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EFFECT OF TREATING SEED WITH DIFFERENT LEVELS OF SALICYLIC ACID IN SOIL TOLERANCE TO SALINITY STRESS FOR DIFFERENT CULTIVARS OF WHEAT CROP (*TRITICUM AESTIVUM* L).

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Abstract

The study includes two studies aimed at assessing the tolerance of three wheat cultivars (IPPA 99 and TAMOOZ 1 and Abu Ghraib) for salinity soil with the determination the most tolerant cultivar for saline and determination of salinity tolerant mechanisms, as well as the use of growth regulator Salicylic acid at three levels (0, 25 and 50 ppm) in the two studies, in order to know the effect of this regulator in increasing the tolerance of salinity. The first study included a rapid assessment of salinity tolerance through germination test of cultivars under different salinity levels (0, 4, and 8 ds.m^{-1}). The results showed that salinity at level 4 ds.m^{-1} did not affect the percentage of healthy seedlings, while the high salinity reduced the germination rate. The growth regulator at Concentration 25 ppm increased the germination rate at different levels of salinity, excelling the level at Concentration (50) ppm and control treatment, respectively. As for the tested cultivars, the cultivars IPPA99 and TAMOOZ 1 were excelled on the Abu Ghraib in the percentage of germination of healthy seedlings. The second study included the effect of growth regulator treatment on the salinity tolerance for three cultivars of wheat grown in soil salinity (9.13 ds.m^{-1}). The results showed that salinity reduced all values of the studied traits. The growth regulator at Concentration 25 ppm increased in the traits of plant height, number of spike and grain weight, excelling the level at Concentration (50) ppm and control treatment, respectively. As for the cultivars, the cultivar IPA 99 was excelled on the two cultivars (TAMOOZ 1 and Abu Ghraib) respectively, in the traits of plant height, number of spike and grain weight.
***Key words* :** Germination, wheat cultivars, Salicylic acid, Salt stress.

Introduction

The soil salinity or irrigation water salinity is one of the most important problems facing agriculture on a global scale, particularly in Dry and semi-dry regions (Munns and Tester, 2008). The problem of salinity in Iraq has been exacerbated in recent years due to the rain scarcity, water scarcity resources and the deterioration of quality or bad management. Al-Anbari *et al.* (2009) indicated after applying a laboratory experiment to study the effect of irrigation with salty water (2, 4 and 8 ds.m^{-1}). In the germination and growth of five cultivars of bread wheat, The increase in the salinity of irrigation water led to a significant decrease in averages height and dry weight of plumule, radical and the content of seedling leaves of chlorophyll and potassium, while the concentration of sodium increased, Yasin (2013) concluded after applying a laboratory experiment, which within it the seeds of wheat were exposed to five levels of salinity (0, 3, 6, 9, and 12) ds.m^{-1}, that the salinity levels did not have a significant effect on the number of germinated seeds after two weeks, While salinity levels significantly reduced the germination speed, lengths and weights of both the plumule and radicle. It, naturally, the best way to obtain plants tolerant for salinity, including wheat in the development of saline-tolerant cultivars. However, this aim is difficult to achieve at present, because salinity is a complex trait controlled by many genes (Multigenic Trait), It is difficult to transfer even using plant genetic engineering techniques. Therefore, it is necessary to use alternative technologies at the present time in order to decrease the damage of salinity on the germination of wheat seeds and from these technologies are the use of soaking in to growth regulators. Afzal *et al.* (2005) indicated that the soaking of wheat seeds in growth regulators such as salicylic acid with three concentrations (25, 50 and 100 ppm) for 12 hours increase the germination speed, length of the plumule and radicle under saline conditions. Depp and Susi (2007) showed that the soaking of wheat seeds in salicylic acid resulted in increased relative tolerance of salinity. Where the soaking caused a significant increase in the final percentage of emergence and mean of emergence time and significantly increased length of the plumule and radicle and the fresh and dry weight under normal conditions. (2.5) ds.m^{-1} and saline (12 ds.m^{-1}). Therefore, the study aims to knowing the highest concentration of salinity that can germinate in it wheat seeds and knowing the effect of wheat seed response to growth organizations as well as the effect for growth regulators As well as the influence of growth regulators on decreasing the negative effects for salt stress.

