özellikleri açısından tuzluluk seviyelerinin önemli bir etkisinin olmadığı gözlemlenirken hidropriming uygulamasının çimlenme özelliklerini iyileştirdiği, ancak salisilik asit uygulamasının olumsuz etki gösterdiği tespit edilmiştir. Fakat salisilik asit uygulamalarının fide gelişimini ve kuru madde birikimini artırdığı, tuzluluk stresi altında bitki gelişimini teşvik ettiği gözlemlenmiştir. Sonuç olarak, bakla bitkisinde tuzluluk stresinin iyileştirilmesi ve bitki gelişiminin teşvik edilmesi için yapraktan 0.5 mM salisilik asit uygulamasının faydalı bir uygulama olduğu gözlemlenmiştir.

Anahtar Kelimeler: Gelişim düzenleyici, Kuru madde, Bakla, Stres yönetimi, Tuzluluk, Yemeklik baklagil

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INTRODUCTION

During their vegetation period, plants may encounter some adverse conditions in their growing environment that will affect their growth and development. These situations they encounter can limit the development of plants and cause stress (Karaağaç et al., 2014). These stress factors that plants are exposed to are divided into two: biotic and abiotic factors. While biotic factors are bacteria, viruses, fungi and insects, abiotic factors are conditions such as salinity, drought, excess water, hot and cold. Some of the inorganic fertilizers used unconsciously and in excessive amounts, especially in agricultural production, leach from the soil and mix with the ground water, while some of them cause salinity in the soil (Baran et al., 2014). Plants growing in soils that become saline over time react in various ways during the vegetation periods. In plants grown under these conditions, developmental regression and even complete death of the plants are observed.

Salinity stress is one of the most important abiotic stress factors that reduces the productivity of agricultural products worldwide and is experienced by a large part of the world (Yılmaz and Çiftçi, 2021; Yilmaz et al., 2023). Approximately 20% of cultivated areas and half of irrigated areas in the world are affected by salinity (Flowers and Yeo, 1995; Yıldız et al., 2014). Salinity stress can cause metabolic problems and poor nitrogen uptake in plants (Yilmaz, 2023). The plant variety to be cultivated is important in terms of obtaining an economic level of product in areas where salinity cannot be reduced below certain levels (Ekmekçi et al., 2005). For this reason, it is of great importance to take various measures against salinity stress in agriculture. The most common studies related to this include breeding varieties resistant to salinity stress, soil improvement, and various practices that can increase the tolerance of plants against salinity. Accordingly, the responses of plants to salt have started to be investigated with studies. Broad bean (*Vicia faba* L.) is an edible legume plant that is moderately resistant to salinity. In Turkey, it ranks 4th among the most cultivated edible legumes after chickpeas, lentils and dry beans. According to 2022 TURKSTAT data, 4,234 tons of production was made in 17,638 da area in Turkey and its yield is 240 kg da^{-1} (Anonymous, 2022). It contributes to nitrogen fixation by maintaining a symbiotic relationship with Rhizobium bacteria. With this feature, it is an extremely important plant in improving the structure of soils.

With its deep roots, it carries the nutrients in the lower layers of the soil to the upper layers of the soil, leaving a more fertile and quality soil for the plant to be grown after it. In addition, since it can be easily broken down in the soil, the harvest residues of the broad bean plant are also very useful in terms of enriching the soil with organic matter. However, salinized soils as a result of excessive and intensive use of chemical fertilizers in agricultural production show a limiting effect on plant growth in faba bean (*Vicia faba* L.) cultivation. In this respect, studies against salinity stress are of great importance. Today, breeding studies for varieties resistant to all stress factors that limit plant growth are continuing. However, it is possible to reduce the harmful effects of salinity with cultural practices. New approaches are emerging in this regard every day. Some of these are various hormone applications, different growing media, microbial fertilizers and organic fertilizers. Various measures can be taken against salinity with different applications depending on the level and type of salinity. Salicylic acid application is one of these measures.

Salicylic acid, an intrinsic plant growth regulator that affects plant growth and development, is a natural phenol product first extracted from willow (*Salix* sp.) bark (Çoban, 2007). Salicylic acid, whose commercial production form is acetyl salicylic acid, is a growth regulator synthesized by higher plants and some microorganisms (Raskin et al., 1990). It has been found to control ion uptake from roots by promoting flowering in many plant species (Raskin, 1992). According to the results of the first study on salicylic acid, it was found to promote flowering and shoot formation in tobacco (Eberhard et al., 1989). Salicylic acid was reported to promote flowering at low concentrations, accelerate vegetative growth and increase nodule formation in legume plants (Ramanujam et al., 1998).

It was reported that foliar application of salicylic acid had positive effects on root length, root and stem wet and dry weights and nitrogen metabolism in bean (Türkyılmaz et al., 2005). It was reported that salicylic acid application increased cell division in root meristem tips and promoted plant growth during the first growth period of wheat (Shakirova et al., 2003). Foliar application of salicylic acid in soybean and maize increased leaf area and plant dry weight, but did not affect plant height and root length (Khan et al., 2003).

In mung bean, foliar salicylic acid application increased pod number and grain yield (Singh and Kaur, 1980).

Salicylic acid has also been reported to increase the tolerance of plants under abiotic stress conditions such as salinity, high and low temperature, water, heavy metal, frost and drought stress (Yağmur and Kaydan, 2006). Salicylic acid is a signaling molecule that has an important role in plant defense mechanism against pathogens (Snyman and Cronjé, 2008). It was reported that salicylic acid application to wheat plants grown under salt stress conditions increased the activities of antioxidant enzymes and was effective in increasing the tolerance of these plants to salt stress (Mutlu et al., 2009). Salicylic acid application was found to increase photosynthesis rate, stomatal conductance, transpiration rate and chlorophyll-b content in corn under salt stress (Tufail et al., 2013).

It has also been reported that salicylic acid has important roles in the regulation of plant responses to many stresses such as salinity, drought, temperature and heavy metals (Hayat et al., 2010). Salicylic acid application in broad bean (*Vicia faba* L.) plant is the subject of this study. Various studies conducted by researchers on this subject are ongoing. In this study, it is aimed to determine the effects of salicylic acid applied in different application methods and doses on the first developmental stages of broad bean (*Vicia faba* L.) plants grown at different salt levels. With this study, it is aimed to determine the most appropriate salicylic acid application method and dose in the first developmental stages of faba bean and to reduce the level of faba bean affected by salt.

