EFFECT OF SALINE WATER MAGNETIZATION ON GROWTH AND DEVELOPMENT OF WHEAT AND RICE SEEDLINGS

Ali H. Jasim[1*],Yusra I. Al-Taee[2],Huda A. Atab[3] and Muslim A. Abdulhusain[4]

[1]**ABSTRACT**

Two experiments were applied in accordance with completely randomized design (CRD) with five replicates, to determine the effect of saline and magnetization water on seedling growth of two wheat genotypes (Hashimia and Tammoze 3) and two rice genotypes (Jasmine and Amber 33). After washing the grain with running water , sterilized, then washed with sterile distilled water, planted in Petri dishes (10 grains in each dish). Seven days after germination , they were treated with 4 treatments with normal or magnetized of river and saline (1.5% NaCl) water. The intensity of magnetization was 1000 gauss with fast flow of 100 ml.second^{-1}. One month after germination, the data were calculated. The results showed that irrigation with magnetic river water led to increase fresh and dry weight and the relative growth rate , while it caused a reduction in the effectiveness of APX and CAT enzymes in seedlings of wheat and rice. Irrigation with salted water caused a significant reduction in fresh and dry weight , and the relative growth rate ,while it led to increase the effectiveness of APX and CAT enzymes in wheat and rice seedlings. Irrigation with magnetized salt water led to increase dry weight and the relative growth rate of both crop seedlings compared to irrigation with salt water, while it led to reduce the effectiveness of APX and CAT enzymes.

Keywords: *wheat, rice, river water, saline water , magnetized water*

تأثير الماء المالح الممغنط في نمو وتطور شتلات القمح والرز

علي حسين جاسم و يسرى اسماعيل الطائي و هدى احمد عتب و مسلم عبد علي عبد الحسين

الخلاصة

أجريت تجربتان حسب التصميم العشوائي الكامل بخمسة مكررات لتحديد تأثير الماء المالح والممغنط في نمو شتلات تركيبين وراثيين من الحنطة (هاشمية و تموز 3) وتركيبين وراثيين من الرز (ياسمين و عنبر 33). بعد غسل الحبوب بالماء الجاري وتعقيمها ثم غسلها بالماء المقطر المعقم ، وزرعت في أطباق بتري (عشرة حبوب في كل طبق) . بعد سبعة أيام من الإنبات ، عوملت البادرات بأربع معاملات من الماء الاعتيادي او الممغنط لكل من ماء النهر أو الماء المملح

[1]Prof. Dr., [2] Assistant lecture , Agriculture Coll., Al-Qasim Green University, Iraq

[3] Doctorate student , Agriculture Coll., Baghdad University, Iraq

[4]Assistant Prof. Dr. ,Agriculture College, Al-Kufa University, Iraq

(*Corresponding author's e-mail: ajasim11@gmail.com)

ISSN 2072-3875

بنسبة 1.5 % من كلوريد الصوديوم . شدة المغنطة كانت 1000 كاوس مع سرعة جريان 100 مل/دقيقة . بعد شهر من الإنبات ، تم اخذ القراءات . بينت النتائج أن الري بماء نهر ممغنط يقود إلى زيادة الوزن الطري والجاف ومعدل النمو النسبي ، بينما أدت إلى تقليل فعالية إنزيمي APX و CAT في شتلات القمح والرز . الري بماء مالح أدت إلى تقليل معنوي في الوزن الطري والجاف ومعدل النمو النسبي بينما أدت إلى زيادة فعالية إنزيمي APX و CAT في شتلات كلا المحصولين. الري بماء مالح ممغنط يقود إلى زيادة الوزن الجاف ومعدل النمو النسبي لشتلات كلا المحصولين قياسا بالري بالماء المالح ، بينما أدت إلى تقليل فعالية إنزيمي APX و CAT.