Materials and Methods

The study included two experiments, the first involved the using of laboratory dishes and the second was cultivation in salty soil.

The first study: rapid assessment of salinity tolerance through germination test

A laboratory experiment was conducted in the laboratories of College of Agriculture, University of Sumer. A factorial experiment was conducted of according to completely randomized design (C.R.D) with three factors including three wheat cultivars (IPPA99 and TAMOOZ 1 and Abu Ghraib), Three levels of salinity (0, 4 and 8 $ds.m^{-1}$) and three levels of growth regulators (0, 25, and 50 mg^{-1}). The experiment of germination in glass dishes was adopted to evaluate the tolerance of cultivars to salinity based on the work method of the researcher Tun *et al*. (2003), which confirmed the effectiveness of rapid detection about the cultivars that endure salinity through culture in salinity solutions in laboratory dishes. The experiment was modified by adding the treatment with plant growth regulators to used salinity solutions, using a salicylic acid with a concentration of (25, 50 mg / l).Within the saline concentrations used in the experiment (0, 4, 8 $ds.m^{-1}$) and it used 15 seeds of each cultivar and cultivated in the laboratory dishes, filter paper was placed at the bottom, and added 10 mL of the solution solutions used in the experiment. In the laboratory, the germination was measured after 10 days the beginning of the experiment and the percentage of the healthy initiations was estimated. It was based on the researcher's description Tun *et al*. (2003) that the total germination and sound initiative is that the length of the plumule and radicle (0.5 cm).

The second study: Agriculture in soil salinity

The experiment was conducted in the plastic house of the College of Agriculture, University of Sumer for the season (2018-2017), A factorial experiment was conducted of according to completely randomized design (C.R.D) with three factors including and with three replicates, The first factor (A) three wheat cultivars (IPPA99 and TAMOOZ 1 and Abu Ghraib) and the second factor (B) Three levels of soil with salinity (0, 4 and 8 $ds.m^{-1}$) It brought from one of the field belonging to Al-Rifai district, north of DhiQar province, The soil salinity was placed in the plastic pot with capacity of 10 kg . The third factor (C) included three different levels of Salicylic acid (0, 25 and 50 mg/l^{-1}). The three cultivars seeds were socked with Salicylic acid growth regulator for 12 hours and water was used as Control treatment. The plants that present in plastic pot were reduced by leaving each five plant in one plastic pot. The physical and chemical properties of the soil used in the experiment were measured in Department of Soil and water Resources, College of Agriculture, Sumer University laboratories, according to the results shown in Table (1). At the end of the agricultural season, the following traits were studied: plant height (cm), weight of spikes (gm / pot), grain weight (gm / pot).

Table 1: Some physical and chemical properties of the study soil

Traits	Value
sand	54.6 %
clay	22.0 %
silt	23.4 %
Soil Texture	sandy salty clay
Organic matter	1.024 %
EC	9.13 $ds.m^{-1}$
pH	7.05 %
Dissolved Sodium	0.73 ml/100g
The extracted Potassium	0.77 ml/100g
Ca	22 ml/L
Mg	21 ml/L
Cl	4.7 ml/L
HCO^{-3}	5 ml/L

Results

Results of the first study: rapid assessment of salinity tolerance through germination test:

Effect of salinity and growth regulator levels in percentage of healthy seedlings for wheat crop:

Table (2) shows the two cultivars IPPA99 (A1) and TAMOOZ 1 (A2) were significantly excelled on the Abu Ghraib (A3) cultivar. As for the salinity (B), the controlled treatment (B1) was significant excelled on the treatment (8 $ds.m^{-1}$) (B3), While the growth regulator factor (C)the controlled treatment and Salicylic acid at a concentration of 25 ppm (C2) were significantly excelled on the Salicylic acid treatment at a concentration of 50ppm (C3). As for the interactions between cultivars and salinity (A*B) it was found that the interactions between IPPA99 (A1) and the controlled treatment (B1) was significantly excelled by giving it a value of (97.59), Compared with the interactions between the Abu Ghraib (A3) and the salinity treatment at concentration of 8 $ds.m^{-1}$ (B3) which gave the lowest value of percentage of healthy seedlings (85.03). As for the interactions between salinity and growth regulators (B*C) showed that the interactions between salinity interaction (B1) and Salicylic acid at a concentration of 25 ppm (C2) which gave the highest value of percentage of healthy seedlings, while the interactions between salinity treatment at concentration of 8 $ds.m^{-1}$ (B3) with growth regulator (C3), which recording it the lowest value for this traits.