MATERIAL AND METHOD

The study was carried out in the laboratory of Siirt University, Faculty of Agriculture, Department of Field Crops in a plant growth cabinet. The temperature of the environment was kept between 25±3 °C during the experiment. During the experiment, plants were grown in the light for 16 hours and in the dark for 8 hours. Kıtık-2003 variety broad bean seed registered by Aegean Agricultural Research Institute was used as seed material in the study. Kıtık-2003 faba bean variety is an upright growing, 68-91 cm tall, beige coloured grain, 100-grain weight 110-115 g, grain yield 260 kg/ha, moderately resistant to anthracnose and an early variety (Anonymous, 2020). Salicylic acid (SA) and salt (NaCl) were used as treatment materials. The experiment was established with 3 replicates according to the factorial trial design in randomised plots. Pre-treatment, salicylic acid application and salt (NaCl) application were the factors of the study. Seeds were pretreated with hydropriming and 0.5 mM salicylic acid before sowing. Salicylic acid was dissolved in distilled water and adjusted to pH 6.5 with NaOH and stock solution was prepared (Kaydan and Yağmur, 2006). Salicylic acid pretreated seeds were kept in 0.5 mM SA solution for 12 hours. The soaking time of the hydropriming seeds in water was also adjusted as 12 hours. Seeds in the control group were not pretreated. After the pre-treatment, the seeds were dried on sterile filter paper for 24 hours and sown in the soil at the same time with the untreated seeds. Three different concentrations of salt (0, 75 and 150 mM NaCl) were applied to the plants from the soil. Three different concentrations of salicylic acid (0, 0.5 and 1.0 mM SA) were applied as soil and foliar applications.

Peat and perlite containing nutrients were used as growing media. 10 seeds were sown in each pot of 2 lt volume filled with peat-perlite mixture at a ratio of 2:1 and after germination, 5 plants were left in each pot. The amount of water required for field capacity was determined before sowing, and irrigation was carried out to reach 80% field capacity to avoid water stress during the study. When the 3rd leaves appeared on the seedlings, salicylic acid was applied to the pots. In foliar salicylic acid application, 0.5 mM and 1 mM doses of SA were sprayed on the aboveground parts of the plant. In soil SA applications, 0.5 mM and 1 mM doses of SA solution were applied to the soil as irrigation water. NaCl was added to the pots 3 days after SA application. The study was continued for 30 days. At the end of this period, the plants were harvested. The treatments carried out within the scope of the study are given in Table 1. The germinated seeds were counted for 10 days after the germinated seeds emerged on the soil surface. According to the data obtained, germination rate (Akıncı and Çalışkan, 2010), average germination time (Ellis and Robert, 1980) and germination index (Wang et al., 2004) parameters were determined. SPAD metre was used to determine the total chlorophyll content in the leaves. The chlorophyll content of full-grown leaves was measured with a Minolta SPAD-502 portable chlorophyllmeter one day before salt application, 3 days after salt application and just before harvest. Sample readings were taken from three parts of the full-grown leaf close to the main vein and from 3 plants in each pot. The measured values were expressed as Soil Plant Analysis Development (SPAD) values. According to the manufacturer of the chlorofilmmeter, the SPAD value scale is 1=chlorotic or yellow colour, 50 = dark green colour (Uzunlu 2006).

Table 1. Application methods and doses of salicylic acid.
Çizelge 1. Salisilik asitin uygulama şekilleri ve dozları.

Abbreviation	Treatments
T1	Salicylic acid (SA) not applied
T2	0.5 mm salicylic acid application through soil
T3	1 mm salicylic acid application from soil
T4	Foliar application of 0.5 mm salicylic acid
T5	Foliar application of 1 mm salicylic acid
T6	Soil application of 0.5 mm salicylic acid + Foliar application of 0.5 mm salicylic acid
T7	1 mm salicylic acid through soil + 1 mm salicylic acid through foliar application

After 30 days of growth, the plants were harvested, cut at the junction of the root and stem and the roots were washed in water to remove surface water. Root and stem lengths were measured with a ruler. Root and stem fresh weights were weighed. After the fresh weights of the roots were determined, they were placed in paper bags and dried at 65 °C until the final weight did not change and then the root dry weight and root wet weight were determined. The data obtained as a result of the research were subjected to variance analysis according to the factorial experiment design in random plots, and the Least Significant Difference (LSD) test was used for grouping the differences between the treatments (Kalaycı, 2005). JMP package programme was used for statistical calculations.

RESULTS AND DISCUSSION

Germination rate (%)

Observations on germination were taken within 10 days after sowing the seeds. Since the soil-foliar salicylic acid and soil salt applications were made when the plants reached the 3-leaf stage, only the effect of the pre-treatments was examined in the observations related to germination. The effect of pre-treatments on germination rate was found to be statistically significant ($p<0.01$). As a result of the experiment, the germination rate of the seeds varied between 60.00-93.33%. It was determined that hydropriming treatment increased the germination rate compared to the control, while salicylic acid pre-treatment decreased the germination rate compared to the control (Table 2 and Table 8). As a result of different studies related to the role of salicylic acid in seed germination, it has been reported that it inhibits germination or increases seed viability, and this effect varies depending on the concentration of salicylic acid applied (Xie et al., 2007; Lee et al., 2010; Yıldız et al., 2014; Ceritoğlu and Erman, 2020). Soliman et al. (2016) and Açıkbaş and Özyazıcı (2022) reported that pre-treatment of seeds with salicylic acid up to 0.5 mM dose promoted germination, but after this dose, it decreased germination by toxic effect. Rajjou et al. (2006) found that salicylic acid concentrations above 1 mM inhibited germination in *Arabidopsis thaliana*. Anaya et al. (2018) reported that salicylic acid pre-treatment of seeds exposed to salt stress increased the germination rate. These studies and our results support each other.

Germination Index

The effect of pre-treatments on germination index was statistically significant ($p<0.01$). According to the results obtained, germination index was determined between 0.97-2.51. According to the control, soaking the seeds in water increased the germination index, while salicylic acid pre-treatment decreased the germination index (Table 2 and Table 8). Açıkbaş and Özyazıcı (2022) reported that there was no statistical difference between 0.25 mM salicylic acid pre-treatment and hydropriming pre-treatment and that salicylic acid pre-treatment higher than 0.25 mM dose showed toxic effect and decreased the germination index.

Anaya et al. (2018) found that pre-treatment of salicylic acid alone did not significantly affect the germination index, but increased the germination index when applied to seeds under salt stress. Similarly, Ceritoğlu and Erman (2020) reported that 0.2 mM salicylic acid application significantly increased the germination index in chickpea seedlings exposed to salinity stress, but negatively affected it when the level was increased.

