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The effect of magnetic treatment in well water used for irrigation and spraying with Triacontanol plant growth regulator on the growth and yield of eggplant.

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I. Abstract:

The experiment was carried out during the (2024/2025) growth season in the south of Dhi-Qar Governorate / Al-Ukikah area with the aim of magnetic treatment of used irrigation water (well water) and improving the growth indicators of the eggplant through spraying with a tricontanol growth regulator. The study included magnetic treatment (0, 500 Kaos, 1000 Kaos) and spraying with three concentrations of tricontanol growth regulator (0, 7.5 mg / L^{-1}, 15 mg / L^{-1}) on the eggplant hybrid SARE-F1. The design of the complete random sectors (R.C.B.D) was used a two-factor working experiment and the averages were compared with the lowest moral difference L.S.D at the probability level of 5%. The referred parameters were studied. To it, as the magnetic treatment gave the intensity of (1000 kaos) the highest indicators of the qualities studied. the height of the plant, the dry weight of the vegetative total, the number of fruits, the yield of one plant and amounted to (92.32 cm, 128.15 g, 25.65 fruits. $Plant^{-1}$, 3.58 kg) respectively, and spraying with growth regulator tricontanol concentration (15 mg. L^{-1}) led to a moral increase in the qualities of plant height, number of leaves, dry weight of the vegetative total, number of fruits, yield of one plant (91.94 cm, 37.19 leaves. $Plant^{-1}$, 129.32g, 24.84 fruit. $Plant^{-1}$, kg 3.35) respectively, as for the overlaps between the transactions, the treatment (magnetic treated irrigation water exceeded the intensity of 500 kaos + spraying with tricontanol at a concentration of 15 mg / L^{-1}) in the height of the plant, the number of leaves, the dry weight of the vegetative total and amounted to (93.50 cm, 38.90 leavs. $Plant^{-1}$, 130.00 g) respectively, while the treatment (magnetic treated irrigation water exceeded the intensity of 1000 kaos + spraying with tricontanol at a concentration of (15 mg / L^{-1}) in the number of fruits and the yield of one plant and amounted to (27.09 fruits.$Plant^{-1}$, kg 3.62) respectively, while the treatment (normal irrigation water + spraying with distilled water only) recorded the lowest results in all studied qualities.

Keywords: magnetic treatment; Tricontanol; eggplant; well water

II. Introduction:

Eggplant is considered one of the vegetable crops belonging to the Solanaceae family, and its scientific name is *Solanum melongena* L. It is believed that it was in the hot regions of China and India (Hassan, 2001). It is one of the widespread vegetables in many parts of the world, especially in the tropical and subtropical areas and the Mediterranean basin. It is one of the most important summer vegetables in Iraq as it enjoys high nutritional and economic importance. It is also a medical plant in many countries of the world, as it is used as a medicine to treat diabetes, bronchitis, asthma and severe diarrhea, and is also used to reduce blood cholesterol (Nisha et al., 2009) and (Daunay et al., 2000). The fluctuation or lack of rainfall has a significant negative impact on the productivity of many crops, and due to the lack of water in the Tigris and Euphrates rivers, the use of groundwater may be a solution in many areas in

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Iraq for use in full or complementary irrigation after the wide spread of modern irrigation systems. The existence of the problem of water scarcity and the fact that the groundwater of the wells of the region has specifications that are not suitable for irrigation. It appeared that large areas of land were affected by salinity in southern Iraq as a result of the misuse of irrigation water previously. The emergence of applications of magnetic techniques in many fields was credited with encouraging researchers in the fields of irrigation to try to study the impact of using this technology in the adaptation and treatment of some qualities of water, including salt groundwater and the possibility of expanding its use in crop cultivation and to reduce its negative effects on productivity and soil salinity. The results obtained (Oleshko 1981 & Takachenko 1995) were the first to open the way for the use of this technology as a source of cheap energy to improve the quality of salt water for use in irrigation. Studies also indicated the possibility of using salt water through its magnetic treatment. This leads to the disassembly of dissolved salt compounds and turning them into ions, which removes the harmful effect of the plant. It also works to further improve the soil properties and reduce the harms of salinity by increasing the speed of salt washing and ridding the root growth area from harm (Hilal2000). As explained (Takachenko 1997) that magnetically treated water has the ability to wash (50%-80%) of the salts in the soil compared to (30%) for ordinary irrigation water, as shown (Al-Jawdari 2006) in his study of the effect of magnetic adaptation of irrigation water on some chemical qualities of the soil and the existence of a moral effect to treat The magnetism of irrigation water on the growth of yellow corn and the weight of dry matter as well as the weight of the dry product, as it was found (Al- Al-Ma'adidi et al., 2009) that the use of magnetic water has a moral effect on the number of branches, the number of leaves, the leaf area, the lengths of the branches, the rate of the number of fruits and the total yield of the crop of the sophistication, as explained by (Al-Shahmani, 2014) All plants irrigated with magnetically treated water superior to the plants irrigated with water that are not magnetically treated (normal irrigation water) as it was moral in the height of the plant, the leaf area, the number of chlorophyll pigment, the number of leaves, the dry weight of the vegetative total, the number of days for the appearance of the first flower (day Sugars with fruits, and the study conducted by (Mohie, 2021) concluded that spraying with the growth regulator tricontanol had a moral effect in increasing vegetative growth indicators as well as increasing the nodes and physical and chemical properties of the apple plant.

