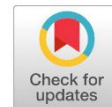


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Impact of Soaking Wheat Grains in Gibberellic Acid Under Varying Sodium Chloride (NaCl) Concentrations

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Abstract

an experiment was conducted in the laboratory of the Department of Crop Science, Faculty of Agriculture, Omar Al-Mukhtar University, during the 2022-2023 season to study the effect of gibberellic acid GA3 on the germination and growth characteristics of wheat seedlings (Salambo) under salt stress. The experiment was conducted using a completely randomized design (C.R.D) in three replications, the treatments were (soaking wheat grains in gibberellic acid, no soaking) and concentrations of sodium chloride salt (NaCl) (distilled water compared to control, 4000ppm, 6000 ppm, and 8000 ppm). The results indicated that the treatment of soaking grains in gibberellic acid was significantly superior to the treatment without soaking in all the studied traits represented by "germination percentage %, seedling length (cm), root length and shoot length "cm", seedling wet and dry weight "g" and Seedling vigour index ". The results showed highly significant differences between sodium chloride salt concentrations compared to the (Control) treatment, where the germination percentage %, seedling length "cm", shoot and root length "cm", seedling wet and dry weight (g), and Seedling vigor index decreased with increasing salt concentration up to (8000 ppm). The results showed no significant differences in the interaction between soaking treatments and sodium chloride salt concentrations in all studied traits except for germination percentage, where the treatment of soaking grains in gibberellic acid with distilled water (control) recorded the highest values compared to the lowest values recorded when grains were not treated with sodium chloride concentration (8000 ppm).

Keywords: wheat, seeding growth, gibberellic acid, conditions of salt stress

تأثير نقع حبوب القمح في حمض الجبريليك تحت تركيزات مختلفة من ملح كلوريد الصوديوم (NaCl)
المستخلص: نفذت تجربة معملية في قسم المحاصيل كلية الزراعة جامعة عمر المختار خلال موسم 2022-2023 وذلك لدراسة تأثير حمض الجبريليك على خصائص إنبات ونمو بادرات القمح صنف (سلامبو) تحت الإجهاد الملحي، نفذت التجربة باستخدام تصميم تام العشوائية في ثلاث مكررات، حيث كانت المعاملات (نقع حبوب القمح في حمض الجبريليك، عدم النقع) وتركيز ملح كلوريد الصوديوم (ماء مقطر مقارنة، 4000 جزء بالمليون، 6000 جزء بالمليون و 8000 جزء بالمليون). أشارت النتائج إلى تفوق معاملة نقع الحبوب في حمض الجبريليك معنوياً على المعاملة عدم النقع في كل الصفات المدروسة المتمثلة في "نسبة الإنبات %، طول البادرة (سم)، طول الرويشة "سم"، الوزن الرطب والجاف للبادرة "جم" وقوة الإنبات". أظهرت النتائج وجود فروقاً عالية المعنوية بين تراكيز ملح كلوريد الصوديوم مقارنة بالمعاملة بالماء المقطر حيث انخفضت صفات نسبة الإنبات %، طول البادرة "سم"، طول الرويشة والجذر "سم"، الوزن الرطب والجاف للبادرة (جم) وقوة الإنبات بزيادة تركيز الأملاح حتى 8000 جزء بالمليون. أظهرت النتائج عدم وجود فروق معنوية في التفاعل بين معاملات النقع وتركيز ملح كلوريد الصوديوم في كل الصفات المدروسة باستثناء صفة نسبة الإنبات حيث سجلت معاملة نقع الحبوب في حمض الجبريليك مع الماء المقطر أعلى القيم مقارنة بأقل القيم المسجلة عند عدم معاملة الحبوب مع تركيز كلوريد الصوديوم 8000 جزء بالمليون. أظهرت النتائج وجود فروقاً عالية المعنوية بين تراكيز ملح كلوريد الصوديوم مقارنة بمعاملة control.

الكلمات المفتاحية: القمح، نمو البادرات، حمض الجبريليك، ملح كلوريد الصوديوم (NaCl).