INTRODUCTION :

Water is the main factor in the development of agricultural production, especially in arid and semi-arid regions, and agricultural expansion (either vertically or horizontally) requires the availability of water in sufficient quantity and quality, and due to its shortage , farmers are going to use salt water. The abiotic stress especially salt stress (salinity of the soil and or water salinity) is a major problem in agricultural production. Saline groundwater is increasingly being used, although it has risks of increasing soil salinity and causing plant salt toxicity [17]. The reduced water potential in saline habitat of plant creates two problems, 1- a corresponding water ,2- ion stress. The use of saline water depends on its content of salts, which can raise the voltage osmosis of soil solution and the degradation characteristics, and over time lead to reduce readiness of nutrients in the soil, In addition, salinity affects 20% of the world's irrigated land, which accounts for one-third of the world food production [8].Several researches by plant breeders to improve plant resistance to salinity has conducted specially for strategy food to ensure the sustainability of food production [25].There are some genotypes and cultivars were elected through breeding and improvement programs carrying recipe endurance saline [2]. In addition to breeding programs may appear from time to time technologies and practices to increase the recipe endurance of salt, including the magnetic field technology to improve the percentage of germination (as the most important stage), [29]. **Nasher**, (2008) [27] reported that some of the physical and chemical changes of water occurs when passing through the magnetic field, and that magnetized water has chemical and physical qualities earned better than ordinary water. According to many researches, water is a polar solution and its electric or magnetic field changeable by rotating the molecule in one direction to take the high effort positive or negative depending on the magnetic field uses and therefore the water molecule will be polarized (Dipolar).The random compositions of water will shatter in the magnetic field and become more regular [16], as well as to be small molecules associated with each water as a result of breaking some hydrogen bonds [20].Some researchers reported that using of magnetized saline water can contribute to increase germination and growth of cereal crops [4, 11, 28]. Therefore, this study aimed to find out the effect of magnetic saline water on growth of wheat and rice.

MATERIALS AND METHODS:

ISSN 2072-3875

This study was conducted at the Agriculture College, University of Al-Qasim Green to find out the influence of water magnetization on the growth of wheat cv.(Hashemite and Tammoz 3) and rice cv. , (Jasmine and Amber 33). Two experiments were applied in accordance with the Completely Randomized Design (CRD) in five replicates. Grains were washed with water , then sterilized with minor trade at concentration of 40% for 15 minutes , then washed with distilled sterile water for three times and then planted in Petri dishes diameter of 9 cm (10 grains in each dish).Seven days after germination, they were treated with water, salt water (NaCl1.5%) and magnetized water(normal and saline water) . The intensity of magnetization was 1000 gauss and flow rate of 100 $ml.second^{-1}$.The data were taken at 30 days after germination, which included: fresh and dry weight , relative growth rate, and seedlings length. It has also been assessing the effectiveness of aschorbate peroxidase enzyme (APX) by the method described by [26], and Catalase enzyme effectiveness by [1]. The data were analyzed according to Genstat program and the means were compared by least significant differences test (LSD) at 0.05 probability.

RESULTS AND DISCUSSION :

Table 1 shows that salty water irrigation , had a significant effect in reducing wheat seedling height with a percentage reduction of 33% compared to seedling with normal water irrigation, while it did not cause significant effect on seedlings of rice. Irrigation with magnetized salty water had no significant effect in reducing the damage caused by salinity in height of wheat and rice seedling. Wheat varieties did not differ significantly in response, while in rice, Amber 33 variety was superior in height compared to Jasmine. This is due to genetic differences of the varieties in this experiment to saline tolerance [2, 12]. The interaction had a significant effect, and Hashemia var. gave the highest height of wheat seedlings when irrigated with magnetized water (20 cm), while the same variety gave the lowest height when irrigated with salty water. In rice, Amber 33 variety gave the highest seedlings height when irrigated with magnetized water (13.83 cm), while Jasmine variety gave least height when irrigated with salty water (2.75 cm).

ISSN 2072-3875

Table1: Effect of magnetic water quality and variety on wheat and rice seedlings height (cm)

Water quality	(1) Wheat varieties				(2) Rice varieties		
	Tammoz 3	Hashimia	Average of water		Amber 33	Jasmine	Average of water
River water	15.33	17.50	16.42		10.83	5.17	8.00
Magnetic river water	16.00	20.00	18.00		13.83	5.37	9.60
Saline water	13.00	9.00	11.00		8.55	2.75	5.65
Magnetic saline-water	14.33	10.00	12.17		10.33	3.75	7.04
Average of variety	14.12	14.67			10.89	4.26	
$LSD_{0.05}$	Var.=2.888 water=4.084 interaction=5.775				Var.=2.733 water=3.864 interaction=5.465		