Study Objective

Given the importance of the quality of water used in irrigation and resorting to other sources for watering due to the drought that the country is going through, this study aimed to know and evaluate the impact of the use of magnetic treatment of well water used in irrigation in order to reduce the harm of salt groundwater and adapt some of its properties for the purpose of expanding its use in the fields of irrigation and agriculture in Dhi-Qar, especially after the modern trend to use these techniques in many areas to address water problems as one of the means that do not need much energy when using the positive role of the water magnetization process as well as spraying with a growth regulator tricontanol and a cycle in encouraging plant growth, and because of the scarcity of studies and research published on These two factors, especially on the eggplant crop in Dhi Qar governorate, the idea of this research was developed to study the effect of water magnetization and spraying with the growth regulator tricontanol and the interference between them in some of the growth traits and the product of the eggplant hybrid SARE-F1.

III. Materials and Methods

1-2 Research steps

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The experiment was carried out in a plastic house in the area of Al-Ukikah, south of Dhi-Qar Governorate, for the period from 15/9/2024 AD to 1/5/2025, to determine the effect of the magnetic treatment of well water and spraying with the tricontanol growth regulator on the eggplant plant. A random sample was taken from different places of the plastic house soil and at a depth of (0-30) cm from the soil surface, then the sample was mixed with a "homogeneous" mixture and one sample was taken from it randomly" representing the soil of the house, and the analysis of the sample was carried out, as shown in Table (1).

Table (1) Some chemical and physical properties of soil.

Characteristics	pH	Ec $ds.m^{-1}$	O.M $g.kg^{-1}$	N $mg.L^{-1}$	P $mg.L^{-1}$	K $meq.L^{-1}$	clay	sand	silt	Soil texture
							$gm.L^{-1}$			
----------	**7.7**	**2.91**	**0.21**	**2.61**	**3.88**	**0.37**	**190**	**244**	**566**	**Sandy loam**

The plastic house was prepared by plowing, smotening, leveling and dividing it into three lines 50 cm away from each other, the length of one line is 56 m and 50 cm wide, and a distance of 75 cm was left from each side of the house, then the irrigation pipes were placed in drip on both sides of the line, and a distance of 90 cm was left at the entrance and end of each sector. The seeds purchased from the agricultural offices for the hybrid eggplant category were planted on 15/9/2010 in the plastic house and the distance between one plant and another was 40 cm (Jaafar, 2012). The plastic house was covered on 15/11/2024 with transparent polyethylene with a thickness of 100 microns to protect the plants from cold damage and lift the cover from the plastic house permanently on 1/3/2025, then all recommended agricultural service operations for the cultivation of eggplants were carried out inside the protected farming facilities and similarly to all transactions

2-2 Transactions used in the experiment

The well water used for irrigation was treated with different intensities of the magnetic field. It used two types of magnetrons, the first is 1\4 inch diameter and with an intensity of 500 kaos and the second type with a diameter of 1 inch and with a severity of 1000 kaos manufactured locally. Where the well water used in irrigation was treated magnetically by passing it through different magnetrons devices of one intensity only once, where the plants were irrigated with magnetically treated water throughout the research period using the plastic tube. A sample of the well water was also taken before and after it was treated magnetically and analyzed as shown in Table No. (2).

Table (2) Some of the qualities of irrigation water before and after magnetic treatment.

