Effect of salt tensile when using a salinity processor for oat genotypes *Avena sativa* L. in gypsum soil

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Abstract

This study was conducted in the fields of the College of Agriculture, Tikrit University for the season 2019-2020 to study the effect of salt stress (0.5, 2.75 and 5 EC) and salinity treatment (0 and 0.006 mm) in six oats genotypes (Alguda, Icarda short, Anotolia, Icarda tall).The experiment was applied with a randomized complete block design RCBD with a split split plot system with three replications, Five traits were studied: the number of active tillers m^{-2}, the number of grains per panicles, the weight of 1000 grains, the grain yield, and the biological yield $ton.ha^{-1}$. The effect of salt stress negatively on each of the number of grains in delta, grain yield, and biological yield,The use of the saline treatment also improved both the number of active tillers , the number of grains in the panicles , the weight of 1000 grains, the grain yield and the biological yield. The genotypes differed in their performance for the studied traits, where the genotype G3 excelled in the number of tillers . m-2 (447.4) and the number of grains in the panicles (29.72), the weight of 1000 grains (31.43 g), and the grain yield (4195.7 $kg.ha^{-1}$) on the rest of the other compositions.

تأثير الشد الملحي عند استخدام معالج الملوحة لتراكيب وراثية من الشوفان**Avena sativa L** . في التربة الجبسية

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المستخلص

أجريت هذه الدراسة في حقول كلية الزراعة جامعة تكريت للموسم 2019-2020 لدراسة تأثير الشد الملحي (0.5 و2.75 و5 EC) ومعالج الملوحة (0 و0.006 ملم) في ست تراكيب وراثية من الشوفان(Alguda، Icarda short ، Anotolia ، Icarda tall ، Mitika،Possum) طبقت التجربة بتصميم القطاعات العشوائية الكاملة R.C.B.D بنظام القطع المنشقة المنشقة Split Split Plot وبثلاثة مكررات ، تم دراسة خمس صفات هي عدد الاشطاء الفعالة .م$^{-2}$ وعدد الحبوب بالدالية ووزن 1000 حبة وحاصل الحبوب والحاصل البايولوجي طن.ه$^{-1}$. اثر الشد الملحي سلبا في كل من عدد الحبوب بالدالية وحاصل الحبوب والحاصل البايولوجي، كما أدى استعمال معالج الملوحة الى تحسين كل من صفة عدد الاشطاء الفعالة وعدد الحبوب بالدالية ووزن 1000 حبة وحاصل الحبوب والحاصل البايولوجي و أختلفت التراكيب الوراثية في أدائها للصفات المدروسة أذ تفوق التركيب 3G في عدد الاشطاء الفعالة.م$^{-2}$ (447.4) وعدد الحبوب بالدالية(29.72) ووزن 1000 حبة (31.43 غم) وحاصل الحبوب(4195.7 كغم.ه$^{-1}$) على بقية التراكيب الاخرى .

Introduction

Oats (Avena sativa L) is a winter annual crop that tolerates salt to a moderate degree. It is found in many countries of the world, and its production is abundant in the United States of America, Russia and Australia. The cultivated area of it in the world is estimated at about 9.50 million hectares and it produces about 23.50 million tons. It contains oats. 100 grams contains (15.89%) protein, (65.27%) carbohydrates, (10.61%) fiber, (6.2%) fats and (1.78%) ash. It is rich in important and rare minerals. It is used as a multi-purpose product for food, medicine and livestock [9]. Water resources are one of the most important means in the growth and development of the agricultural sector to ensure food security for mankind [6]. The use of saline water as additional or supplementary sources of irrigation water affected the growth and

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production of crops in dry areas.As about 23% of the cultivated land in the world is saline [4]. Treating soil salinity is one of the not easy operations, and therefore work must be done to control the salts in the soil and coexist with them so that they do not exceed the permissible limits through the integration of agricultural operations such as tillage, fertilizing, irrigation and drainage and the salinity treatment is one of the important solutions, including the nitro-sol compound, and it is one of the modern agricultural technology that aims at the best treatments for soil salinity problems, especially the lands around which there are no drains for washing and draining salty water.