Table 2 showed that irrigation plants by magnetized water led to a significant increase in fresh weight of wheat seedlings (0.22 g) compared to irrigation by normal water (0.139 g) with a percentage increase of 58.3%. The results were in the same trend at rice seedlings with a percentage increase of 65.9%. This may be due to that water penetrating through plant cell easily[9 , 21], which will reflect positively on shoot growth , better absorption of water by the plant and faster entry, and also may be due to that magnetized water led to increase ions movement and plant absorption [30].This plays an important role in promoting photosynthesis and seedlings growth. These findings are consistent with the results of[5] on soybeans and [27, 36]on chickpeas. Irrigation by magnetized salty water caused non-significant increase on fresh weight of wheat and rice seedling compared to irrigation with salty water. Salty water decreased fresh weight of wheat and rice seedlings with a percentage reduction of 10% and 43% ,respectively compared to normal water irrigation. This is due to the salt damage effect [19, 25] by reducing the osmotic potential, nutritional imbalance, the effect of chloride and sodium ions, a combination of these factors, in addition to that salt leads to produce oxidative effect as a result of the production of radical oxygen species (ROS), [13]. Irrigation with magnetized salty water led to eliminate the damage resulting from the salinity and improve the fresh weight better than irrigation with normal water with an increase of 22% in wheat seedlings, while in rice it caused a reduction of 24% of salinity damage (about half of the damage caused by salt water irrigation). This could be due to that, magnetized water leads to increase water absorption by plant and increase plant absorption of calcium and potassium ions [33], which leads to increase germination ,plant growth and alleviate the damage of salt. The effect of magnetization in alleviation salt stress on germination and

ISSN 2072-3875

seedling growth were consistent with [5, 35], which explain that the reason was due to increasing nutrients absorption. Varieties of wheat did not differ significantly in their response, but Hashemia variety tends to increase compared to the Tammoz3 variety , while in rice, Amber 33 variety was superior significantly compared to Jasmine, this is due to the difference in genetic variation of the varieties [2]. The interaction caused a significant effect on the fresh weight of wheat and rice seedlings, and higher fresh weight obtained from Hashemite wheat variety irrigated by magnetized water(0.285) and less weight from Tammoz 3 variety irrigated by saline water (0.116). In rice seedlings, higher fresh weight obtained from Amber 33 variety Irrigated by magnetized water (0.184) and less fresh weight from Jasmine variety irrigated by salty water (0.033).

Table2: Effect of magnetic water quality and variety on wheat and rice seedlings fresh weight (g)

Water quality	(1) Wheat varieties				(2) Rice varieties		
	Tammoz 3	Hashimia	Average of water		Amber 33	Jasmine	Average of water
River water	0.140	0.200	0.139		0.087	0.063	0.075
Magnetic river water	0.156	0.285	0.220		0.184	0.063	0.124
Saline water	0.116	0.134	0.125		0.051	0.033	0.042
Magnetic saline-water	0.138	0.140	0.170		0.054	0.060	0.057
average	0.137	0.190			0.094	0.055	
$LSD_{0.05}$	Var.=0.099 water=0.069 interaction=0.140				Var.=0.022 water=0.032 interaction=0.046		

Table 3 shows that irrigation by magnetized water led to increase dry weight of wheat seedlings (0.110 g) significantly compared to irrigation by normal water (0.073 g) with a percentage increase of 50%. The results get the same trend in rice seedling with an increase percentage of 32%.This is due to the magnetic effect on increasing water and nutrient absorption [24], an increase of photosynthesis efficiency and increase the speed of their products transfer within the plant [10, 24]. This were consistent with the results of[24, 33, 36]. When irrigation by saline caused a significant reduction in dry weight compared to irrigated by river water with a reduction percentage of 69.2% in wheat seedling and 67.5% in rice seedlings. It were due to the effect of salinity on the overall plant biological processes (including reduction of photosynthesis), resulting in a lack of dry plant material [6].Irrigation by magnetized saline water led to minimize the damage caused by salinity on the dry weight of wheat by 32%, and in rice it reduced the salinity damage by 36% (almost alleviate half of the salinity harmful of wheat and

ISSN 2072-3875

rice seedlings). This were due to the effect of magnetization in increasing absorption of water and potassium ion, which plays an important role in the photosynthesis process and increase the transfer of nutrients in plants [30]. Wheat and rice varieties were differed significantly , and Hashemia variety was superior compared to Tammoz 3 variety in wheat, and Amber 33 was superior compared t0 Jasmine variety in rice. This is due to the genetic differences in these varieties [2]. The interaction caused a significant effect on wheat and rice seedlings, and the highest dry weight in wheat seedlings obtained from Hashemia variety irrigated by magnetized river water (0.147 g) and less dry weight from Tammoz 3 irrigated by saline water (0.021 g). In rice seedlings, higher dry weight obtained from Amber 33 irrigated by magnetized river water (0.077 g) and less dry weight from Jasmine irrigated by saline water (0.014 g).