Average Germination Time (day)

The effects of pre-treatments on the average germination time of seeds were found to be statistically significant ($p<0.01$). The average germination time varied between 3.50-6.28 days. Salicylic acid pre-treatment delayed germination compared to control, while soaking the seeds in water accelerated germination compared to control and salicylic acid pre-treatment (Table 2 and Table 8). Lee et al. (2010) reported that salicylic acid pre-treatment delayed germination. Anaya et al. (2018) found that salicylic acid pre-treatment at a dose of more than 0.25 mM delayed germination and prolonged the average germination time. Özkorkmaz and Öner (2022) found that germination time increased with increasing salt and SA doses. On the other hand, Nun et al. (2003) reported that salicylic acid can inhibit the activity of catalase enzyme in plants, and with the decrease in the activity of catalase enzyme, hydrogen peroxide increases and improves seed germination.

Stem Length (cm)

The effects of pre-applications, pre-application x salicylic acid, pre-application x salt, pre-application x salt x salicylic acid interactions on body length were not found to be statistically significant. The effect of salt application on stem length was found to be statistically significant at the $p<0.01$ level, and the effect of salicylic acid applications and salt x salicylic acid interaction on stem length was found to be statistically significant at the $p<0.05$ level. Body length varied between 36.11-39.47 cm. Increasing the salt dose reduced the stem length compared to the control. While the highest stem length was obtained from the control, the lowest stem length was determined in 150 mM salt application. Salicylic acid applications increased stem length compared to the control. The highest stem length was obtained from the application of 0.5 mM SA from soil + 0.5 mM SA from leaves, and it is statistically in the same group with salicylic acid applications other than the application of 1 mM SA from soil + 1 mM SA from leaves. The lowest body length in terms of salicylic acid application was determined in the control. When the combined effect of salt and salicylic acid was examined, it was determined that the stem length of plants to which salt was applied was shortened, but when applied together with salicylic acid, salicylic acid alleviated the effect of salt (Table 2, Table 4, Table 6 and Table 9). Tammam (2005) and Kaydan (2006) reported that salicylic acid application increased the stem length of broad beans and reduced the negative effect of salt. Azooz et al. (2011) reported that the application of salicylic acid under salt-free and salty conditions increased stem length and the highest stem length value was obtained from the application of 1 mM salicylic acid.

Root Length (cm)

The effect of salt application on root length was found to be statistically significant at the $p<0.01$ level, and the effect of salicylic acid and salt x salicylic acid interaction was found to be statistically significant at the $p<0.05$ level. Pre-treatments and other interactions did not affect root length at a statistically significant level. Considering all applications, it was determined that the root length varied between 27.12-30.57 cm. As the salt dose increased, root length decreased. Salt applications reduced root length compared to the control. Positive effects of salicylic acid applications on increasing root length have been observed. All salicylic acid doses and application methods increased root length compared to the control. All salicylic acid applications, except the application of 1 mM SA from the soil + 1 mM SA from the leaves, are statistically in the same group, and the highest root length value was obtained from the application of 0.5 mM SA from the soil + 0.5 mM SA from the leaves. Co-administration of salt and salicylic acid; It alleviated the effect of salt on reducing the root length of the plant. The highest root length value was obtained from the control x 1 mM SA interaction, while the lowest root length value was obtained from the 150 mM salt x control interaction (Table 2, Table 4, Table 6 and Table 9). Tammam (2005) reported that salicylic acid application increased the root length of broad bean and reduced the negative effect of salt. Azooz et al.

(2011) found that the application of salicylic acid alone and under saline conditions increased root length, and the highest value was found in the application of 1 mM salicylic acid.

Root Fresh Weight (g)

The effect of salt, salicylic acid applications and salt x salicylic acid interaction on root fresh weight was found to be statistically significant at p<0.01 level, while the effect of pre-applications and other interactions was found to be insignificant. The fresh root weight was determined to be between 2.796-3.413 g. It was determined that as the salt concentration increased, the fresh root weight decreased compared to the control. Salicylic acid applications increased the fresh root weight compared to the control. The highest root fresh weight value was obtained from the 1 mM SA application to the leaf, while the lowest root fresh weight value was obtained from the control. When the salt x salicylic acid interaction was examined, the highest root fresh weight value was determined in the Control + 1 mM SA from soil interaction, and the lowest root fresh weight value was determined in the 150 mM salt x Control interaction. It was determined that the effect of salt in reducing the fresh root weight was alleviated by the application of salicylic acid (Table 2, Table 4, Table 6, and Table 9). Özkorkmaz and Öner (2022) reported that the fresh root weight decreased as the salicylic acid and salt concentration increased.

Root Dry Weight (g)

While the effect of priming, priming x salt, priming x salicylic acid and priming x salt x salicylic acid interactions on root dry weight was not found to be statistically significant, the effect of salt application was significant at the p<0.01 level, and the effect of salicylic acid application and salt x salicylic acid interaction. was found to be statistically significant at p<0.05 level. It was determined that the root dry weight varied between 0.299-0.396 g according to all applications. It was determined that as the applied salt dose increased, the root dry weight of the plants decreased and remained below the root dry weight of the control plants. It was determined that salicylic acid applications increased the root dry weight of the plants compared to the control, but all salicylic acid applications except 1 mM SA from the soil + 1 mM SA from the leaves were statistically in the same group. It was determined that the effect of salt in reducing root dry weight in plants where salt and salicylic acid were applied together decreased with the application of salicylic acid. Although root dry weight decreased as the salt dose increased, it was concluded that root dry weight was less negatively affected in plants where salicylic acid was also applied (Table 3, Table 5, Table 7, and Table 10). Azooz et al. (2011) reported that application of salicylic acid alone and under saline conditions increased root dry weight; They reported that the highest root dry weight was obtained from the application of 1 mM salicylic acid.

Stem Fresh Weight (g)

While the effect of salt and salicylic acid applications and salt x salicylic acid interaction on stem fresh weight was found to be statistically significant at p<0.01 level, the effect of pre-applications and other interactions was not found to be significant. It was determined that the stem fresh weight varied between 4.404-5.006 g according to all applications. It was determined that as the salt concentration increased, the stem fresh weight decreased. While the highest stem fresh weight was obtained from the control, the lowest stem fresh weight was determined in 150 mM salt application. It was determined that salicylic acid applications increased stem fresh weight compared to the control. While the highest stem fresh weight value was obtained from the application of 1 mM SA from the leaf, it is statistically in the same group with the applications of 1 mM SA from the soil, 0.5 mM SA from the soil + 0.5 mM SA from the leaf, 0.5 mM SA from the leaf, and 0.5 mM SA from the soil. The lowest stem fresh weight was found in the control group. When the effect of salt x salicylic acid interaction on trunk fresh weight was examined, it was determined that the combined application of salt and salicylic acid alleviated the effect of salt on reducing stem fresh weight (Table 3, Table 5, Table 7, and Table 10). Anaya et al. (2018) reported that salicylic acid application increased stem fresh weight under saline conditions.

