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Influence of Magnetized Saltwater Irrigation on Chemical Characteristics of Soil

Kadhim Naief Kadhim **Najm O. Alghazali**

Civil Engineering, College of Engineering, University of Babylon, Babel, Iraq
eng.kadhim.naief@uobabylon.edu.iq eng.najm.obaid@uobabylon.edu.iq

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Abstract

This study looks at how soil chemical characteristics are affected by the magnetization of saline irrigation water from Almasab Alam. The dirt was gathered from the research location and put into pots that were completely identical to one another. Onion plants were sown in the soil, with three replications done for each case to determine the average results. Different types of irrigation water were used to irrigate the anvils. Seven different methods of testing the irrigation water were used, including irrigating with river water, irrigating with salty Almasab Alam drainage water without magnetization, and irrigating with magnetized Almasab Alam water with intensities (7000, 5000, 3000, 2000, and 1000) gauss. The highest decrease of the three important elements that nourish the plant: netrate, phosfate, and potasum, was found in the case of irrigation with magnetized water with an intensity of 3000 gauss. The highest percentage decrease in all chemical properties occurred when using magnetized water with strength of 3000 gauss.Utilizing magnetic technology, provides appropriate water for irrigating crops by Almasab Alam water, and overcoming the investigation location's water scarcity.

Keywords: Chemical Properties, Magnetization, Onion, Soil, Irrigation Water

1. Introduction

Compared to 30% with conventional irrigation water, the magnetic water can remove 50–80% of soil salts. Additionally, by accelerating the washing of the salts and removing them from the root zone, it enhances the soil's qualities by lessening the harm caused by its salinity [1]. Due to its superior ability to remove salts compared to regular water by a factor of two, magnetic water also helps to repair the matter of soil that has been degraded by the application of highly concentrated synthetic fertilizers [2].

One of the biggest issues in agriculture is salinity of soil, which results in a severe reduction in soil's energy and a concentration of salts in the capillaries of plant roots. This causes a reduction in the plant's yield relative to its nutritional requirements, which causes wilting and eventually plant death. In order to easily flow through capillaries of plant roots and soil pores,

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the magnetic systems must first split large crystals into smaller crystals. The magnetic system in agriculture promotes water solubility and removes ions from the soil [3, 4].

The magnetic technology modifies the water, giving it a strong capacity to remove salts from the soil and raising the soil's nutritional readiness. It was discovered that irrigation with magnetized water accelerates the washing of bicarbonate by a percentage of 30% and chloride by a percentage of 50-80% when compared to regular water's 30 percent. Additionally, it raises the concentration of dissolved oxygen by 10% [5].

A high degree of hardness is typically present in the crust that forms on the soil's surface, which is reflected in the soil's poor aeration and other physical qualities that are unsuitable for plant growth and development. The crust that forms on the soil as a result of the magnetic treatment's alteration of its physical and chemical properties has recently been controlled using water that has undergone a magnetic treatment. By altering some substances' ionic states and lowering the concentrations of others, particularly sodium salts, it increases solubility and prevents sodium ions from adhering to the soil. The surface crust's hardness is decreased, the water's capacity to remove sodium salts' detrimental effects is increased, and some soil properties are enhanced by magnetic treatment. [4].

2. Materials and Methods

The project of AL-Masab Alam has become one of Iraq's most important development projects. It is necessary for the transmission of saltwater obtained from reclaimed land in southern and central Iraq via a linked network of drainages that begins with a total of drainage fields covered and ends with collected drainages. AL-Masab Alam's channel seems to be in charge of sending salty water to the Arab Gulf via the homes of its portions.

The investigation location is between the station 441+000 with coordinates (461006, 3630087) and the stations 360+000 with coordinates (519159, 3563531). AL-Masab Alam location is located in Babylon governorate in Iraq as demonstrated in Figure (1) [5].