Table3: Effect of magnetic water quality and variety on wheat and rice seedlings dry weight (g)

Water quality	(1) Wheat varieties				(2) Rice varieties		
	Tammoz 3	Hashimia	Average of water		Amber 33	Jasmine	Average of water
River water	0.059	0.087	0.073		0.053	0.031	0.042
Magnetic river water	0.072	0.147	0.110		0.077	0.039	0.058
Saline water	0.021	0.024	0.023		0.014	0.014	0.014
Magnetic saline-water	0.023	0.031	0.027		0.021	0.016	0.018
average	0.044	0.072			0.041	0.025	
$LSD_{0.05}$	Var.=0.0007 water=0.0005 interaction=0.001				Var.=0.0007 water=0.001 interaction=0.0014		

Table 4 shows that irrigation by magnetized water caused an increase in the relative growth rate of wheat seedlings to (0.044) significantly compared to irrigation by river water (0.032) with a percentage increase of 37.9%. The results gave the same trend in rice seedlings led to a significant increase in the relative growth rate of rice seedlings and with a percentage increase of 29.9%. Irrigation by saline water led to a decline in relative growth rate with a percentage decline of 38.8% in wheat seedling and 44.8% in rice seedling compared to irrigation with river water. This was due to the effect of salinity in reducing photosynthesis rate [6] and therefore the lack of growth rate proportional [37].Irrigation by magnetized saline water led to reduce the damage caused by salinity in the relative growth rate and underestimated the saline damage by 32% in wheat and 36% in rice (almost cancel half the damage that is caused by saline irrigation water on wheat and rice seedling). This was due to the effect of magnetization in increasing water and

ISSN 2072-3875

nutrient absorption and reduce the oxidative stress caused by salinity [18]. Wheat and rice varieties were differed significantly , and Hashemia wheat variety was superior compared to Tammoz 3 whereas in rice, Amber 33 was superior compared to Jasmine. This was due to the genetic differences in these varieties [2]. The interaction caused a significant effect on wheat and rice seedlings, and the highest relative growth rate in wheat seedlings obtained from Hashemia variety irrigated by magnetized river water (0.059 g/day) and lower relative growth rate from Tammoz 3 irrigated by saline water (0.017 g/g/day). In rice seedlings, higher relative growth rate obtained from Amber 33 irrigated by magnetized river water (0.106 g/g/day) and less relative growth rate from Jasmine irrigated by saline water (0.024 g/g/day).

Table4: Effect of magnetic water quality and variety on relative growth rate(g/g/day)

Water quality	(1) Wheat varieties				(2) Rice varieties		
	Tammoz 3	Hashimia	Average of water		Amber 33	Jasmine	Average of water
River water	0.027	0.038	0.032		0.068	0.054	0.061
Magnetic river water	0.030	0.059	0.044		0.106	0.053	0.079
Saline water	0.017	0.022	0.020		0.043	0.024	0.034
Magnetic saline-water	0.025	0.027	0.026		0.040	0.052	0.046
average	0.025	0.036			0.064	0.046	
$LSD_{0.05}$	Var.=0.018 water=0.026 interaction=0.037				Var.=0.007 water=0.009 interaction=0.013		

Table 5 shows that irrigation by magnetized river water reduce the effectiveness of APX enzyme significantly in wheat seedlings compared to irrigation with river water. This may be due to the role of the magnetization in reducing plant oxidative stress by reducing ROS. This results were consistent with the results of [34], while it has no significant effect on rice seedlings. Irrigation by saline water caused a significant effect on increasing the effectiveness of APX enzyme compared to river water irrigation in both wheat and rice protecting them against damage caused by ROS[14] due to increased salinity. This is consistent with the results of [32].Irrigation by magnetized saline water led to reduce the effectiveness significantly compared to irrigation with saline water. This is due to the role of the magnetization in mitigating saline damage [18] as a result of the magnetization effect in improving plant's absorption of water and nutrients and increase the efficiency of photosynthesis, leading to a lack of oxidative stress in plants. Varieties had no significant effect on the effectiveness of APX enzyme of both wheat and rice.The

ISSN 2072-3875

interaction had a significant effect , where the highest value in wheat seedlings obtained from Hashemia variety when irrigated with saline water, while the lowest value obtained from Tammoz3 irrigated with magnetized river water. In rice seedlings, Amber 33 gave higher value when irrigated with saline water, while Jasmine variety gave the lowest value when irrigated with magnetized river water.