Stem Dry Weight (g)

The effect of salt and salicylic acid applications and salt x salicylic acid interaction on stem dry weight was found to be statistically significant at the p<0.01 level. The dry body weight was determined between 0.473-0.557 g. It has been determined that increasing doses of salt applications reduce the trunk dry weight compared to the control. All salicylic acid applications except 1 mM SA from the soil + 1 mM SA from the leaves are statistically in the same group, the highest stem dry weight value was obtained from the 0.5 mM SA application from the leaves, and the lowest stem dry weight value was obtained from the control. Salt x salicylic acid interaction significantly affected the stem dry weight, the highest stem dry weight value was detected in the control + 1 mM SA from soil application, and the lowest stem dry weight was detected in the 150 mM salt + control application. It was determined that salicylic acid reduced the negative effect of salty conditions on stem dry weight (Table 3, Table 5, Table 7, and Table 10). Anaya et al. (2018) reported that the application of salicylic acid lower than 0.25 mM dose increased stem dry weight under saline conditions. Azooz et al. (2011) reported that the application of salicylic acid in salt-free and salty conditions increased stem dry weight.

Chlorophyll Content Before Salt Application

While the effect of salicylic acid application on chlorophyll content before salt application was found to be statistically significant at the $p<0.05$ level, the effects of other applications and interactions were not found to be significant. According to all treatments, the chlorophyll content of the plants before salt application was found to be between 38.39-48.92. Salicylic acid application increased the chlorophyll content of the plants compared to the control, and the highest chlorophyll content before salt application was obtained from the application of 0.5 mM SA from the soil + 0.5 mM SA from the leaves (Table 3, Table 5, Table 7, and Table 11). Türkyılmaz et al. (2005) found that salicylic acid application increased the chlorophyll content of the plant compared to the control.

Chlorophyll Content After Salt Application

After salt application, the effect of salt application on the chlorophyll content of plants was found to be statistically significant at $p<0.01$, and the effect of salicylic acid application was found to be statistically significant at $p<0.05$. The effect of pre-applications and interactions on the chlorophyll content of plants after salt application was not found to be statistically significant. As the salt concentration increased, the chlorophyll content of the plants decreased and remained below the chlorophyll content of the control plants. After salt application, the chlorophyll content of plants was positively affected by salicylic acid application. Salicylic acid applications increased the chlorophyll content of plants compared to the control. Salicylic applications are statistically in the same group. After salt application, the chlorophyll content of the plants varied between 35.51-45.33 (Table 3, Table 5, Table 7, and Table 11). Baran and Doğan (2014) reported that chlorophyll content decreases as salt concentration increases.

Chlorophyll Content Before Harvest

The effect of salt application on the chlorophyll content of plants before harvest was found to be statistically significant at the $p<0.01$ level, and the effect of salicylic acid application and salt x salicylic acid interaction was found to be statistically significant at the $p<0.05$ level. The effect of pre-applications and other interactions on pre-harvest chlorophyll content was not found to be statistically significant. As the salt concentration increased, the chlorophyll content of the plants decreased. Salt applications reduced chlorophyll content compared to the control. It was determined that salicylic acid applications increased the chlorophyll content of plants before harvest compared to the control, and all salicylic acid applications except 1 mM SA from the soil + 1 mM SA from the leaves were statistically in the same group. According to all treatments, the chlorophyll content of plants before harvest varied between 40.97-50.56 (Table 3, Table 5, Table 7, and Table 11). Tohma (2007), in a study conducted with the Camarosa strawberry variety, found that the application of different concentrations of salt and salicylic acid reduced membrane permeability and increased the total amount of chlorophyll. Baran and Doğan (2014) found that the chlorophyll content increased after applying salicylic acid to soybean plants grown in saline conditions.

Table 2. Effect of priming, saline doses, treatments (SA), and priming x treatments (SA) interaction on germination rate, germination index, average germination time, stem length, root length, and root fresh weight of broad bean.

Çizelge 2. Ön uygulama, tuz dozları, salisilik asit uygulamaları ve ön uygulama x salisilik asit uygulaması interaksiyonunun baklanın çimlenme oranı, çimlenme indeksi, ortalama çimlenme süresi, gövde uzunluğu, kök uzunluğu ve kök yaş ağırlığına etkisi.

Priming		**Germination rate (%)**	**Germination index**	**Average germination time (day)**	**Stem length (cm)**	**Root length (cm)**	**Root fresh weight (g)**
Control		75.87 b	1.61 b	4.83 b	37.93	28.92	3.205
Hydropriming		80.63 a	2.19 a	3.83 c	37.89	28.88	3.197
Salicylic acid		68.25 c	1.18 c	5.89 a	37.85	28.84	3.188
Saline doses		**Germination rate (%)**	**Germination index**	**Average germination time (day)**	**Stem length (cm)**	**Root length (cm)**	**Root fresh weight (g)**
Control		74.76	1.58	5.06	38.47 a	29.46 a	3.344 a
75 mM		73.65	1.67	4.73	37.92 b	28.91 b	3.210 b
150 mM		76.35	1.73	4.75	37.27 c	28.27 c	3.036 c
Treatments		**Germination rate (%)**	**Germination index**	**Average germination time (day)**	**Stem length (cm)**	**Root length (cm)**	**Root fresh weight (g)**
T1		75.93	1.66	4.88	37.42 c	28.42 c	3.084 b
T2		74.44	1.65	4.83	37.98 ab	28.97 ab	3.224 a
T3		78.89	1.75	4.80	38.02 ab	29.01 ab	3.248 a
T4		75.93	1.65	4.91	38.12 a	29.10 a	3.228 a
T5		72.96	1.60	4.86	38.04 ab	29.03 ab	3.255 a
T6		72.22	1.61	4.84	38.14 a	29.12 a	3.245 a
T7		74.07	1.68	4.80	37.52 bc	28.52 bc	3.094 b
Priming x Treatments		**Germination rate (%)**	**Germination index**	**Average germination time (day)**	**Stem length (cm)**	**Root length (cm)**	**Root fresh weight (g)**
Control	T1	76.67	1.62	4.85	37.85	28.87	3.109
	T2	76.67	1.63	4.80	38.30	29.28	3.235
	T3	80.00	1.70	4.80	37.87	28.86	3.241
	T4	75.56	1.57	4.90	37.72	28.68	3.214
	T5	73.33	1.55	4.83	37.82	28.81	3.254
	T6	74.44	1.59	4.83	38.07	29.06	3.262
	T7	74.44	1.61	4.77	37.84	28.86	3.119
Hydropriming	T1	81.11	2.18	3.84	37.18	28.14	3.050
	T2	78.89	2.15	3.82	37.75	28.74	3.218
	T3	78.89	2.31	3.77	37.92	28.90	3.279
	T4	80.00	2.18	3.89	38.12	29.14	3.275
	T5	84.44	2.11	3.88	38.46	29.45	3.273
	T6	82.22	2.16	3.81	38.64	29.63	3.227
	T7	78.89	2.23	3.78	37.17	28.13	3.060
Salicylic acid	T1	70.00	1.19	5.96	37.22	28.24	3.092
	T2	67.78	1.18	5.88	37.90	28.88	3.218
	T3	72.22	1.26	5.83	38.27	29.26	3.224
	T4	70.00	1.20	5.94	38.52	29.47	3.196
	T5	66.67	1.15	5.86	37.82	28.81	3.237
	T6	63.33	1.10	5.88	37.69	28.68	3.245
	T7	67.78	1.19	5.84	37.54	28.56	3.103
LSDpriming		69.37**	5.61**	11.42**	ns	ns	ns
LSDsaline dose		ns	ns	ns	6.710**	6.630**	1.717**
LSDtreatment		ns	ns	ns	2.140*	2.090*	0.540**
LSDpriming x treatment		ns	ns	ns	ns	ns	ns