INTRODUCTION

Wheat is considered the most important and widespread seed crop in the world, as it leads field crops in terms of the globally cultivated area where the total area (217) million hectares reached global production of about (624) million tons (FAO, 2005). Wheat is the most important food seed crop in the world, as it provides 19% of the calories for humanity, it is the largest commercial crop that is circulated internationally and its unique flexible physical properties make it an industrial material value, so the countries are interested in cultivating its high nutritional value as well as its strategic role and its role in achieving security Food. (Collins, 1993).

Stress factors are a major reason for the deterioration of agricultural productivity, with losses ranging from 50 % and 80 % according to the type of crop and geographical location (Shinozaki et al., 2015) However, adaptation to salinity during germination of visibility and the growth of rams is very important for plants, while seed germination is a mechanism in which morphological and physiological changes lead to the stimulation of the fetus, seeds absorb water before germination, which leads to the elongation of the seed fetus when it grows The root is a layer of covered seeds, the seed germination process (Hermann et al., 2007). germination is the most important stage in the life cycle of the plant, and it is a decisive factor in determining the distribution of vegetarian species (1993, many researchers assess the processes included in seed germination and how they are affected by non -non-biological stress, and salt mediation on one type or more of the stressful media that which that It is known that it affects many physiological and environmental characteristics such as plant growth, development, reproduction and geographical distribution (QU and Huang, 2005). Research revealed the effect of salinity on the germination of the various seeds of crops belonging to the naughty, vertical, and vehicle families, the most important of which is wheat germination (Akbarimoghaddam et al.,2011).

The growth of crops in harsh environments, including saline soils, remains one of the most significant challenges for researchers in agriculture and plant production. Soil salinity is a critical issue that restricts agricultural expansion in many regions worldwide, particularly in arid and semi-arid areas. Salinity adversely impacts seed germination rates and affects various stages of plant growth, disrupting physiological functions critical to development.

As global populations grow, countries are striving to increase agricultural production to achieve self-sufficiency and ensure nutritional security. To address this, farmers employ diverse strategies to enhance crop yields, such as the application of fertilizers or plant growth regulators like gibberellic acid (GA3). Gibberellic acid, a plant hormone produced in the leaves and developing tips of roots and stems, promotes cell elongation and helps reduce the detrimental effects of saline stress.

This study aims to evaluate the effects of gibberellic acid on the Salambo wheat variety, focusing on its ability to improve germination characteristics and early growth under saline stress conditions. By investigating these effects, the study seeks to provide insights into practical solutions for managing salinity challenges in agriculture.

MATERIALS AND METHODS

A lab experiment was carried out in the Seed Technology Laboratory, Department of Crop Sciences, Faculty of Agriculture, Omar Al-Mukhtar University, during the "2022-2023" season to determine the effect of soaking wheat seeds with gibberellic acid on improving germination characteristics under saline solution conditions. A completely random design with three replica-

tions was used to carry out the experiment I used 10 sterile seeds for each dish under the factors of the laboratory in the degree of temperature ($25\text{ }^{\circ}\text{C}$) to know the effect of soaking the seeds with gibberellic acid (GA3) 500PPM for 24 hours and another soaked in distilled water for the same fruit for germination and growth of seeds in salt circles with different concentrations resulting from Dissolve the quantities of sodium chloride salt (NaCl) with a concentration of 99.9 % in distilled water(Control, 4000 PPM, 6000 PPM, and 8000 PPM) to study the effect of gibberellin and sodium chloride salts levels on the characteristics of germination and growth of wheat seeds. The studied characteristics were as follows:-

1- germination percentage (%) It was measured after the end of the period of measurement 7 days) according to (ISTA, 2005).

Germination percentage (%) = Number of developing seedlings /number of total seeds x 100.

After "14 days of germination, the following traits were recorded:

2-Seedling length(cm).

3-Root length "cm".

4-Shoot length "cm".

5-Wet weight of seedling (g)

6- Seedling dry weight (g).