Table5: Effect of magnetic water quality and variety on the effectiveness of APX enzyme(*M*mol/min/p)

Water quality	(1) Wheat varieties				(2) Rice varieties		
	Tammoz 3	Hashimia	Average of water		Amber 33	Jasmine	Average of water
River water	0.1506	0.1560	0.1533		0.0625	0.0583	0.0604
Magnetic river water	0.0711	0.1265	0.0988		0.0521	0.0432	0.0476
Saline water	0.3661	0.4167	0.3914		0.1518	0.1211	0.1365
Magnetic saline-water	0.1902	0.1982	0.1942		0.0929	0.0690	0.0810
average	0.1945	0.2243			0.0898	0.0729	
$LSD_{0.05}$	Var.=n.s water=0.0541 interaction=0.0766				Var.=n.s water=0.0249 interaction=0.0352		

Table 6 shows that magnetic irrigation water caused a significant reduction of CAT (enzyme) activity in seedlings of wheat and rice compared to river water irrigation. This results were consistent with the results of[34]. Saline water irrigation caused a significant effect in increment of CAT activity compared to irrigation with river water in both wheat and rice in order to protect against the damage that caused by ROS[14]. It is known that CAT removes hydrogen peroxide gathered, while APX scavenge hydrogen peroxide which did not eliminate by CAT. Although the enzymes that scavenge hydrogen peroxide work in a collaborative way to stay alive cell bowed at normal conditions[22]. CAT is an effective key in the removal of hydrogen peroxide, and thus regulates the activity of APX [12]. APX use ascorbic acid as electron donor and possibly plays the role of regulator in the defense system to remove toxicity of hydrogen peroxide in addition to protecting ascorbic acid [38], in other words, hydrogen peroxide is a part of the series, referring to the production of APX [23].This explains why higher decline in the effectiveness of CAT accompanied by a slight decrease in the effectiveness of APX when exposed to a magnetic field. This was consistent with the results of [18]. Irrigation by magnetized saline water led to reduce the effectiveness significantly compared to the values when irrigated with saline water and reached to the value that did not differ from its effectiveness when irrigated with river water in wheat

ISSN 2072-3875

seedling. This was due to the magnetized water role in mitigate the damage that caused by salt stress [31]. Varieties had no significant effect on the effectiveness of CAT in wheat seedlings, while varieties differed significantly in the effectiveness of CAT in rice seedlings, and Amber 33 was superior compared to Jasmine, which shows that Amber 33 was more tolerant to the salinity than Jasmine[7]. The interaction caused a significant effect where Hashemia variety grown with saline water gave the highest value, while the lowest value obtained from Tammoz 3 when irrigated with magnetized river water in wheat seedlings. In rice seedlings, Amber 33 gave the highest value when irrigated with saline water, while the lowest value obtained from Jasmine variety when irrigated with magnetized river water.

Table 6: Effect of magnetic water quality and variety on the effectiveness of CAT enzyme (*M*mol/min/p)

Water quality	(1) Wheat varieties				(2) Rice varieties		
	Tammoz 3	Hashimia	Average of water		Amber 33	Jasmine	Average of water
River water	0.042	0.044	0.043		0.018	0.016	0.017
Magnetic river water	0.020	0.035	0.028		0.015	0.012	0.013
Saline water	0.103	0.117	0.110		0.043	0.034	0.038
Magnetic saline-water	0.053	0.056	0.054		0.026	0.019	0.023
average	0.055	0.063			0.025	0.020	
$LSD_{0.05}$	Var.=n.s water=0.0152 interaction=0.0214				Var.=0.0017 water=0.0024 interaction=0.0034		

CONCLUSIONS :

It could be concluded that magnetic tap water caused increases in seedling weight and reduced the activity of APX and CAT enzymes in wheat and rice seedlings. Irrigation with magnetic saline water relieved and sometimes eliminated the harmful impact of saline water and usually reduced the activity of APX and CAT enzymes.

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