ns:non-significant, **p<0.01, *p<0.05

Table 3. Effect of priming, saline doses, treatments (SA), and priming x treatments (SA) interaction on root dry weight, stem fresh weight, stem dry weight, chlorophyll content before salt application, chlorophyll content after salt application, and chlorophyll content before harvest of broad bean.

Çizelge 3. Ön uygulama, tuz dozları, salisilik asit uygulamaları ve ön uygulama x salisilik asit uygulaması interaksiyonunun baklanın kök kuru ağırlığı, gövde yaş ağırlığı, gövde kuru ağırlığı, tuz uygulaması öncesi klorofil içeriği, tuz uygulaması sonrası klorofil içeriği ve hasat öncesi klorofil içeriğine etkisi.

Priming		**Root dry weight (g)**	**Stem fresh weight (g)**	**Stem dry weight (g)**	**Chlorophyll content before salt application**	**Chlorophyll content after salt application**	**Chlorophyll content before harvest**
Control		0.351	4.828	0.522	43.7	40.8	46.1
Hydropriming		0.351	4.829	0.522	43.6	40.6	46.1
Salicylic acid		0.349	4.811	0.520	43.8	40.5	45.9
Saline doses							
Control		0.367 a	4.970 a	0.538 a	45.3 a	42.3 a	47.7 a
75 mM		0.351 b	4.838 b	0.523 b	43.8 b	40.7 b	46.1 b
150 mM		0.333 c	4.659 c	0.504 c	42.0 c	38.9 c	44.3 c
Treatments							
T1		0.337 c	4.701 b	0.508 b	42.2 c	39.3 c	44.7 c
T2		0.353 ab	4.848 a	0.524 a	44.0 ab	41.0 b	46.3 b
T3		0.354 ab	4.881 a	0.527 a	44.1 ab	41.0 ab	46.4 ab
T4		0.357 a	4.865 a	0.529 a	44.4 ab	41.3 a	46.7 a
T5		0.355 ab	4.885 a	0.527 a	44.1 ab	41.1 ab	46.5 ab
T6		0.357 a	4.866 a	0.528 a	44.4 a	41.3 a	46.8 a
T7		0.340 bc	4.711 b	0.510 b	42.7 bc	39.6 bc	45.0 bc
Priming x Treatments							
Control	T1	0.349	4.706	0.516	43.2	40.3	45.9
	T2	0.362	4.853	0.530	44.8	41.8	47.2
	T3	0.350	4.887	0.525	43.9	40.8	46.0
	T4	0.346	4.871	0.522	43.1	40.3	45.6
	T5	0.348	4.890	0.523	43.5	40.6	45.8
	T6	0.356	4.871	0.525	44.0	41.2	46.6
	T7	0.349	4.716	0.516	43.6	40.5	45.9
Hydropriming	T1	0.330	4.707	0.506	41.5	38.7	44.0
	T2	0.346	4.854	0.520	43.1	40.2	45.6
	T3	0.351	4.887	0.523	43.4	40.4	46.1
	T4	0.357	4.872	0.525	44.2	41.1	46.7
	T5	0.367	4.891	0.535	45.4	42.3	47.7
	T6	0.372	4.872	0.541	46.2	43.0	48.2
	T7	0.330	4.717	0.506	41.7	38.8	44.0
Salicylic acid	T1	0.331	4.689	0.501	42.0	39.0	44.1
	T2	0.351	4.836	0.521	44.0	40.8	46.1
	T3	0.361	4.870	0.533	45.2	41.9	47.1
	T4	0.368	4.853	0.538	45.7	42.5	47.8
	T5	0.349	4.873	0.522	43.5	40.5	45.9
	T6	0.345	4.854	0.517	43.1	39.7	45.5
	T7	0.340	4.699	0.508	42.9	39.4	45.0
LSDpriming		ns	ns	ns	ns	ns	ns
LSDsaline dose		0.19**	1.73**	0.19**	18.58**	18.91**	19.17**
LSDtreatment		0.06*	0.59**	0.06**	6.30*	6.15*	6.11*
LSDpriming x treatment		ns	ns	ns	ns	ns	ns

ns:non-significant, **p<0.01, *p<0.05

Table 4. Effect of priming x saline doses interaction on germination rate, germination index, average germination time, stem length, root length, and root fresh length of broad bean.

Çizelge 4. Ön uygulama x tuz dozları interaksiyonunun baklanın çimlenme oranı, çimlenme indeksi, gövde uzunluğu, kök uzunluğu ve kök yaş ağırlığına etkisi.

Priming x Saline Doses		Germination rate (%)	Germination index	Average germination time (day)	Stem length (cm)	Root length (cm)	Root fresh weight (g)
Control	Control	75.71	1.53	5.06	38.44	29.43	3.352
	75 mM	73.81	1.61	4.69	38.03	29.01	3.220
	150 mM	78.10	1.69	4.73	37.31	28.31	3.043
Hydropriming	Control	80.95	2.08	4.02	38.54	29.51	3.344
	75 mM	79.05	2.20	3.74	37.89	28.88	3.209
	150 mM	81.90	2.28	3.73	37.25	28.24	3.039
Salicylic acid	Control	67.62	1.12	6.11	38.46	29.45	3.336
	75 mM	68.10	1.20	5.76	37.84	28.83	3.203
	150 mM	69.05	1.21	5.79	37.26	28.26	3.026
LSDpriming x saline doses		ns	ns	ns	ns	ns	ns

ns:non-significant

Table 5. Effect of priming x saline doses interaction on root dry weight, stem fresh weight, chlorophyll content before salt application, chlorophyll content after salt application, and chlorophyll content before harvest of broad bean.

