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ESPONSE OF SOAKING WITH (ACADIAN) ON SEED VIGOR OF WHEAT UNDER SALT STRESS

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ABSTRACT

A laboratory experiment was carried out in the laboratories of (Seed Examination and Certification Department of the Ministry of Agriculture and Postgraduate Laboratories- College of Agricultural Engineering Sciences - University of Baghdad) in 2021-2022, to determine the best combination of acadian concentration (seaweed extract) 0, 1500, 2000 and 2500 mg/L , under three levels of salt stress 5, 10 and 15 dS/m as well as control treatment through traits of seedlings of wheat (cv. Tammuz). A factorial experiment was applied according to a completely randomized design with three repetitions. The seed soaking treatment was superior to the concentration 2500 mg/L in the first count, final count, radicle length, stalk length, seedling strength index, and seedling dry weight. The salt tensile level 15 dS/m negatively affected the averages of all studied traits. The combination 5 dS/m × 2500 mg/L recorded a significant superiority in (first count, radicle length, stalk length, seedling strength index). A combination of 0 NaCl × 2500 mg/L significantly in the final count.

Keywords: Acadian, seaweed, germination, seed vigor, salt stress, saline, NaCl

استجابة النقع بمستخلص (الأكاديان) في قوة بذور الحنطة تحت الأجهاد الملحي

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الخلاصة

نفذت تجربة مختبرية في مختبرات دائرة فحص وتصديق البذور لوزارة الزراعة ومختبرات الدراسات العليا - لكلية علوم الهندسة الزراعية – جامعة بغداد للعام 2021 -2022 ، لتحديد أفضل توليفه من تركيز الأكاديان (مستخلص الطحالب البحرية) 0 و1500و2000 و2500 ملغم/لتر، تحت ثلاثة مستويات من الأجهاد الملحي 5 و10 و15 ديسي سيمنز/م فضلاً عن معاملة المقارنة من خلال الصفات لبادرات الحنطة صنف تموز. طبقت تجربة عاملية على وفق تصميم تام التعشية بثلاث تكرارات. تفوقت معاملة نقع البذور التركيز 2500 ملغم/لتر في العد الأول والعد النهائي وطول الجذير طول الرويشة ودليل قوة البادرة والوزن الجاف للبادرة. ان مستوى الشد الملحي15 ديسي سيمنز/م أثر سلباً في متوسطات الصفات المدروسة كافة. سجلت التوليفة 5 ديسي سيمنز/م × 2500 ملغم/لتر تفوقاً معنوياً في (العد الأول، طول الجذير، طول الرويشة، دليل قوة البادرة). وسجلت توليفة 0 كلوريد الصوديوم × 2500 ملغم/لتر معنوياً في صفة العد النهائي.

الكلمات المفتاحية: أكاديان، الطحالب البحرية، الأنبات، قوة البذور، الإجهاد الملحي، الملوحة، كلوريد الصوديوم.

INTRODUCTION

Wheat is one of the crops that are moderately sensitive to salinity. Bread wheat varieties that grown at central and southern of Iraq, which lands consider medium to highly saline. The most important soluble salts in the soil are sodium and magnesium chloride, and

sodium, calcium and magnesium sulfate. Many studies dealt with the effect of salinity on germination, growth and plant productivity, and proved that the seeds of many plants are not germinate in environments with high salinity due to the inability of the embryo to germinate as a result of damage to the embryonic organs under these conditions **(Aklous, 2001)**. Therefore, the researchers sought great interest in increasing the wheat yield and narrowing the gap between production and consumption by increasing the yield per unit area by vertical expansion by following field practices, the most important of which is the use of fertilizers. Recently, studies have proven that the use of marine algae extracts has a positive effect on the rate of seed germination and on the speed of growth and production quality of the studied agricultural crops. This is due to the fact that these extracts contain effective compounds such as fatty acids, amino acids, vitamins and hormones, which in turn make the plant tolerate salt stress **(Karim & AL-Ajeel, 2012)**. Research has confirmed that plants have mechanisms to withstand abiotic stress. Among these mechanisms (protein synthesis, accumulation of multiple amines, facilitation of membrane transport, change in gene expression, regulation of hormonal balance, and accumulation of solutes), these solutes include a wide range of compounds such as proline, monosaccharides, disaccharides, alcohols, and citrulline **(Hamzawy, 2013)**.Studies have been sought to mitigate these damages in several ways, including choosing salinity-resistant varieties and farming in ways that reduce the effect of salt on the plant, this includes the soaking treatment with marine algae extracts, as it is a good source of active substances that can benefit in mitigating and overcoming the negative effects of salinity, which are hormones such as auxine, cytokinin and gibberellic, in addition to amino acids, as well as betaine compounds **(AL-Zraidi, 2019)**. Acadian extract activates the seeds, thus reducing the time needed for germination and stimulating germination enzymes, thus reducing the period of time needed for seed germination and seedling growth. Among the previous studies, a study showed that soaking sorghum seeds with Acadian extract at a concentration of 1500 mg/L for 24 h gave an increase in germination percentage of 86% and an increase in radicle length by 4.425 cm and an increase in the plumule length 19.04 cm **(AL-Rawi, 2018)**.