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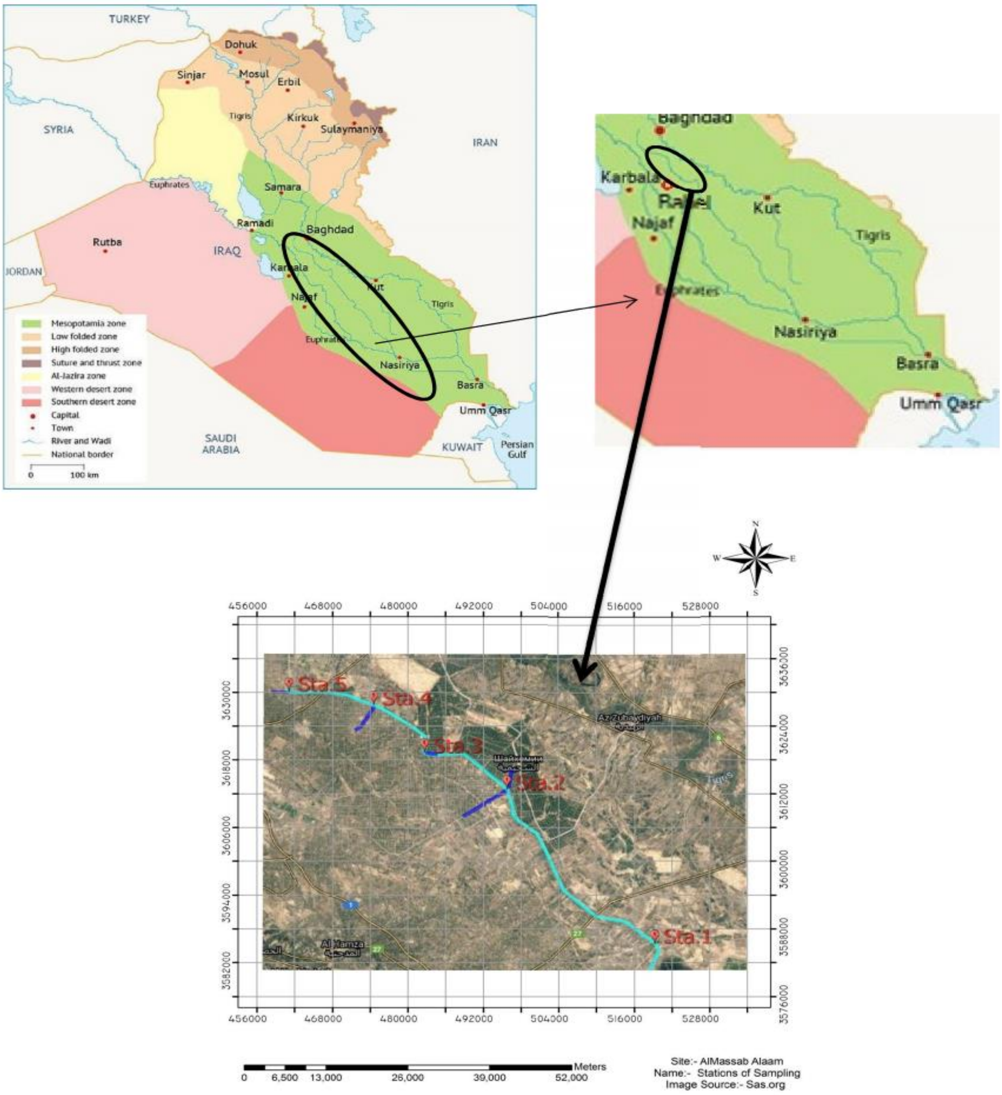

Figure 1: Investigation Location

In pots with identical specifications on all sides, the soil that was gathered from the study site was put. With three replications in each case, onion was planted in the soils, and the results that were averaged were used. The only thing that differs is how well these pots were irrigated, not the irrigation water itself. Seven irrigation scenarios were used on the pots: salinity-free drainage water from Almasab Alam, river water from the investigation site (the Mashroa Al- Musayyab Al-Kabeer river), and five different magnetic intensities (7000, 5000, 3000, 2000, and 1000 Gauss) of magnetized Almasab Alam water.