Çizelge 5. Ön uygulama x tuz dozları interaksiyonunun baklanın kök kuru ağırlığı, gövde yaş ağırlığı, gövde kuru ağırlığı, tuz uygulaması öncesi klorofil içeriği, tuz uygulaması sonrası klorofil içeriği ve hasat öncesi klorofil içeriğine etkisi.

Priming x Saline Doses		Root dry weight (g)	Stem fresh weight (g)	Stem dry weight (g)	Chlorophyll content before salt application	Chlorophyll content after salt application	Chlorophyll content before harvest
Control	Control	0.366	4.975	0.537	45.2	42.3	47.6
	75 mM	0.354	4.843	0.525	44.1	41.1	46.4
	150 mM	0.334	4.665	0.505	41.9	39	44.4
Hydropriming	Control	0.369	4.976	0.540	45.3	42.4	47.9
	75 mM	0.350	4.844	0.523	43.6	40.7	46.0
	150 mM	0.332	4.666	0.504	42.0	38.8	44.2
Salicylic acid	Control	0.367	4.958	0.537	45.5	42.2	47.7
	75 mM	0.349	4.826	0.521	43.7	40.5	45.9
	150 mM	0.332	4.648	0.503	42.1	38.9	44.2
LSDpriming x saline doses		ns	ns	ns	ns	ns	ns

ns:non-significant

Table 6. Effect of saline doses x treatments (SA) interaction on germination rate, germination index, average germination time, stem length, root length, and root fresh weight of broad bean.

Çizelge 6. Tuz dozları x salisilik asit uygulaması interaksiyonunun baklanın çimlenme oranı, çimlenme indeksi, ortalama çimlenme süresi, gövde uzunluğu, kök uzunluğu ve kök yaş ağırlığına etkisi.

Saline Doses x Treatment		Germination rate (%)	Germination index	Average germination time (day)	Stem length (cm)	Root length (cm)	Root fresh weight (g)
Control	T1	76.67	1.61	5.09	38.63 a	29.59 ab	3.383 a
	T2	71.11	1.47	5.18	38.51 ab	29.48 a-c	3.367 ab
	T3	84.44	1.74	5.18	38.71 a	29.77 a	3.397 a
	T4	78.89	1.59	5.20	38.50 ab	29.43 a-d	3.359 ab
	T5	73.33	1.59	4.90	38.43 a-c	29.40 a-e	3.331 a-c
	T6	70.00	1.54	4.95	38.55 a	29.59 ab	3.380 a
	T7	68.89	1.50	4.92	38.02 a-e	28.99 a-f	3.193 de
75 mM	T1	74.44	1.57	5.03	37.04 f-h	28.01 gh	3.055 fg
	T2	68.89	1.62	4.55	38.68 a	29.75 a	3.320 a-c
	T3	72.22	1.71	4.54	37.81 a-f	28.74 b-g	3.284 bc
	T4	72.22	1.67	4.69	38.51 ab	29.48 a-c	3.256 cd
	T5	75.56	1.68	4.78	38.05 a-e	29.08 a-f	3.312 a-c
	T6	70.00	1.55	4.87	38.30 a-d	29.27 a-f	3.253 cd
	T7	82.22	1.92	4.66	37.05 f-h	28.02 gh	2.991 g
150 mM	T1	76.67	1.79	4.53	36.59 h	27.66 h	2.813 h
	T2	83.33	1.88	4.77	36.74 gh	27.67 h	2.985 g
	T3	80.00	1.82	4.69	37.55 c-g	28.52 e-h	3 063 fg
	T4	76.67	1.69	4.84	37.35 e-h	28.39 f-h	3.070 fg
	T5	70.00	1.55	4.90	37.63 b-g	28.60 c-g	3.121 ef
	T6	76.67	1.75	4.70	37.55 c-g	28.52 e-h	3.101 f
	T7	71.11	1.61	4.81	37.48 d-h	28.55 d-h	3.098 f
LSDsaline doses x treatment		ns	ns	ns	1.90*	2.01*	0.389**

ns:non-significant, **p<0.01, *p<0.05

Table 7. Effect of saline doses x treatments (SA) interaction on root dry weight, stem fresh weight, stem dry weight, chlorophyll content before salt application, chlorophyll content after salt application, and chlorophyll content before harvest of broad bean.

Çizelge 7. Tuz dozları x salisilik asit uygulaması interaksiyonunun baklanın kök kuru ağırlığı, gövde yaş ağırlığı, gövde kuru ağırlığı, tuz uygulaması öncesi klorofil içeriği, tuz uygulaması sonrası klorofil içeriği ve hasat öncesi klorofil içeriğine etkisi.

Saline Doses x Treatment		Root dry weight (g)	Stem fresh weight (g)	Stem dry weight (g)	Chlorophyll content before salt application	Chlorophyll content after salt application	Chlorophyll content before harvest
	T1	0.371 a	5.000 a	0.541 a	45.5	42.8	48.1 a
	T2	0.368 ab	4.998 a	0.540 a	45.7	42.5	47.8 ab
	T3	0.374 a	4.999 a	0.542 a	46.1	43.0	48.4 a
Control	T4	0.368 ab	4.997 a	0.540 a	45.3	42.3	47.8 ab
	T5	0.366 a-c	4.990 ab	0.540 a	45.3	42.4	47.6 a-c
	T6	0.369 a	4.993 a	0.539 a	45.4	42.3	47.9 a
	T7	0.354 a-e	4.810 d	0.523 a-d	44.0	41.0	46.4 a-e
	T1	0.326 f-h	4.686 ef	0.500 e-g	41.2	38.3	43.6 f-h
	T2	0.373 a	4.923 c	0.539 a	45.8	42.9	48.3 a
	T3	0.348 a-f	4.922 c	0.524 a-d	43.5	40.5	45.8 a-f
75 mM	T4	0.368 ab	4.915 c	0.540 a	45.6	42.4	47.8 ab
	T5	0.355 a-e	4.926 bc	0.527 a-c	44.1	41.1	46.5 a-e
	T6	0.362 a-d	4.870 cd	0.531 ab	45.0	42.0	47.2 a-d
	T7	0.326 f-h	6.623 a	0.499 e-g	41.3	38.0	43.6 f-h
	T1	0.313 h	4.415 g	0.481 g	39.9	36.9	42.3 h
	T2	0.318 gh	4.623 f	0.493 fg	40.4	37.5	42.8 gh
	T3	0.341 c-g	4.723 e	0.514 b-e	42.9	39.7	45.1 c-g
150 mM	T4	0.335 e-h	4.683 ef	0.506 d-f	42.1	39.2	44.5 e-h
	T5	0.343 b-g	4.738 e	0.513 b-e	42.9	39.9	45.3 b-g
	T6	0.341 c-g	4.733 e	0.512 b-e	42.9	39.6	45.1 c-g
	T7	0.339 d-h	4.700 e	0.508 c-f	42.9	39.7	44.9 d-h
LSDsaline doses x treatment		0.054*	0.364**	0.048**	ns	ns	5.42*

ns:non-significant, **p<0.01, *p<0.05

Table 8. Effect of priming x treatments (SA) x saline doses interaction on germination rate, germination index, and average germination time of broad bean.