7- Seedling vigor index)SVI).

Seedling vigor index(SVI)= shoot length+ root length X Germination percentage (%).

According to (Arafa et al., 2009)

Statistical analysis

Data were subjected to regular analysis of variance of CRD according to the method outlined by (Gomez & Gomez 1984) using the Gestate computer program. The comparison test between treatments was made according to the least significant differences method (LSD). LSD values were calculated to verify differences between means).

RESULTS AND DISCUSSION

Germination percentage (%)

Results in Table (1) showed that there is a highly moral effect of gibberellic acid on the percentage of germination, as the highest values were recorded when the wheat bean was soaked in the gibberellin GA3 (95.80 %) compared to the least when the soaking in distilled water (80.00 %) and this is agreed upon With what is mentioned (Attia & Jaddoa, 2011)that gibberellic acid is one of the most important growth organizations that increase physiological changes, which increases the percentage of germination and stimulating cell elongation. The data in Table (1) demonstrated that the increase in the concentration of salts led to a reduction in the percentage of germination, as the treatment of the control (distilled water) exceeded morality over the rest of the concentration transactions. 8000 ppm (53.3 %) and the reason may be attributed to the fact that the increase in salinity in growth leads to a decrease in the percentage of germination due to rising salts for osmotic pressure in the center of the cell, which reduces the amount of water that is easy Which causes failure or delaying germination (Othman et al., 2006)

The interaction between the soaking of gibberellic acid and the concentration of sodium chloride showed moral differences, as the treatment of grain soaking with gibberellic acid exceeded the distilled water in giving the highest values to the average percentage of the germination of (99.7 %), while the treatment of illegal grains with the concentration of sodium chloride salt

8000 PPM was recorded less Values (66.30 %). The observed differences arise from the role of gibberellin in promoting seed growth under stress conditions.

This response was linked to the activation of antioxidant systems. (Carvalho et al., 2011).

Table (1). Effect of Soaking Wheat Seeds of the Salambo Variety in Gibberellic Acid under Different Concentrations of Sodium Chloride Salt on Germination Percentage (%) Characteristics

Salt concentration					
gibberellic acid treatment	0 ppm	4000 ppm	6000 ppm	8000 ppm	Square gibberellin
soaking with gibberellin	99.70	95.70	80.00	67.20	95.80
non-soaking with gibberellin	95.00	86.70	76.60	66.30	80.00
L.S.D _{0.05}	9.09				
Square salt concentration	93.90	91.70	83.30	53.30	7.07
L.S.D _{0.05}	7.04				

Seedling length (cm)

From the results shown in Table (2), we notice that there are highly significant differences between soaking treatments with gibberellin or non-soaking, as the treatment of soaking wheat seeds in gibberellin gave the shoot length characteristic the highest value (8.63 cm) compared to the lowest value when not treated (7.39 cm). Increasing salt concentrations led to a decrease in seedling length, as the highest value (11.56 cm) was recorded when treated with distilled water compared to the lowest value (5.27 cm) when the salt concentration was 8000 ppm. This is consistent with what (Piwowarczyki *et al.*, 2014) mentioned that the decrease in length Transplantation with increased salt stress led to an impediment in the absorption of water and mineral elements due to a decrease in the difference in the solution potential between the plant and the growth medium. The interaction between grain soaking treatments in gibberellin and salt concentrations did not reach the level of significance, which indicates the independence of the two study factors in their effect on the seedling length (cm).