Cases are designated as MW (Magnetic Water), NMW (No Magnetic Water), MW1 (1000 G), MW2 (2000 G), MW3 (3000 G), MW4 (5000 G), and MW5 (7000 G), as well as the soil before experiment (SBE) and the soil after experiment (SAE). Three laboratories

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performed the tests on the samples, and because the results were so similar, the study used the average of these readings.

3. Magnetize Water Device

This investigation employed magnetized water apparatus with five separate Gauss intensity (1000, 2000, 3000, 5000, and 7000). The magnetic apparatus was made out of a 1.6 cm plastic tube that is encircled by a consistent magnetic strength that seems to be necessary for every apparatus . Figure 2 shows the experimental setup.

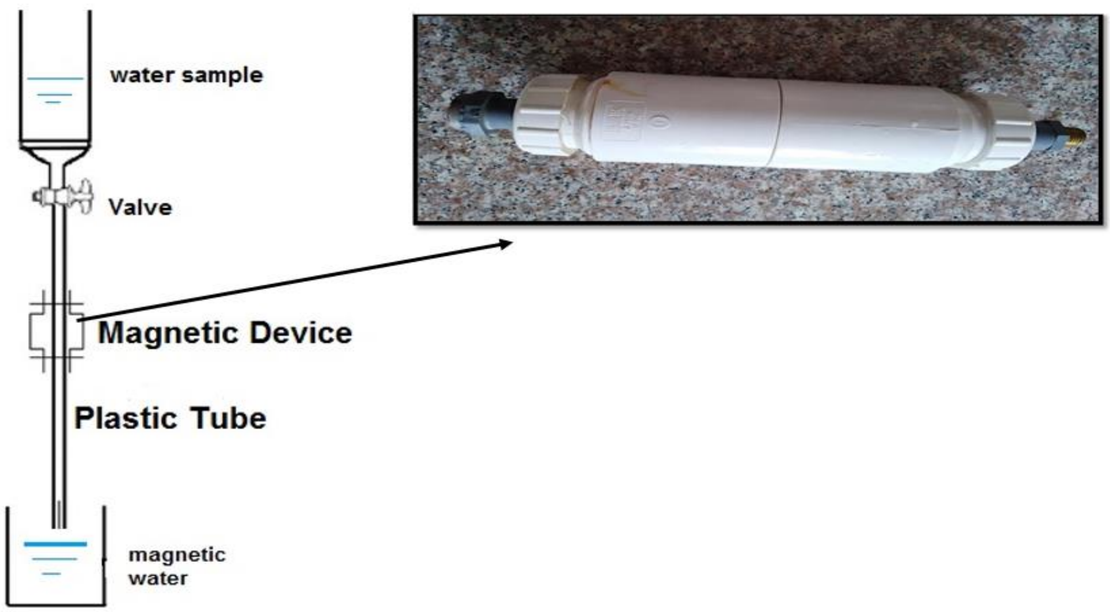

Figure 2: Schematic diagram of the experimental

Table 1 represents a specifications of irrigation water used in the study.

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Table 1: A typical properties of salted water from Almasab Alam and the examined river before and after magnetization. (FAO 1991)

Water Tybe	CW	NMW	1000G	2000G	3000G	5000G	7000G
Ec(μs/cm)	0.971	5.841	5.85	5.86	5.88	5.91	5.96
TDS ppm.)	664	3701	3704	3711	3715	3741	3775
Cl (ppm.)	68.1	569	569	553	501	517	565
So4 (ppm)	294	823	824.1	829	839	845	849
Na^+ (ppm.)	141	393	392.2	394	399	402	403
K (ppm)	8.1	9.49	9.5	9.53	9.75	9.50	9.61
Mg^{+2} (ppm.)	51	110.51	111	114	126	128	131
Ca^{+2} (ppm)	164	254.51	256	262	290	296	302
NO3 (ppm)	1.41	1.3	1.30	1.54	1.85	1.32	1.38
PO4 (ppm)	0.72	0.27	0.27	0.31	0.66	0.41	0.46
PH	7.621	7.90	7.90	7.97	8.10	8.20	8.26
T.H (ppm)	442	966	1014	1044	1147	1162	1188
Do (ppm)	14.5	9.50	9.50	9.97	10.9	10.10	10.36