To improve soil properties by providing free calcium to the plant, which displaces sodium ions and replaces them in clay particles [15].Salinity affected the components of the grain yield of oats in different methods according to the time of occurrence of salt stress and the stage of growth in which the stress was exposed, where the components of the crop that develop before exposure to salt stress are not affected much in that the continuous stress affects the stages of growth in the different yield components in plants exposed to stress. [20] The salt stress had an effect on the number of ripening days, the number of panicles, the number of panicles, and the weight of 1000 grains. The number of panicles and the number of panicles was the most sensitive component of the yield to salt stress, and the yield of oats decreased as a result of the decrease in the number of grains of the plant and the weight of the grain. The results of the experiment showed a significant effect of irrigation with saline water on yield traits and components of oats by increasing the salinity of the irrigation water to reach its lowest levels at the level of salinity of the irrigation water 9 dSm^{-1} [3].The compositions also varied in their tolerance to salinity according to its genetic base and its variance in its components, which leads to a difference in the traits of the yield and its components [7] and. The use of saline water in irrigation without significant effects on the soil and the crop can be one of several methods of mixing saline water with fresh water to obtain water with a certain salt level commensurate with the degree of salt tolerance of the cultivated crop and the type of soil or alternating irrigation, any irrigation with fresh water followed by irrigation with salt water or irrigation with saline water at specific stages of the crop's life that is tolerant of salinity [3].The salinity processor contains a good percentage of calcium (12%), which may contribute to improving the properties of the soil by replacing calcium with sodium on the exchange complex and then leaving it in the soil solution, washing it and getting rid of it [15].The interaction between genetic structure and environmental factors (E × G) is an important issue in crop production, so a recommendation is made for a specific genetic model and for several sites on the basis of it, since agricultural environmental conditions cannot be changed, but it is possible to coexist with these conditions through scientific management and the correct methods of soil water and services, as well as changing the genetic structure, either through breeding and genetic improvement, or by adopting appropriate and available biotechnologies, Therefore, plant breeders always seek to derive or adapt new genotypes to develop crops to suit diverse climatic and agricultural regions [14]. The research aims at evaluating the response of the input compositions of oats to different levels of salt stress under the influence of the salinity treatment.

MATERIALS AND METHODS

The field experiment for the season 2019 - 2020 was conducted in the fields of the College of Agriculture / Tikrit University at latitude 34.67o and longitude 43.65o, with the aim of studying three factors, the first factor, salt stress (0.5, 2.75 and 5 EC).The second factor was saline treatment (Neutra-Sol 335) with a concentration of (0 and 0.006) at a ratio of 1 liter / 500 m^2 and the third factor was six genotypes of oats Icarda tall, Mitika, Alguda, Passam, Anotolia and Icarda Short.

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1- irrigation water

The salt tension parameters were prepared by adding coarse salt to the irrigation water tank using the following approximate relationship

To convert conduction to TDS (Total Dissolved Solids) at 25°C [21]

TDS ($mg.L^{-1}$)=640×EC($ds.m^{-1}$).

By calculating the amount of table salt as a source of sodium chloride that each liter of distilled water needs to obtain an electrical conductivity of (2.75 and 5) ds.m-1 using the aforementioned equation, it was:

2.75 $ds.m^{-1}$=1.280 $mg.L^{-1}$

5 $ds.m^{-1}$=2.560 $mg.L^{-1}$

2- The experiment design

The experiment was conducted in the 2019-2020 season using a factorial randomized complete block design with a twice split split plot system on 36 experiment units.Each experimental unit contained two lines of each cultivar , with a length of 2 m for each line, with a distance of 0.15 m between one line and another, with a seed quantity of 25 kg. 1 dunum. the seeds were planted in swarm lines, each replica was separated from the other and between each secondary and other experimental unit with a distance of 2 and 1 m. respectively, It also planted guard lines between them. The seeds were planted after tillage and preparing the soil. Nitrogen fertilization was carried out at an amount of (120 $kg.ha^{-1}$) and in two batches at planting and at the beginning of branching. Phosphate fertilization was carried out at an amount of (100 kg.ha-1) when planting and all agricultural operations were carried out according to the need of the crop. Data were analyzed by design, Excel and Genestat.

Results and Discussion

Effect of salinity of irrigation water, treated and compositions

1- Effect on the number of $tillers.m^{-2}$

The trait of the number of active tillers represents the number of panicles and therefore is one of the important components of the yield, and it is a measure of the activity of the plant where it is a hereditary traits in the primary degree and the availability of available water for the plant in the length of the growth period in a secondary methods, and that the cultivar that has the ability to give more number of active roots with a number of the grains in the panicles make it excelled in giving the highest yield per unit area [12]In Table (1), the increase in the level of salt tension did not have a significant effect on this trait.The salinity treatment also significantly excelled on the treatment of T1 (439.28 $tillers.m^2$) than the treatment without the treatment T0(424.75 $tillers.m^2$) and the reason is to reduce the negative effects of salinity by the treatment and increase the supplementary organic matter in addition to providing the plant with nitrogen and calcium, which increases the strength the plant in giving effective tillers These results are consistent with [18], meaning that the salinity processor has a role in increasing growth indicators because of its positive impact on various vital processes such as respiration, carbon metabolism, protein synthesis, and encouragement of vegetative and yield growth traits.While the genotype G3 (447.4 $tillers.m^2$) significantly excelled on all the genotypes, the least of which was the genotype G6 (423.27 $tillers.m^2$). The catalytic and supportive factor in the production of tillers is the genetic material of the synthesis and its interaction with the availability of sunlight, the plant density per unit area, and the nature of The available soil and water, on the other hand, led to the production of the highest value of the fertile branches and that the high level of salinity of irrigation water may lead to a decrease in the number of total rims due to the toxicity and accumulation of sodium ion. Functions per unit area, It may be due to the early effect of salinity on plant growth and its ability to give branches, and the interaction of genetic material when the appropriate conditions are provided for the production of effective rips.

Table (1) The number of active tillers.m^{-2} of oats genotypes with the effect of salt stress levels and salinity treatment

<table>
<tr><td rowspan="4">average</td><td colspan="6">salt tension</td><td rowspan="4">Genotype</td></tr>
<tr><td colspan="2">S2</td><td colspan="2">S1</td><td colspan="2">S0</td></tr>
<tr><td colspan="6">Salinity processor</td></tr>
<tr><td>T1</td><td>T0</td><td>T1</td><td>T0</td><td>T1</td><td>T0</td></tr>
<tr><td>433.58</td><td>429.70</td><td>409.70</td><td>463.70</td><td>418.43</td><td>447.90</td><td>432.06</td><td>G1</td></tr>
<tr><td>425.62</td><td>440.30</td><td>415.20</td><td>42000.</td><td>41100.</td><td>439.90</td><td>427.33</td><td>G2</td></tr>
<tr><td>447.40</td><td>453.70</td><td>431.20</td><td>451.6</td><td>436.73</td><td>459.43</td><td>451.73</td><td>G3</td></tr>
<tr><td>432.32</td><td>439.56</td><td>427.20</td><td>422.63</td><td>425.43</td><td>434.73</td><td>444.36</td><td>G4</td></tr>
<tr><td>429.92</td><td>444.06</td><td>411.90</td><td>438.70</td><td>419.93</td><td>438.10</td><td>426.83</td><td>G5</td></tr>
<tr><td>423.27</td><td>429.70</td><td>411.93</td><td>419.83</td><td>412.63</td><td>433.63</td><td>431.93</td><td>G6</td></tr>
<tr><td colspan="3">428.68</td><td colspan="2">428.38</td><td colspan="2">438.99</td><td>salt tension average</td></tr>
<tr><td colspan="4">439.28</td><td colspan="3">424.75</td><td>Salinity processor averages</td></tr>
<tr><td colspan="2">(8.58) Genotype</td><td colspan="3">(7.93(Salinity processor</td><td colspan="2">(ns) salt tension</td><td>L.S.D</td></tr>
</table>