The research aims to study the effect of different concentrations of sodium chloride salt NaCl on the germination and growth of seedlings of the wheat plants (cv. Tammuz), as well as an attempt to reduce the damage of salinity to the germination and growth of seedlings by using the soaking technique with seaweed extract (Acadian).

MATERIALS AND METHODS

A laboratory experiment was carried out to find out the best combination of soaking wheat seeds with Acadian extract 0, 1500, 2000 and 2500 mg/L under three saline stresses in addition to the control treatment 5, 10 and 15 dS/m. The experiment was carried out according to a factorial experiment in completely randomized design with three replicates. The seeds of cv. Tammuz obtained from the Research Station of Agricultural Research Department, Ministry of Agriculture. Seed of working Samples, then 300 pure seeds were taken for each treatment and divided to 100 seeds for each replicate **(ISTA, 2020).** then washed well with water. The concentrations under study were prepared from Acadian solutions of Canadian origin (a natural vital nutrient of plant origin containing 50% of marine algae) after dissolving 3 g of Acadian in a beaker and adding a little deionized water to it and mixing the solution using the electric mixer to dissolve the solution and homogeneity and then complete the volume to 1 L to prepare a solution with a concentration of 1500 mg/L , and so for the rest of the concentrations, and those seeds were distributed alternately on special germination papers with dimensions (20×30) cm and the method of rolling was used and then they were inserted

into sterile and clean nylon bags to maintain their moisture, then they were placed in incubator at a temperature (25±2°C) and a humidity of 70% for 8 d. At the end of germination period, the required traits were estimated.

Standard laboratory germination test

From each experimental unit, 300 pure seeds were taken, soaked for 12 h, then washed and dried, with a rate of 100 seeds for each replicate. Seeds distributed alternately on special germination sheets of dimensions 20 × 30 cm^2 between two layers of paper, two sheets at the bottom and covered with the third, using the method of wrapping, then inserted into nylon bags. to maintain moisture, then placed in the incubator at a temperature of (25±2°C), and humidity 80%, and lighting for 8 d **(ISTA, 2020)**.

Studied characters:

First count:

The first count of germination was calculated after the 4 d of sowing **(ISTA, 2020)**.

Final germination count:

This examination was carried out after 8 d of placing the seeds in the germinator and the percentage of germination was calculated by dividing the number of natural seedlings by the total number of seeds expressed as a percentage **(ISTA, 2020)**.

Radicle length (cm):

The length of the radicle was measured after separating it from the seed connect point and measured using a ruler **(Hampton & Tekrony، 1995)**.

Plumule length (cm):

It was measured after separating it from the point of its connection with the embryonic peduncle using a ruler **(Hampton & Tekrony، 1995)**.

Seedling vigor index:

$Seedling\ vigor\ index = (\%\ germination\ in\ the\ final\ count) \times (radicle\ length\ cm + plumule\ length\ cm)$ **(Murti *et al.*, 2004).**

Dry weight of seedling (mg) in standard germination:

The embryonic axonal parts (radicle and pulmule) were placed in perforated bags in an electric oven at a temperature of 80ºC for 24 h, then weighed with a sensitive electric scale and extracted the average of dry weight by dividing the total weights of seedlings by their number **(Farooq *et al*., 2005)**.