The chemical characteristics of the soil were investigated before starting the experiment and following the conclusion of the winter onion plants' agricultural season . In order to determine the impact of magnetized water (MW) on the chemical characteristics of the soil of the investigation location . This soil is characterized by being silty clay loam. Table 2 shows the chemical characteristics of the soil before experiments start .

Table 2: The chemical characteristics of the soil before experiments start

Chemical Properties (ppm)	Ec	pH	Ca	NO3	PO4	K	Na	Mg	Cl	SO4%
SBE	13.40	7.85	280	30.10	0.31	10.80	317	199	765	1.23

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3. Results

Table 3 illustrates the results of soil chemical properties tests of investigation location before the experiments (SBE) start and after the onion-planting season end .

Table 3 The chemical properties of the soil after the end of experiments

Type of water	Chemical Properties (ppm)									
	Ec	pH	Ca	NO3	PO4	K	Na	Mg	Cl	SO4%
CW	8.61	7.76	194	21	0.12	5.38	172	135	532	0.86
NMW	15.30	7.90	341	32.35	0.33	11.20	375	238	995	1.54
MW1	12.30	7.84	276	29.75	0.30	10.80	294	193	760	1.21
MW2	5.20	7.42	178	8.12	0.15	2.85	98	122	316	0.70
MW3	4.01	7.25	157	4.81	0.05	1.62	76	102	272	0.59
MW4	9.30	7.60	221	17.47	0.19	6.75	191	152	532	0.93
MW5	4.41	7.38	172	5.20	0.08	1.78	91	112	305	0.65

Table 4 shows the percentages of the difference in the values of the chemical elements in the soil of the investigation location after the end of the experiment from their values before the experiment.

Table 4 The different ratio of the chemical properties of soil (SAE) with SBE(%).

Type of water	Chemical Properties (%) Difference									
	Ec	pH	Ca	NO3	PO4	K	Na	Mg	Cl	SO4
CW	-35.75	-1.15	-30.71	-30.23	-61.29	-50.19	-45.74	-30.46	-30.46	-30.10
NMW	+14.18	+0.64	+21.79	+4.15	+6.45	+3.70	+18.30	+19.60	+30	+25.20
MW1	-8	-0.12	-1.40	-1.16	-3.23	0	-7.26	-3	-0.65	-1.63
MW2	-61.20	-5.48	-36.43	-73	-51.61	-73.61	-69.10	-38.69	-58.69	-43.10
MW3	-70	-7.64	-43.93	-84	-83.87	-85	-76.03	-48.74	-64.44	-52
MW4	-30.60	-3.18	-21.07	-41.96	-38.71	-37.50	-39.75	-23.62	-30.46	-24.39
MW5	-67	-5.99	-38.57	-82.72	-74.19	-83.52	-71.29	-43.72	-60.13	-47.15

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4.1 The Impact of Magnetic Water on Chemical Soil Properties

4.1.1 A Dissolving of Salts Soil

Through the results in Table 3, it is found that the impact of magnetized water in all its states leads to a decrease in the value of the electrical conductivity (Ec) of its amount for the soil of investigation location before the experiments start. The difference rates for all cases are illustrated in Table 4.