Table 2: Effect of salinity and levels of growth regulator in percentage of healthy seedling for wheat crop

Cultivars (A)	Salinity (B)	Growth regulators (C) 0 ppm C1	25 ppm C2	50 ppm C3	Interactions between cultivars & Salinity (A*B)
IPPA99 (A1)	Control B1	98.44	99.33	95	97.59
	4 dS/m B2	95.22	97.33	95	95.85
	8 dS/m B3	93.33	95.33	90	92.89
TAMOOZ 1 (A2)	Control B1	97.33	96.33	80.30	91.65
	4 dS/m B2	96	93.67	78.33	89.33
	8 dS/m B3	90.12	91.67	76.33	86.04
Abu Ghraib (A3)	Control B1	92.33	98.37	80	90.23
	4 dS/m B2	90.73	96	76.67	87.80
	8 dS/m B3	90.33	90.76	74	85.03
Interactions between cultivars and Growth regulators (A*B*C)		93.87	95.42	82.85	

Results of the second study: Agriculture in soil salinity

***Effect of salinity and growth regulator levels in plant height average of wheat crop (cm):**

Table (3) shows that the IPPA99 (A1) cultivar was significantly excelled on the two cultivars TAMOOZ 1 (A2) and (Abu Ghraib) (A3). As for growth regulators (C), it was shown that the concentration of (25 ppm) (C2) has significantly excelled on the rest of the treatments. As for the interactions between cultivars and growth regulators (A*C), showed that the interactions between the IPPA99 cultivar (A1) and the growth regulator (salicylic acid) at a concentration of 25 ppm (C2) achieved the highest value of the plant height average (cm), while the interactions between Abu Ghraib (A3) and the controlled treatment (C1), which recording it the lowest value for this traits.

Table 3: Effect of salinity and levels of growth regulator in plant height average of wheat crop (cm)

Cultivars* Growth regulators (A*C)	Growth Regulators (C) 0 ppm C1	25 ppm C2	05 ppm C3	Cultivars
IPPA99 (A1)	71.10	76	68.47	71.86
TAMOOZ 1 (A2)	68.77	71	65.44	68.40
Abu Ghraib (A3)	60	64	62	62
Average	66.62	70.33	65.30	

*** Effect of salinity and growth regulator levels in the number of spikes (spike / pot) of wheat crop:**

Table (4) shows that the IPPA99 (A1) cultivar was significantly excelled on the two cultivars TAMOOZ 1 (A2) and (Abu Ghraib) (A3). As for growth regulators (C), it was shown that the concentration of (25 PPm) (C2) has significantly excelled on the rest of the treatments. As for the interactions between cultivars and growth regulators (A*C), it was shown that the interactions between the IPPA99 (A1) and the growth regulator (salicylic acid) at a concentration of 25 ppm (C2) achieved the highest value of the number of spikes (spike/pot) of wheat crop. While interactions between Abu Ghraib cultivars (A3) with the controlled treatment (C1), which recording it the lowest value for this traits.

Table 4: Effect of salinity and levels of growth regulator in the number of spikes (spike / pot) of wheat crop

Cultivars* Growth regulators (A*C)	Growth Regulators (C) 0 ppm C1	25 ppm C2	05 ppm C3	Cultivars
IPPA99 (A1)	3.66	4.00	3.50	3.72
TAMOOZ 1 (A2)	2.66	2.66	2.33	2.55
Abu Ghraib (A3)	3.33	3.66	3.03	3.34
Average	3.22	3.44	2.95	

***Effect of salinity and growth regulator levels in grain weight (g / pot) of wheat yield:**

Table (5) shows that the IPPA99 (A1) cultivar was significantly excelled on the two cultivars TAMOOZ 1 (A2) and (Abu Ghraib) (A3). As for growth regulators (C), it was shown that the concentration of (25 ppm) (C2) has significantly excelled on the rest of the treatments. As for the interactions between cultivars and growth regulators (A*C), showed that the interactions between the IPPA99 cultivar (A1) and the growth regulator (salicylic acid) at a concentration of 25 ppm (C2) achieved the highest value of the plant height average (cm), while the interactions between Abu Ghraib (A3) and Salicylic acid at a concentration of 50 ppm (C3), which recording it the lowest value for this traits.