2- Effect on the number of grains in panicles

The number of panicles grains is the final result of the number of flowering origins that are formed in the panicles , and the percentage of fertilization in them.It was shown in Table (2) that the saline tension treatment S0(27.13) was significantly excelled on the treatment S2(23.11) and that S0 did not differ significantly with S1 that the decrease in the number of grains in the panicles is due to the effect of salinity on the number and activity of pollen grains, where salinity caused a decrease in pollen activity, which This led to the failure of a large number of eggs in fertilization and the formation of grains [3] and this is consistent with what was reported by [11] that salinity has negative effects on the growth and development of organs during vegetative growth and grain formation, which leads to differences in the number of grains in the panicles .The treatment of the saline treatment T1 (27.37 grains. panicles) was significantly excelled on the treatment without the treatment T0 (23.92 grains. panicles) because the salinity treatment to reduce the salt tension pressure (NaCl), which helps to absorb the beneficial elements, grow well and produce active flowers that can be fertilized. and seed production, and that the difference in the number of seeds in panicles is due to the variation in their genetic composition and agrees with [13] and [14] and differs with [1], where they found that the influence of the environment and environmental factors is more influential than the genetic factors in the trait of the number of seeds in the panicles .While the best genotype was G3 (29.72 grains. panicles -1) and at the same time it was significantly excelled on all genotypes, and the least genotype was G1 (21.44 grains. panicles). This trait is determined by the number of florets carried by the genotype and the percentage of fertilization in it as well. The reason may be due to a decrease in apical dominance between spikelets and florets in which abortion occurs, which led to an increase in the proportion of florets fertilized and producing grains [7] and this seems clear with the G3 structure consistent with what was found in the mechanism [5]. Those who indicated differences in the number of grains in panicles as a result of irrigation with saline water, and who due to the reason to the effect of salinity on the fertility average .

Table (2) Number of grains per panicles for oats genotypes with the effect of salt stress levels and salinity treatment

average	salt tension						Genotype
	S2		S1		S0		
	Salinity processor						
	T1	T0	T1	T0	T1	T0	
21.44	2200.	2000.	2200.	1800.	2600.	20.66	G1
25.55	24.33	2200.	27.33	2400.	30.33	25.33	G2
29.72	2700.	2400.	34.33	30.66	32.33	3000.	G3
25.72	2400.	22.66	2800.	2400.	3000.	25.66	G4
27.33	2500.	22.33	3100.	27.33	3000.	28.33	G5
24.11	23.33	20.66	29.66	2400.	2600.	2100.	G6
23.11			26.69		27.13		salt tension average
27.37				23.92			Salinity processor averages
Genotype (1.39)		(0.65) Salinity processor			(2.98) salt tension		L.S.D

3- The effect on the weight of 1000 grains (gm)