Table (2). Effect of Soaking Wheat Seeds Salambo Variety in gibberellic acid under different concentrations of Sodium Chloride Salt to Seedling length(cm) characteristic

Salt concentration						
	gibberellic acid treatment	0 ppm	4000 ppm	6000 ppm	8000 ppm	Square gibberellin
soaking with gibberellin		12.70	9.04	7.50	5.30	8.63
non-soaking with gibberellin		10.42	7.47	6.43	5.23	7.39
L.S.D _{0.05}		N.S				0.96
Square salt concentration		11.56	8.25	6.97	5.27	
L.S.D _{0.05}		1.36				

Root length (cm):

Data from Table (3) show that there are no significant differences between the grain soaking treatments in gibberellic for root length (cm), while the data from the same table showed that there are highly significant differences between salt concentrations. The irrigation treatment with distilled water recorded the highest values with an average root length (5.27 cm) compared to the lowest values (2.18 cm) recorded when wheat grains were treated with salts at a concentration of 8000 ppm. This is consistent with what was stated by (Leyl et al., 2012) that increas-

ing the concentration of salts leads to negative effects on the length of the root and shoot. The interaction between soaking treatments of wheat grains in ink and salt concentrations did not show a significant effect, which indicates the independence of the two study factors in their effect on this trait.

Table (3). Effect of Soaking Wheat Seeds Salambo Variety in gibberellic acid under different concentrations of Sodium Chloride Salt to Root length (cm) characteristic.

Salt concentration gibberellic acid treatment	0 ppm	ppm 4000	6000 ppm	8000 ppm	Square gib- berellin
soaking with gibberellin	5.67	3.91	2.77	2.07	3.60
non-soaking with gibberellin	4.86	3.00	2.77	2.10	3.23
L.S.D _{0.05}	N.S				
Square salt concentration	5.27	3.34	2.88	2.18	N.S
L.S.D _{0.05}	0.87				

Shoot length (cm)

The results obtained from Table (4) show that there are highly significant differences between the treatments in the character of the shoot length (cm), where the treatment of soaking wheat grains in gibberellin gave the highest values compared to the lowest values recorded when the grains were not treated, (5.03 cm), (4.16 cm) respectively. Increasing the concentration of salts up to a concentration of 8000 ppm led to a decrease in the length of the shoot. The highest values were recorded in the irrigation treatment with distilled water (6.29 cm) compared to the lowest averages recorded at a concentration of 8000 ppm (3.08 cm). This was consistent with what was mentioned by (Leyl et al., 2012) that salinity hurts the length of the shoot. The interaction between the treatments of soaking wheat grains in acrylic and salt concentrations did not show a significant effect, which indicates the independence of the two study factors in their effect on this trait.

Table (4). Effect of Soaking Wheat Seeds Salambo Variety in gibberellic acid under different concentrations of Sodium Chloride Salt to shoot length(cm) characteristic

Salt concentration gibberellic acid treatment	0 ppm	4000 ppm	6000 ppm	ppm8000	Square gibberellin
soaking with gibberellin	7.03	5.13	4.73	3.23	5.03
non-soaking with gibberellin	5.55	4.70	3.43	2.93	4.16
L.S.D _{0.05}	N.S				
Square salt concentration	6.29	4.92	4.08	3.08	0.59
L.S.D _{0.05}	0.83				

Seedling wet weight (g)

Data from Table (5) show that there are significant differences between the treatments of soaking grains in gibberellin for the seedling wet weight (g). Gibberellin treatment of wheat grains produced the highest average (0.309 g), whereas non-soaking (control) produced the lowest value (0.292 g). The salinity treatments had a significant effect on the wet weight. Increasing

the salinity concentration led to a decrease in the wet weight up to a concentration of 8000 ppm. The treatment of irrigating the wheat grains with water gave the salinity treatments a significant effect on the wet weight. Increasing the salinity concentration led to a decrease in the wet-weight up to a concentration of 8000 ppm, the treatment of irrigating wheat grains with distilled water gave the highest values with an average of (0.331 g) compared to the lowest values recorded at a concentration of 8000 ppm with an average of (0.267 g). When wheat grains were treated with distilled water and gibberellin, the greatest value was 0.342 g, while the lowest value was 0.265 g when the grains were not soaked at a salt concentration of 8000 ppm. (Anaya et al., 2013) indicated that the fresh and dry weights of the raw wheat or the stem are affected by changes in salinity concentration. The interaction between soaking treatments of wheat grains in acrylic and salt concentrations did not show a significant effect.