RESULTS AND DISCUSSION

First count (%)

The results showed that there were significant differences in the first count with an increase in Acadian concentrations (Table, 1) as the concentration 2500 mg/L gave the highest mean of 84.17% with insignificant differences from the concentration 2000 mg/L, which gave an average of 83.25% compared to the control treatment that recorded the lowest average of 78.58%. This is explained by the fact that the Acadian contains compounds that have the ability to stimulate the proteinase enzyme, which works to degrade proteins at the start of germination, and that soaking with seaweed extracts improves the physiological processes inside the seed, which contribute to increasing the germination rate of most crops to give strong seedlings **(Zhang & Ervin, 2008; AL-Rawi, 2018)**.

The results showed a decrease in the germination rate of wheat seeds with an increase in saline concentrations, as the control treatment recorded a significant increase over the rest of the concentrations amounting to 94% with no significant differences from the concentration 5

dS/m, which gave an average of 93% (Table, 1). The decrease in the percentage of germination due to the effect of salts may be due to the role of salts in inhibiting the metabolic processes that occur during germination and the subsequent processes that promote growth and the creation of a normal seedling, this agrees with what indicated by **(Mustafa *et al.*, 2020)**.

Table (1). Effect of soaking wheat seed with Acadian and NaCl and their interaction on first count (%).

NaCl Concetration (dS/m)	Acadian (mg/L)				NaCl mean
	0	1500	2000	2500	
0	93.33	96.00	95.00	95.00	94.83
5	90.67	93.33	95.33	96.00	93.83
10	74.00	75.67	78.67	79.67	77.00
15	56.33	63.00	64.00	66.00	62.33
$LSD_{0.05}$	2.81				1.41
Acadian mean	78.58	82.00	83.25	84.17	
$LSD_{0.05}$	1.41				

The results also showed the significance of the interaction between saline concentrations and Acadian extract concentrations, as the combination 5 sodium chloride × Acadian 2500 mg/L gave the highest mean for the character 96%, compared to the combination 15 dS/m × soaking with deionized water which gave the lowest average of 66%.

Final count (%)

The results showed that there were significant differences in the percentage of germination in the final count by increasing the concentrations of Acadian extract, as the concentration of 2500 mg/L gave a maximum average of 86.42% compared to the untreated seeds (deionized water) which gave the lowest mean of 80.67% (Table, 2). This is consistent with **(AL-Rawi, 2018)**.

where the researcher indicated that there is an increase in the percentage of laboratory germination with an increase in the concentration of Acadian, the reason may be that Acadian contains compounds that have the ability to stimulate the proteinase enzyme, which works to degrade proteins at the start of germination, which leads to an improvement in the process of seed germination, thus increasing the percentage of seed germination, these results are consistent with what was reached **(Ashraf, 2005)**.

The results showed that there was a decrease in the percentage of germination in the final count by increasing the salinity concentrations, as the control treatment was significantly superior to the rest of the concentrations, as it gave an average of 97.25%, while the lowest average was at the concentration 15 dS/m with 65.17%. Studies have shown that the seeds of many types of plants do not germinate in environments with high salinity as a result of the inability of the embryo to germinate due to damage to the embryonic organs under these conditions, which causes salt stress, failure or slow germination due to the effects of salinity in raising the osmotic pressure in the vicinity of the seed and a decrease or slow absorption with water, as well as affecting physiological and biological processes **(Aklous, 2001; Ur- Rahman *et al.*, 2008)**.

The results also showed a significant interaction between the salt concentrations and the concentrations of Acadian extract, as the combination 0 sodium chloride × Acadian 2500 mg/L

gave the highest mean for the character reached 98.33% compared to the combination 15 dS/m× soaking with deionized water, which gave the lowest average of 59%.

Table (2): Effect of soaking wheat seeds with Acadian and NaCl and their interaction on final count (%).