Çizelge 8. Ön uygulama x salisilik asit uygulaması x tuz interaksiyonunun baklanın çimlenme oranı, çimlenme indeksi ve ortalama çimlenme süresine etkisi.

		Germination rate (%)			Germination index			Average germination time (day)		
		Saline doses			Saline doses			Saline doses		
Priming x Treatments x Saline Doses		Control	75 mM	150 mM	Control	75 mM	150 mM	Control	75 mM	150 mM
Control	T1	76.67	73.33	80.00	1.56	1.5	1.79	5.06	4.98	4.50
	T2	76.67	66.67	86.67	1.52	1.5	1.88	5.14	4.54	4.73
	T3	86.67	73.33	80.00	1.69	1.67	1.74	5.19	4.50	4.70
	T4	80.00	73.33	73.33	1.55	1.62	1.55	5.21	4.63	4.85
	T5	76.67	73.33	70.00	1.59	1.58	1.48	4.90	4.72	4.87
	T6	66.67	73.33	83.33	1.38	1.57	1.81	4.95	4.82	4.71
	T7	66.67	83.33	73.33	1.38	1.86	1.59	4.95	4.64	4.73
Hydropriming	T1	83.33	80.00	80.00	2.13	2.07	2.33	4.05	3.98	3.50
	T2	76.67	73.33	86.67	1.91	2.12	2.42	4.14	3.60	3.73
	T3	93.33	76.67	83.33	2.33	2.24	2.36	4.11	3.57	3.65
	T4	83.33	80.00	83.33	2.04	2.25	2.26	4.16	3.71	3.81
	T5	76.67	83.33	76.67	2.03	2.22	2.07	3.90	3.87	3.88
	T6	80.00	73.33	83.33	2.15	2.01	2.32	3.89	3.82	3.71
	T7	73.33	86.67	80.00	1.98	2.51	2.19	3.87	3.65	3.83
Salicylic acid	T1	70.00	70.00	70.00	1.16	1.15	1.26	6.16	6.14	5.59
	T2	60.00	66.67	76.67	0.97	1.23	1.34	6.28	5.52	5.83
	T3	73.33	66.67	76.67	1.19	1.22	1.36	6.23	5.56	5.71
	T4	73.33	63.33	73.33	1.19	1.12	1.28	6.23	5.74	5.85
	T5	66.67	70.00	63.33	1.15	1.23	1.09	5.89	5.74	5.95
	T6	63.33	63.33	63.33	1.07	1.09	1.13	6.00	5.95	5.68
	T7	66.67	76.67	60.00	1.14	1.38	1.04	5.95	5.70	5.89
LSDpriming x treatments x saline doses			ns			ns			ns	

ns:non-significant

Table 9. Effect of priming x treatments (SA) x saline doses interaction on stem length, root length, and root fresh weight of broad bean.

Çizelge 9. Ön uygulama x salisilik asit uygulamaları x tuz dozları interaksiyonunun baklanın gövde uzunluğu, kök uzunluğu ve kök yaş ağırlığına etkisi.

		Stem length (cm)			Root length (cm)			Root fresh weight (g)		
		Saline doses			Saline doses			Saline doses		
Priming x Treatments x Saline Doses		**Control**	**75 mM**	**150 mM**	**Control**	**75 mM**	**150 mM**	**Control**	**75 mM**	**150 mM**
Control	T1	38.30	38.15	37.10	29.31	29.12	28.20	3.409	3.088	2.830
	T2	39.38	38.90	36.61	30.34	30.00	27.50	3.400	3.337	2.969
	T3	39.24	37.38	37.01	30.33	28.27	27.98	3.413	3.269	3.041
	T4	37.72	38.33	37.12	28.62	29.30	28.12	3.344	3.234	3.064
	T5	38.26	37.36	37.84	29.23	28.36	28.84	3.308	3.306	3.147
	T6	38.51	38.43	37.28	29.51	29.43	28.24	3.374	3.279	3.134
	T7	37.67	37.65	38.20	28.67	28.61	29.29	3.219	3.024	3.114
Hydropriming	T1	38.98	36.45	36.11	29.88	27.42	27.12	3.347	3.007	2.796
	T2	37.63	38.60	37.01	28.60	29.61	28.01	3.318	3.303	3.033
	T3	38.54	37.45	37.75	29.54	28.46	28.72	3.380	3.333	3.125
	T4	38.64	38.56	37.16	29.64	29.52	28.26	3.408	3.317	3.099
	T5	38.32	38.98	38.10	29.28	30.07	28.99	3.392	3.342	3.085
	T6	39.47	38.62	37.83	30.57	29.52	28.81	3.410	3.217	3.053
	T7	38.19	36.56	36.77	29.08	27.54	27.77	3.157	2.942	3.080
Salicylic acid	T1	38.59	36.52	36.56	29.59	27.48	27.65	3.393	3.070	2.814
	T2	38.54	38.54	36.61	29.50	29.64	27.50	3.382	3.321	2.951
	T3	38.34	38.60	37.88	29.43	29.49	28.85	3.397	3.251	3.025
	T4	39.13	38.65	37.77	30.02	29.63	28.78	3.326	3.218	3.046
	T5	38.70	37.81	36.95	29.68	28.81	27.96	3.292	3.288	3.131
	T6	37.69	37.85	37.54	28.69	28.85	28.50	3.356	3.263	3.116
	T7	38.21	36.93	37.48	29.21	27.90	28.57	3.203	3.006	3.098
LSDpriming x treatments x saline doses		**ns**			**ns**			**ns**		

ns:non-significant

Table 10. Effect of priming x treatments (SA) x saline doses interaction on root dry weight, stem fresh weight, and stem dry weight of broad bean.
Çizelge 10. Ön uygulama x salisilik uygulamaları x tuz dozları interaksiyonunun baklanın kök kuru ağırlığı, gövde yaş ağırlığı ve gövde kuru ağırlığına etkisi.