Table (5). The effect of soaking Salambo variety wheat seeds in gibberellic acid at varying sodium chloride salt concentrations on the wet weight (g) characteristics of the seedlings

Salt concentration gibberellic acid treatment	Salt concentration				
	0 ppm	4000 ppm	6000 ppm	ppm8000	Square gibberellin
soaking with gibberellin	0.342	0.320	0.304	0.286	0.309
non-soaking with gibberellin	0.320	0.317	0.268	0.265	0.292
L.S.D _{0.05}	9.09				0.16
Square salt concentration	0.331	0.319	0.287	0.267	
L.S.D _{0.05}	0.03				

Dry weight of seedlings (g)

Data from Table (6) shows that there are highly significant differences between the treatments for soaking wheat grains in gibberellin regarding the dry weight of the seedling (g), where the treatment of soaking wheat grains in gibberellic acid gave the highest averages (0.176 g) compared to the non-soaking treatment (0.157 g). The seedling dry weight (g) was significantly affected by increasing salt concentrations. Seedling weight decreased with increasing salt concentration up to 8000 ppm, which gave the lowest average seedling weight (0.137 g) compared to the highest values recorded when irrigating wheat grains with distilled water (0.195 g). These results are in agreement with what was stated by (Memon *et al.*, 2010) that the dry and fresh weights are affected by increasing the concentration of salts and the type of plant. The interaction between gibberellic acid soaking treatments and salt concentrations did not show significant differences.

Table (6). The effect of soaking Salambo variety wheat seeds in gibberellic acid at varying sodium concentrations Chloride Salt to Dry weight of seedlings (g) characteristic

Salt concentration gibberellic acid treatment	Salt concentration				
	0 ppm	4000 ppm	6000 ppm	ppm 8000	Square gibberellin
soaking with gibberellin	0.206	0.184	0.169	0.143	0.176
non-soaking with gibberellin	0.184	0.181	0.132	0.129	0.157
L.S.D 0.05	N.S				
Square salt concentration	0.195	0.183	0.151	0.137	0.015
L.S.D 0.05	0.022				

Seedling vigor index (SVI)

The results obtained in Table (7) showed that there were highly significant differences between the soaking treatments in gibberellin for the Seedling vigor index (SVI) the treatment of soaking wheat grains in gibberellic acid gave the highest average for SVI (825) compared to the lowest value when not treated (608). This came as follows: In agreement with what was found by (Attia and Jaddoa, 2011), they indicated that gibberellic acid is considered an essential auxiliary factor in the formation of the alpha-amylase enzyme in the aleurone layer of the endosperm of cereal grains. This enzyme mainly works to convert starch into reducing sugars, which leads to raising the osmotic pressure in the cells. Plants then increase the entry of water and food into them, causing them to swell and increase in size. The data from the same table also showed that there were highly significant differences between the salt concentration treatments. The highest averages were recorded when treating wheat grains with distilled water (1081) compared to the lowest (420) at a concentration of 8000. Ppm. The interaction between soaking treatments of wheat grains in ink and salt concentrations did not show a significant effect, which indicates the independence of the two study factors in their effect on this trait.

Table (7). The effect of soaking Salambo variety wheat seeds in gibberellic acid at varying sodium chloride salt concentrations on the characteristics of the seedling vigor index (SVI)

Salt concentration Gibberellic acid treatment	Salt concentration					Square gibberellin
	0 ppm	4000 ppm	6000 ppm	ppm8000		
soaking with gibberellin	986	869	678	530		825
non-soaking with gibberellin	938	651	495	349		608
L.S.D _{0.05}	N.S					96.4
Square salt concentration	1081	760	586	420		
L.S.D _{0.05}	136.4					

CONCLUSION

To obtain good germination of wheat grains under conditions of salt stress, it is necessary to treat the wheat grains by soaking them in gibberellic acid GA3 at a concentration of 500 ppm for 24 hours, which improves the germination and growth characteristics of the seedlings.

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