Table 5: Effect of salinity and levels of growth regulator in grain weight (g/pot) of wheat yield.

Cultivars* Growth regulators (A*C)	Growth Regulators (C) 0 ppm C1	25 ppm C2	05 ppm C3	Cultivars
IPPA99 (A1)	0.86	0.92	0.65	0.81
TAMOOZ 1 (A2)	0.44	0.55	0.38	0.46
Abu Ghraib (A3)	0.67	0.71	0.51	0.63
Average	0.66	0.73	0.51	

Discussion

The results indicated that the salinity factor led to the inhibition of plant height and grain yield. This result is logical because the effect of inhibitory salinity is caused by many factors such as water availability, Osmosis effect, the specific effect of ions, their toxicity, nutritional disturbance or the accumulation of some toxic compounds as well as the salinity effect in Effectiveness of enzymes, Membranes and cellular organelles (Al-Rajbu *et al*., 1991). The most important effect of salinity is the reduction of the associated yield with two phenomena. The first is to inhibit growth in general, and the second is to reduce the number of spikes. Growth inhibition may be due to the need of the plant exposed to the saline to the energy to maintain the ionic balance. And this consumed energy under salt stress will inevitably be used in construction if plants are not exposed to salinity (Gale, 1975). Inhibition of growth in plants exposed to salinity may inhibit the expansion of cells without affecting their division (Termaat *et al*., 1985; Yaseen *et al*., 1987; Popova *et al*., 1997). As for the phenomenon of the salinity effect in reducing the yield may be due to the reduction of the apical dominance in plants exposed to salinity, High salinity leads to the maintaining apical dominance because of the weak production of Cytokine in the plant roots, The mother plant is unique in its apical dominance, which reduces the growth of lateral buds and thus reduces the number of tillers for the plant. As for the cultivar factor, it is clear from the study that the cultivar (IPPA99) is significantly excelled in the traits of the percentage of healthy seedling, plant height, and weight of spikes and yield. The results show that the IPPA99 cultivar owned most salinity bearing mechanisms .These traits combined or most of them led to the superiority of Tamooz 1 cultivar on the Abu Ghraib cultivar in the yield trait and through observing the results of the studied traits for the three cultivars, the cultivar IPPA99 appears to have a special behavior In salinity tolerance, represented by the strength of plant growth, which is attributable to it more than 30% of differences in salinity tolerance, where a strong-growth cultivar can form more vegetative growths in which the absorbed salts can be distributed on it Which are transferred to the leaves so that the average concentration of the salts is low in the strong growth plants (Hassan and Abdel-Moneim 1995). As for the influence of growth regulators (C) on salinity, it is known that the regulation of the growth of any plant is made by plant hormones, where Auxins initially controls the expansion of cells while the Gibberellins regulates both expansion and division. Cytokinins also have a major effect on cell division. Salicylic acid also regulates many physiological processes including Induction of flowers, regulation of ion absorption, hormonal balance, stoma movement, and photoreceptors (Peter *et al*., 1988). The hormones interfere with the effectiveness of each of the three hormones mentioned above, but it is clear that the plant hormones are involved between them in the work and It is not due to the regulating of any process of growth on the work of one hormone, but that control belongs to some or all hormones that work together, and several studies has shown that the technique of soaking with growth regulators also gave positive results, Both in increasing productivity and bearing environmental stress in general or salt in particular. The results of the study show that the growth regulator (Salicylic acid) generally reduced the adverse effect of salinity in the three cultivars. This is observed in the traits of the percentage of germination, weight of the spikes, plant height and grain yield. In the past few years, researchers have been focusing on the effective role of Salicylic Acid in improving the tolerance of plants to various saline stresses and biological stresses, because the growth regulator (Salicylic Acid) increases cell growth by increasing the content of the cell components, thus absorbing water, cell proliferation, as well as stimulate the elongation of cells through several mechanisms, including activation of cell division, stimulate the growth and expansion of the cell and increase the flexibility of the wall and thus the cells expansion.

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