Table 4 shows that the percentage of decrease in electrical conductivity of the soil after the end of the growing season for onion plants, which were planted in these experiments, ranged from the lowest value of 8% in the case of MW1 to the highest value of 70% in the case of MW3. The electrical conductivity decreases by 35.75% for the soil in the case of irrigation with CW. Its value increases by 14.18% when irrigated with NMW. The reason for this increase is the increase in the concentration of salts in the soil, which causes the plant to not be able to absorb them. The reason for the low electrical conductivity of the soil of the investigation location when irrigated with magnetized water is that this water increases the availability of nutrients in the soil, so it is easily absorbed by the plant and thus leads to an increase in the growth of plants as a result of its absorption of these elements. This was confirmed by [3, 5, 6]. The best case found is that of magnetized water with a strength of 3000 gauss. In this case, it was found that the amount of the remaining elements of salts and other ions was less than in all other cases. This indicates that the consumption of these elements by the plant is the highest possible and thus will lead to an increase in its growth and productivity. It is also found that this case has surpassed that of river water CW.

4.1.2 pH of Soil

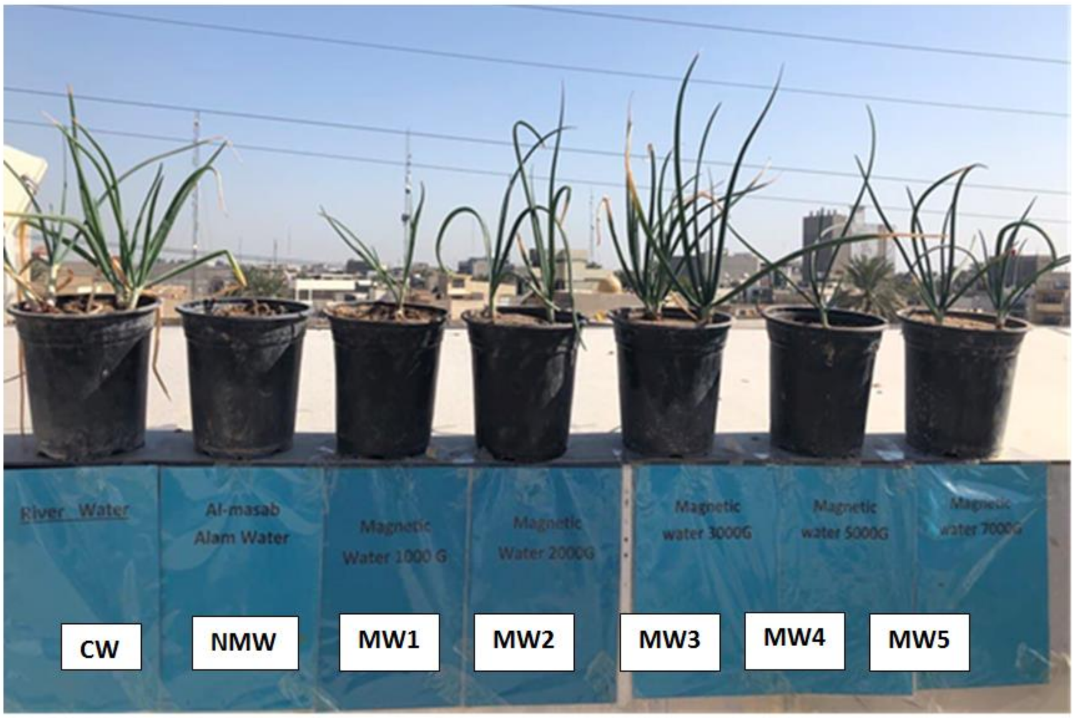
Table 3 indicates the results of the pH interaction values for the soil of the investigation location for all cases. Table 4 shows the decrease and rise of the reaction values for the soil from its value before the start of the experiments. The results indicate that magnetized water in all its states leads to a decrease in the value of the soil interaction at the end of the agricultural season with different percentages. The lowest percentage, which is 0.12%, was achieved in the case of MW1 and the maximum decrease occurred in MW3, which is 7.64%. The percentage decrease in river water CW is 1.15%. The value of the interaction of the soil in the case of NMW increases by 0.64% over its value before the beginning of the experiment. The reason for this is the neutral salts that cause a decrease in the soil pH towards the neutral direction As for the results obtained, they are in agreement with the results of [7, 8, 9], who indicated a decrease in the interaction of soil with an increase in its salinity.