		Root dry weight (g)			Stem fresh weight (g)			Stem dry weight (g)		
		Saline doses			Saline doses			Saline doses		
Priming x Treatments x Saline Doses		**Control**	**75 mM**	**150 mM**	**Control**	**75 mM**	**150 mM**	**Control**	**75 mM**	**150 mM**
Control	T1	0.362	0.358	0.328	5.005	4.692	4.420	0.533	0.522	0.492
	T2	0.393	0.379	0.314	5.004	4.928	4.628	0.556	0.543	0.492
	T3	0.389	0.336	0.325	5.004	4.928	4.728	0.552	0.516	0.505
	T4	0.346	0.363	0.328	5.003	4.920	4.689	0.525	0.539	0.502
	T5	0.361	0.335	0.349	4.995	4.932	4.743	0.539	0.513	0.516
	T6	0.368	0.366	0.333	4.999	4.875	4.738	0.539	0.532	0.505
	T7	0.344	0.344	0.359	4.815	4.628	4.705	0.514	0.510	0.523
Hydropriming	T1	0.382	0.309	0.300	5.006	4.693	4.421	0.553	0.491	0.473
	T2	0.343	0.371	0.325	5.005	4.929	4.629	0.526	0.540	0.495
	T3	0.369	0.338	0.347	5.005	4.929	4.729	0.540	0.513	0.515
	T4	0.372	0.369	0.330	5.004	4.921	4.690	0.540	0.536	0.499
	T5	0.363	0.382	0.356	4.996	4.933	4.744	0.534	0.544	0.527
	T6	0.396	0.371	0.349	5.000	4.876	4.740	0.557	0.542	0.523
	T7	0.359	0.313	0.318	4.816	4.629	4.706	0.531	0.492	0.494
Salicylic acid	T1	0.370	0.311	0.312	4.989	4.674	4.404	0.539	0.486	0.479
	T2	0.369	0.369	0.314	4.986	4.912	4.610	0.538	0.535	0.491
	T3	0.363	0.371	0.350	4.988	4.910	4.712	0.533	0.542	0.524
	T4	0.386	0.372	0.347	4.985	4.904	4.671	0.555	0.545	0.516
	T5	0.374	0.348	0.324	4.979	4.914	4.727	0.549	0.522	0.497
	T6	0.345	0.349	0.340	4.981	4.859	4.720	0.522	0.519	0.510
	T7	0.360	0.323	0.339	4.799	4.610	4.689	0.525	0.493	0.506
LSDpriming x treatments x saline doses			**ns**			**ns**			**ns**	

ns:non-significant

Table 11. Effect of priming x treatments (SA) x saline doses interaction on chlorophyll content before salt application, chlorophyll content after salt application, and chlorophyll content before harvest in broad bean.

Çizelge 11. Ön uygulama x salisilik asit uygulamaları x tuz dozları interaksiyonunun tuz uygulaması öncesi klorofil içeriği, tuz uygulaması sonrası klorofil içeriği ve hasat öncesi klorofil içeriği üzerine etkisi.

		Chlorophyll content before salt application			Chlorophyll content after salt application			Chlorophyll content before harvest		
		Saline doses			Saline doses			Saline doses		
Priming x Treatments x Saline Doses		**Control**	**75 mM**	**150 mM**	**Control**	**75 mM**	**150 mM**	**Control**	**75 mM**	**150 mM**
Control	T1	44.7	43.7	41.1	42.0	40.8	38.2	47.2	46.8	43.8
	T2	48.9	46.5	39.1	45.3	43.7	36.4	50.3	48.9	42.4
	T3	47.6	42.8	41.3	44.6	39.6	38.3	49.9	44.6	43.5
	T4	43.1	44.8	41.4	40.1	42.0	38.9	45.6	47.3	43.8
	T5	44.9	42.0	43.4	42.2	39.1	40.6	47.1	44.5	45.9
	T6	44.9	45.4	41.8	42.2	42.7	38.8	47.8	47.6	44.3
	T7	42.5	43.3	45.0	39.8	39.7	42.0	45.4	45.4	46.9
Hydropriming	T1	46.3	39.8	38.4	43.5	37.0	35.5	49.2	41.9	41.0
	T2	42.4	45.4	41.5	39.7	42.5	38.6	45.3	48.1	43.5
	T3	44.9	42.1	43.2	41.9	39.2	40.0	47.9	44.8	45.7
	T4	46.0	44.8	41.8	42.9	41.9	38.3	48.2	47.9	44.0
	T5	45.2	46.9	44.0	42.3	43.9	40.6	47.3	49.2	46.6
	T6	48.1	45.9	44.4	45.3	43.2	40.6	50.6	48.1	45.9
	T7	44.3	40.0	40.9	41.4	37.0	37.9	46.9	42.3	42.8
Salicylic acid	T1	45.6	40.1	40.3	42.8	37.2	37.0	48.0	42.1	42.2
	T2	45.9	45.6	40.5	42.4	42.6	37.4	47.9	47.9	42.4
	T3	45.9	45.5	44.1	42.4	42.6	40.7	47.3	48.1	46.0
	T4	47.0	47.0	43.2	43.9	43.3	40.2	49.6	48.2	45.7
	T5	45.8	43.5	41.3	42.7	40.2	38.4	48.4	45.8	43.4
	T6	43.1	43.7	42.5	39.4	40.3	39.4	45.5	45.9	45.0
	T7	45.3	40.6	42.9	41.7	37.3	39.2	47.0	43.3	44.9
LSDpriming x treatments x saline doses		ns			ns			ns		

ns:non-significant

CONCLUSION

In this study, which was conducted to determine the effects of different application methods and doses of salicylic acid on the early development stages of broad beans grown under salt stress, germination rate, germination index, average germination time, stem length, root length, stem fresh weight, stem dry weight, root fresh weight, root dry weight, chlorophyll content before salt application, chlorophyll content after salt application and chlorophyll content before harvest were examined. While hydropriming had a positive effect on germination-related properties, salicylic acid pre-application was found to have negative effects. On the other hand, it has been determined that foliar and soil application of salicylic acid has positive effects on plant development. Increasing effects of salicylic acid compared to the control were detected in all parameters except germination parameters. Regardless of whether salicylic acid is applied foliar or soil, stem length, root length, stem fresh weight, root fresh weight, stem dry weight, root dry weight, chlorophyll content before salt application, chlorophyll content after salt application and chlorophyll content before harvest. While increasing the values compared to the control; Increasing salt concentration decreased these values compared to the control. It was determined that the salt x salicylic acid interaction had significant effects on the parameters examined. It has been determined that in plants where salt and salicylic acid are applied together, salicylic acid has a reducing effect on the negative effects of salt on the plant. It was concluded that 0.5 mM SA application is an effective method in terms of improving salinity tolerance and promoting plant development in broad bean.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

DECLARATION OF AUTHOR CONTRIBUTION

The authors declare that they have contributed equally to the article.

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