NaCl Concetration (dS/m)	Acadian (mg/L)				NaCl mean
	0	1500	2000	2500	
0	95.33	97.67	97.67	98.33	97.25
5	92.67	95.67	97.33	97.67	95.83
10	75.67	78.00	79.67	81.00	78.58
15	59.00	66.33	66.67	68.67	65.17
$LSD_{0.05}$	3.12				1.56
Acadian mean	80.67	84.42	85.33	86.42	
$LSD_{0.05}$	1.56				

Radicle length (cm)

The results showed that there were significant differences in radicle length, and the best results were obtained from the treatment of soaking Acadian extract at a concentration 2500 mg/L, which gave a maximum average of 11.03 cm compared with the untreated seeds that gave the lowest average of 9.82 cm (Table, 3). This agrees with **Demir *et al*. (2006)** that marine algae increase the growth of radicles and the vegetative system, increases the plant's resistance to biotic and abiotic stress, increases the quantity of yield, improves its quality, and delays the aging of fruits.

The results showed a significant effect of sodium chloride salt concentrations on the mean radicle length of wheat seedlings and, as the concentration 15 dS/m gave the lowest mean of 8.13 cm compared to the control treatment, which gave the highest mean of 12.54 cm. The reason for the low average of radicle length in high concentrations of sodium chloride is due to the damage caused by salt stress, as high concentrations of salt impede water absorption and radicle emergence **(AL-Zraidi, 2019)**.

The results also showed a significant interaction between the salt concentrations and the concentrations of Acadian extract, as the combination 5 dS/m × Acadian 2500 mg/L gave a higher mean for the trait that reached 13.40 cm, compared to the combination 15 dS/m × soaking with deionized water, which gave the lowest mean of 7.73 cm.

Table (3): Effect of soaking wheat seeds with Acadian and NaCl and their interaction on radicle length (cm).

NaCl Concetration (dS/m)	Acadian (mg/L)				NaCl mean
	0	1500	2000	2500	
0	11.80	12.57	12.97	12.83	12.54
5	10.43	11.23	12.53	13.40	11.90
10	9.30	9.67	9.37	9.77	9.53
15	7.73	8.23	8.47	8.10	8.13
$LSD_{0.05}$	0.70				0.35
Acadian mean	9.82	10.43	10.83	11.03	
$LSD_{0.05}$	0.35				

Plumule length (cm)

The results showed significant differences in the length of the plumule, and positive results were obtained from the treatment of soaking Acadian extract at a concentration of 2500 mg/L, which gave a maximum average of 7.76 cm (Table, 4). The reason for the increase in the length of the plumule by the effect of the Acadian extract is that the seaweed fertilizer increases the percentage of seed germination and encourages the growth of the radicle and the plumule in the seed. It also increases the permeability of the cell wall in the cells of the plant radicles and thus increases the rate of entry of nutrients to the plant, which in turn encourages plant growth **(AL-Rawi, 2018)**.

The results showed that there was a significant effect of the concentration of sodium chloride salt in the mean length of the plumule in the seedling, as the concentration 15 dS/m gave the lowest mean of 4.69 cm compared to the control treatment, which gave the highest mean of 8.28 cm. The reason for the decrease in the average length of the plumule at high salt concentrations may be because salt stress affects the growth of seedlings by reducing or slowing down the transport of nutrients necessary for cell division and expansion and causing damage to the plumule sheath **(Tezara *et al*., 2003)**.

The results also showed a significant interaction between the salt concentrations and the concentrations of Acadian extract, as the combination 5 dS/m × Acadian 2500 mg/L gave a higher mean of 9.67 cm compared to the combination 15 dS/m × soaking with deionized water which gave the lowest mean of 4.10 cm.

Table (4): Effect of soaking wheat seeds with Acadian and NaCl and their interaction on plumule length (cm).

NaCl Concetration (dS/m)	Acadian (mg/L)				NaCl mean
	0	1500	2000	2500	
0	7.90	8.23	8.87	8.13	8.28
5	7.53	8.93	9.23	9.67	8.84
10	6.43	7.53	8.50	8.63	7.78
15	4.10	5.07	5.00	4.60	4.69
$LSD_{0.05}$	0.77				0.39
Acadian mean	6.49	7.44	7.90	7.76	
$LSD_{0.05}$	0.39				

Seedling vigor index

The results showed that there were significant differences in the mean of the seedling vigor index, as the results were achieved when the Acadian extract was soaked with a concentration of 2500 mg/L , which had a maximum average of 1669.2, compared with the untreated seeds control treatment, which gave the lowest mean of 1358.5 (Table, 5). This is due to the role of the hormone Auxin, which is contained in the extract of marine algae, which is known to encourage cell elongation and the growth of radicles and leaves, as well as to the content of the extract on amino acids, which is attributed to its role in the positive impact on vegetative growth and radicle system **(AL-Zraidi, 2019)**.