4.1.3 Soluble Content of Ca, Na, Mg, Cl, and SO_4 in the Soil

Table 3 shows the values of positive and negative ions for the soil of the investigation location after the end of the experiment. Table 4 shows the difference between these elements from their values before the experiments started. From the results, it was found that the magnetized water in all its states leads to a decrease in the amounts of these elements in different proportions. A maximum decrease was discovered in the case of MW3.This case outperformed all cases, including the case of CW. The lowest value of decrease occurred in the case of MW1, but in the case of NMW it increased. Evaluating these elements is due to the increase in the concentration of soil salts and the inability of the plant to benefit from them. The reason for the decrease in the concentrations of positive and negative ions in the soil irrigated with magnetized water is that this water increases the availability of nutrients in the soil, so it is easier to be absorbed by the plant [10,11].

4.1.3 Plant Nutrients: NO3, PO4, K

Through the results in Table 3, it can be noticed that the values of the three elements (NO, PO4, and K) are decreased in the soil after the end of the experiment. That is, the end of the agricultural season for onion plant growth in that soil and for all cases of magnetized water at a rate ranging between (0, 1.16, 3.23) % in the case of MW1 and (83.87, 84, 85) % in the case of MW3 for the elements NO3, PO4, and K, respectively.



Picture 1 Plant Onion with different irrigation case

When irrigated with non-magnetized general downstream water (NMW), the values of these elements rise by 6.45, 4.15, and 3.70%, respectively, for the elements NO3, PO4, and K.It decreases by (30.23, 61.29, 50.19%) for the elements NO3, PO4, and K, respectively, when irrigated with (CW). The highest decrease of these three important elements that nourish the plant was found in the case of 3000 gauss. The reason is due to the consumption of these elements by the cultivated plant (onions), which indicates that the plant in this case is the best in terms of vegetation and production, as shown in picture 1.

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The reason for using magnetic devices is not the chemical change of the salts in MTW but the magnetic water's ability to affect directly the chemical and physical properties of the soil and its indirect impact on the plant's uptake of available nutrients [9,10,12]. The main properties of MTW are the reduction of water molecules and the storage of water within the water. When water travels through the soil, it causes positive charges in the physical and chemical characteristics, such as lower soil EC and pH, improved soil permeability, faster flow velocity to dissolved soil salts, and improved nutrient absorption for plant uptake [12].

5. Conclusions

The impact of magnetic fields remedation on soil chemical characteristics was investigated in this paper. The following are the findings of the investigation:

The amount of salinity, positive and negative ions, and the interaction of a soil in all cases of magnetized water, as well as the state of river water, decreases and increases in the case of Almasab alam non-magnetized water. The values of plant nutrients NO3, PO4, and K decrease in the soil at the end of the growing season for all cases of magnetized water, as well as river water, and the maximum decrease occurs in a magnetized water with a strength of 3000 gauss.

It is advised to utilize 3000 gauss magnetized water for irrigation at the inquiry site. It is regarded as the ideal irrigation situation, even irrigation using river water. The investigation site's usage of Al-masab Alam water without magnetization damages the chemical characteristics of the soil and speeds up the crusting of its surface. It was discovered in the investigation location that using magnetic technology, it is possible to provide water suitable for irrigating crops from a Al-masab Alam water, overcoming the water scarcity, and improving the chemical properties of the investigation location by washing it or planting agricultural crops there using the magnetic technique of irrigation water.

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References

[1] Muzahem, Mahmoud Abdel-Ani, Iftikhar Abdel-Gawad and Marei, Nadia Ahmed. Impact of technology applications Magnetism in the treatment of saline well water for use in the irrigation of wheat and barley. Northern Iraq, Babylon University Journal. Pure and applied sciences, 23 (1 :) 278 , 2015.

[2] Kazem, Raad Jawad Muhammad. The use of magnetized water in the reclamation of salt-affected soils. Magazine Al-Furat for Agricultural Sciences, 2 (2 :) 97 – 10. 2010.