Table (3) that the increase in salt tension affected the weight of 1000 grains, but it did not reach the level of significance.While the treatment of the saline treatment T1 (31.05 g) was significantly excelled on the treatment without the treatment T0 (29.44 g), the reason for this is that the salinity treatment reduced the concentration of sodium and because of the ionic symmetry of the salinity of the irrigation water with the gypsum soil solution and its stay in the soil for a longer period, which helps the plant to absorb The nutrients in the soil optimally and the utilization of the elements and ions of the soil solution in increasing the products of photosynthesis and converting them into grains in the form of stored nutrients, which increased the weight of the grain.The study of [1] and [2], who indicated that the decrease in the area of vegetative expansion as well as the scarcity of the main elements due to the replacement and competition of sodium and chlorine ions, the high osmotic pressure of the soil solution, and the decrease in water absorption averages due to the low level of available water and low photosynthesis. The trait of a thousand grains is highly heritable when compared with the components of the yield [7] that the composition of G3 is significantly excelled and gave the highest value for the weight of 1000 grains on average (31.43 g), followed by the structures G5 and G1, which did not differ significantly between them and gave the weight of 1000 grains reached 30.45 and 30.30 (g) sequentially, while the lowest weight was the composition G4 (47.29 g).The reason for the significantly in the weight of a thousand grains is due to the activity of the leaves, the percentage of chlorophyll in them, the amount of metabolites

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and the ability of the grains to be received and stored. Between the number of grains in panicles and the weight of a thousand grains.

Table (3) Weight of 1000 grains (g) of oats genotypes by the effect of salt stress levels and salinity treatment

average	salt tension						Genotype
	S2		S1		S0		
	Salinity processor						
	T1	T0	T1	T0	T1	T0	
30.30	31.11	30.28	29.60	2800.	32.18	30.61	G1
29.41	30.42	29.95	29.43	27.54	30.05	29.10	G2
31.43	33.04	30.58	32.24	29.84	33.16	29.72	G3
29.47	30.09	29.25	29.47	27.75	30.83	29.41	G4
30.45	31.54	29.79	30.42	29.58	31.50	29.85	G5
30.43	31.30	29.76	31.12	30.10	31.42	28.85	G6
30.59			29.59		30.56		salt tension average
31.05				29.44			Salinity processor averages
(0.56) Genotype		(0.25 (Salinity processor		(ns) salt tension			L.S.D

4- The effect on the trait of grain yield (ton.ha^{-1})

The harmful effects of salt stress on the trait of the plant, namely the number of effective grains, the number of grains per panicles, and the weight of 1000 grains, ultimately leads to a reduction in the grain yield, which is more affected and which can be relied upon in studying the harmful effects of salt stress in crop cultivation. The trait of grain yield is the final sum of several traits in the plant that affect the yield, including the time required for the vegetative and reproductive phases, the duration of the grain's fullness, its growth average , the number of leaves in the plant, its area, and others. The weight of a thousand grains or the weight of a grain [19].Table (5) shows that the increase in the salinity of the irrigation water led to a decrease in the grain yield, where the lowest was the treatment S2 (3,040.37 ton.ha^{-1}) and it differed significantly from the two treatments S0 and S1, which gave a yield of (3695.13 and 3450.11 ton.ha^{-1}). Respectively, the reason for this decrease is mainly due to the number of panicles that were carrying small percentages of seeds or because the grain was not full and the weight of 1000 grains decreased, and that everything that affects some or all of these traits (1, 2, and 3) is negatively reflected on the final yield of the plant and the unit area. ,It is consistent with the findings of the mechanism [3] who mentioned the correlation of grain yield with an inverse relationship with the level of salt stress through irrigation water. Whereas, the treatment of salinity treatment T1 (3768.54 ton.ha^{-1}) was significantly excelled on the treatment without the treatment T0(3021.87 ton.ha^{-1}) in yield traits, which reflected positively on the yield, where the trait of grain yield is the final yield of several traits in the plant. Which affects the components of the yield, including the time that takes throughout the length of the vegetative and fruitful growth period.The duration of the grain's fullness, its growth average , the

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number of leaves in the plant, its area, and others, which represent the components of the secondary yield, while the main ones are the number of effective tillers , the number of grains in the panicles, and the weight of a thousand grains in Table 2, 3 and 4) [19].We note that the G3 genotype (4195.71 ton.ha^{-1}) was significantly excelled on all the structures included in the study, and the lowest genotype G1 was obtained with an average of (2837.25 ton.ha^{-1}). A thousand grain, this result agreed with [8] and [7].Those who indicated that the increase in yield is related to the components of the yield, namely the number of panicles, the number of grains per panicles, and the weight of 1000 grains, and that an increase in any of these trait affects the increase in yield.