The results indicated that there was a significant effect of sodium chloride salt concentrations on the mean of the seedling vigor index, as the concentration 15 dS/m gave the lowest mean of 838.0 compared to the control treatment which gave the highest mean of 2026.0.

The results also showed the significant interaction between saline concentrations and Acadian extract concentrations, as the combination of 5 dS/m × Acadian 2500 mg/L gave the highest mean of 2252.8, compared to the combination 15 dS/m × soaking with deionized water, which gave the lowest average of 699.9.

Table (5): Effect of soaking wheat seeds with Acadian and NaCl and their interaction on seedling vigor index.

NaCl Concetration (dS/m)	Acadian (mg/L)				NaCl mean
	0	1500	2000	2500	
0	1877.9	2031.6	2132.8	2061.8	2026.0
5	1664.8	1929.0	2118.6	2252.8	1991.3
10	1191.1	1341.6	1423.2	1490.0	1361.5
15	699.9	882.1	897.9	872.2	838.0
$LSD_{0.05}$	114.0				57.0
Acadian mean	1358.5	1546.1	1643.1	1669.2	
$LSD_{0.05}$	57.0				

Dry weight (mg)

The results showed a significant effect of the concentrations of Acadian extract on dry weigh, as the dry weight increased by increasing the concentration of Acadian extract. The concentration 2000 mg/L gave the highest mean of 0.170 mg compared to the untreated seeds (the control treatment), which gave the lowest mean of 0.123 mg for dry weight (Table, 6). The reason for the increase in dry weight may be due to the role of vitamins E, B, and C, as well as to the role of the compounds included in marine algae extract such as enzymes, chlorophyll and the necessary amino acids, which led to an increase in the ability of the plant to manufacture soluble materials and their accumulation in the plant **(Mohammed & Saleh, 2019)**. These results agreed with what was found by **AL-Janabi *et at.* (2017)** who obtained an increase in the dry weight of fig seedlings by the effect of spraying seaweed extract.

The results indicated that there was a significant effect of sodium chloride salt concentrations on the percentage of dry weight and, as the concentration 15 dS/m gave the lowest mean of 0.116 mg compared to the concentration 5 dS/m, which gave the highest mean of 0.166 mg. The reason for the low dry weight in the high salt medium 15 dS/m may be attributed to the fact that salt stress increases the absorption and collection of toxic ions such as Na^+ and Cl^- in the vegetative system and reduces the absorption of some nutrients and thus affects the vegetative growth in general **(AL-Nuaimi, 2015)**. These results agreed with (**Khayatnezhad & Gholamin, 2011)** who indicated that the dry weight of maize seedlings was negatively affected by an increase in the levels of sodium chloride salinity.

The results also showed the significant interaction between saline concentrations and Acadian extract concentrations, as the combination 10 dS/m × Acadian 2000 mg/L gave the highest mean for the characteristic of 0.197 mg, compared to the combination 15 dS/m × soaking with deionized water, which gave the lowest average for the character was 0.102 mg.

Table (6): Effect of soaking wheat seeds with Acadian and NaCl and their interaction on dry weight (mg).

NaCl Concetration (dS/m)	Acadian (mg/L)				NaCl mean
	0	1500	2000	2500	
0	0.148	0.163	0.173	0.173	0.164
5	0.132	0.162	0.185	0.184	0.166
10	0.110	0.143	0.197	0.190	0.160
15	0.102	0.116	0.125	0.120	0.116
$LSD_{0.05}$	0.010				0.005
Acadian mean	0.123	0.146	0.170	0.167	
$LSD_{0.05}$	0.005				

CONCLUSION

the soaking of wheat seeds (Tammuz) with Acadian extract reduces the effect of salt stress and increases the viability of the seeds by increasing the viability and vigor of the seeds by improving the percentage of germination and its properties. We recommend soaking wheat seeds at a concentration of 2000 mg/L of Acadian extract before planting.

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