[3] Kadhim N. K. and Ahmed H. Experimental Study of Magnetization Impact on Ground Water Characteristics. Jordan Journal of Civil Engineering, Volume 12, No. 2, 2018.

[4] Diaa F. Hassan, Rafal J. Mohammed, Alaa M. Akol, Esraa H. Abd, Thameena F. Kadhim, Effect of Magnetization of Fresh and Salt Water for Irrigation in Some of the Physical Characteristics of the Soil and the Growth of Wheat , Copyright to IJIRSET, p: 61-72. 2016.

[5] Kadhim N. Kadhim and Najm O. Alghazali, Effect of Magnetization on Some Physical Properties of Almasab AlamSalty Water IOP Conf. Series: Earth and Environmental Science 856 (2021) 012045. doi:10.1088/1755-1315/856/1/012045

[6] Karkush M. O., Ahmed, M. D., & Al-Ani, S. M. Magnetic field influence on the characteristics of water treated by reverse osmosis. Engineering Technology Applied Science Research, 9(4), 4433-4439, 2019.

[7] Diaa F. Hassan and etal. Effect of Magnetization of Fresh and Salt Water for Irrigation in Some of the Physical Characteristics of the Soil and the Growth of Wheat, IJIRSET, (2016), Vol. 5, Issue 12, December 2016.

[8] Katorova, D. and B. Soltysov.. The crop rotation and fluvisol properties on the East – Slovakian low land. Actafyto. Technica of Zootechica 4: 96 – 99. 2001.

[9] Al-Zubaidi, Rashad Adel Omran. Effect of soil moisture content and method of adding phosphate fertilizer on phosphorous availability and its relationship to growth and water consumption of barley. Master Thesis, Faculty of Agriculture, Al-Basrah University 2007.

[10] Gallon, P. A. The magnetizer and water, internet, life streams international. Mfg. Co. 24 p. 2004.

[11] Al-Kubaisi, Walid Mahmoud. Correlation between factors affecting the vegetation of soil aggregates and the speed of wetting. Master Thesis. Faculty of Agriculture. Baghdad University. 1982.

[12] Al-Atab, Salah Mahdi Sultan. Effect of soil aggregate sizes on soil physical properties, water movement and maize plant growth. Master Thesis. Faculty of Agriculture, Al-Basrah University. 2001.

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تأثير الري بالمياه المالحة الممغنطة على الخصائص الكيميائية للتربة

كاظم نايف كاظم نجم عبيد الغزالي
الهندسة المدنية– كلية الهندسة– جامعة بابل– بابل– العراق
eng.kadhim.naief@uobabylon.edu.iq eng.najm.obaid@uobabylon.edu.iq

الخلاصة

تناولت هذه الدراسة كيفية تأثر الخصائص الكيميائية للتربة عند ريها بمياه المصب العام المالحة الممغنطة . تم اخذ تربة من موقع البحث ووضعها في سنادين متطابقة تمامًا مع بعضها البعض . زرعت نباتات البصل في السنادين مع ثلاث مكررات لكل حالة واخذ المعدل.

تم استخدام سبعة أنواع لمياه الري لسقي السنادين وهي الري بمياه النهر والري بمياه المصب العام غير الممغنطة وكذلك الري بماء المصب العام الممغنط بخمس شدات مغناطيسية هي (2000,1000, 3000, 5000 , و 7000) غاوس . تم العثور على أعلى انخفاض للعناصر الثلاثة المهمة التي تغذي النبات وهي الفوسفات والنترات والبوتاسيوم عند حالة السقي بالماء الممغنط بشدة 3000 غاوس. كذلك حدثت أعلى نسبة انخفاض في جميع الخواص الكيميائية عند استخدام الماء الممغنط بقوة 3000 جاوس. باستخدام التكنلوجيا المغناطيسية سوف يساعدنا بتوفير مياه صالحة لري المحاصيل والتغلب على شحة المياه في موقع الدراسة.

الكلمات الدالة: الخواص الكيميائية ، المغنطة ، البصل ، التربة ، مياه الري