Table (4) Grain yield (ton.ha^{-1}) of oats genotypes by the effect of salt stress levels and salinity treatment

average	salt tension						Genotype
	S2		S1		S0		
	Salinity processor						
	T1	T0	T1	T0	T1	T0	
2837.25	2941.4	2478.79	3021.86	2111.86	3740.62	2728.97	G1
3207.13	3256.92	2728.13	3375.45	2719.77	4000.3	3162.18	G2
4195.71	4045.26	3163.45	4995.60	3995.97	4948.51	4025.48	G3
3281.2	3172.4	2826.01	3484.97	2835.04	4005.33	3363.46	G4
3620.49	3491.67	2726.08	4214.8	3400.72	4281.47	3608.19	G5
3229.46	3124.05	2530.31	3876.91	3368.41	3856.19	2620.9	G6
3040.37			3450.11		3695.13		salt tension average
3768.54				3021.87			Salinity processor averages
Genotype (203.77)			Salinity processor (154.61)		) salt tension (351.29)		L.S.D

5- The effect on the trait of the biological yield (ton.ha^{-1})

Table (5) showed that irrigation with river water led to an increase in the biological yield, where treatment S1 (6604.59 tons.ha-1) was significantly excelled on treatment S2 (6082.801 tons.ha-1) and did not differ significantly from S0. The reason is that salt stress causes disruption of the nutritional balance as a result of the lack of nutrient availability, competitive absorption, transport, and distribution within the plant, which negatively affects photosynthesis and its products [3].While the treatment of saline treatment T1 (6721.85 ton.ha^{-1}) was significantly superior to the treatment without the treatment T0 (6092.2 tons.ha-1) and the reason for this is that reducing the effect of the level of salt stress on the plant increases its ability to grow and that the lack of available water effects on the biological yield of the plant and the effect of its components of leaves and stems [15].While the genotype G5 (6890.37 tons.ha-1) was significantly excelled on all the compounds included in the study, and the lowest composition was G2 (5762.78 ton.ha^{-1}) that the excelled of G5 in the biological yield means that straw significantly increased the grain yield because G3 is the excelled in grain yield.The reason is due to the different cultivars in their average growth, as well as their different response to saline stress. These results agreed with the findings of [20] who pointed out the variation in field traits between the structures.

Table (5) Biological yield (ton.ha^{-1}) of oats genotypes with the effect of salt stress levels and salinity treatment

average	salt tension						Genotype
	S2		S1		S0		
	Salinity processor						
	T1	T0	T1	T0	T1	T0	
6325.48	6161.99	5826.52	6765.91	6005.51	6941.47	6251.46	G1
5762.78	5815.31	5513.39	6665.27	5399.38	5971.91	5211.44	G2
6597.09	6443.33	5994.27	7370.91	6810.65	6812.37	6151.03	G3
6366.68	6229.1	5244.98	6732.38	6070.39	7202.07	6721.17	G4
6890.37	6575.81	6094.92	7383.26	6430.44	7778.91	7078.86	G5
6499.7	6432.61	6061.39	7168.22	6452.74	6542.39	6341.09	G6
6032.8			6604.59		6583.68		salt tension average
6721.85				6092.2			Salinity processor averages
Genotype (181.98)		Salinity processor (127.81)		salt tension (121.81)			

Conclusions

1- The study showed that the genotype G3 excelled in the yield of its components

2- The priority of the salinity processor, which is excelled in all field traits and yield components

3- Increasing the salt tension to 5 dSm-1 negatively affected the yield components

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