Characteristics	Well Water	Water Processed Magnetically		Unit
		500 kaos	**1000 kaos**	
pH	**7.3**	**7.5**	**7.2**	
Ec	**1.355**	**1.219**	**1.232**	
TDS	**679**	**669**	**675**	**$Ds.M^{-1}$**
TSS	**35**	**25**	**38**	**$Mg.L^{-1}$**

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The first factor is magnetic water treatment: **W0**: Well water is non-magnetized water
W1: Strongly magnetized water 500 kaos
W2: Strongly magnetized water 1000 kaos

As for the second factor, the vegetative aggregate of the eggplant plant was sprayed with the plant growth regulator tricontanol using three concentrations (0, 7.5, 15 mg liter-1). The plants were sprayed during the vegetative growth period three times and during flower growth three times, so that the total sprays were six times during the plant growth period. Liquid soap was added at a rate of two drops per liter of spray solution as a diffuser, the plants were sprayed with a growth regulator concentrations until complete wet using a manual sprayer.

The second factor is spraying with Tricontanol:
T0: Comparative treatment of spraying with distilled water only. **T1**: Treatment of plant spray with a growth regulator Tricontanol at a concentration of 7.5 mg / L^{-1}.
T2: Treatment of plant spray with growth regulator Tricontanol at a concentration of 15 mg / L^{-1}.

2-3 Experimental design and transactions:

A working experiment was conducted with two factors according to the design of the complete random sectors (R.C.B.D.) Randomized Complete Block Design with three repeats. The experiment included two factors, the first factor is the treatment of the well water used in irrigation magnetically and the second factor is spraying with a growth regulator tricontanol with three concentrations using the design of the Randomized Complete Block Design C.R.B.D.At the rate of three repeaters per transaction, the results were analyzed using the statistical analysis program t dec-2008)-31 Genstat and then compared the differences between the averages using the lowest moral difference R.L.S.D. And with a probability level of 5% (Al-Rawi and Khalaf Allah, 1981).

2-4 The Characteristics studied

8 plants were randomly selected from each experimental unit of the three repeaters and at the end of the experiment on 1/5/2025 to measure the following qualities:

1- Plant height (cm. $Plant^{-1}$)
The height of the plants was measured from their place of contact with the soil to the highest growing peak in the plants taken from each experimental unit and per transaction.
2- Total number of leafs (leaf. $Plant^{-1}$)
The total number of leaves in each plant taken from each experimental unit was calculated.
3- Dry weight of the vegetative total (g. $Plant^{-1}$)
The dry weight of the vegetative total (leaves and stems) was measured at the end of the growing season by taking 6 plants randomly from each experimental unit, as the vegetative total was cut when connected to the roots, then the plants weighed each separately by means of a scale and dried the samples using the electric oven at a temperature of 75 C^0 for a period of 48 hours, then the dry weight was estimated until the weight was fixed as an average of eight plants (Hocking, 1997).
4- Number of fruits (fruit. $Plant^{-1}$)
According to the number of fruits from the beginning of the genie to the last pound by dividing the total fruits in the experimental unit by the number of its plants of all fairies.
5- Yield of one plant (kg. $Plant^{-1}$)

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It was calculated by multiplying the number of fruits by the average weight of the fruit and each experimental

3. Results and Discussion

Table (3) The effect of magnetic treatment of irrigation and spray water with Tricontanol on Plant height (cm. Plant^{-1}) Eggplant hybrid

Tricontanol / Magnetic water	T0	T1	T2	Average Magnetic water
W0	80.11	88.06	88.90	85.69
W1	89.27	93.31	93.50	92.03
W2	88.99	94.05	93.92	92.32
Average Tricontanol	86.12	91.81	92.11	
L.S.D P ≤ 0.05				
W * T		T		W
4.11		2.79		2.79

It is clear from Table No. (3) that irrigation with magnetically treated water, the intensity of 1000 kaos may exceed irrigation with ordinary water (well water) by giving it the highest height of the plant of (92.32cm) compared to (85.69cm) when watering with well water . It is clear that when treating water with magnetization, it leads to an increase in the height of plants and for all coefficients. The reason for this is due to the increase in the availability of nutrients as a result of the effect of the magnetic field on the hydrogen bonds in the soil water, which causes their easy entry into the roots due to the small size of water groups that accelerate the entry of water to the root hairs, carrying with it nutrients and this What was indicated by (Al-Jawdari 2006), as the treatment of spraying with tricontanol is (15 mg. L $^{-1}$)gave a moral increase in the height of the plant of (92.11 cm) compared to (86.12 cm) when spraying with distilled water only. The results of bilateral interference between magnetic irrigation water treatment coefficients and tricontanol spraying had moral differences, as the treatment was recorded (magnetic treated irrigation water with a intensity of 100 kaos + spraying with tricontanol at a concentration of 7.5 mg / l^{-1}.) The highest moral superiority of this trait compared to the rest of the transactions was (94.05), while the treatment (normal irrigation water + spraying with distilled water only) gave the lowest rate of plant height of (80.11 cm).

Table (4) The effect of magnetic treatment of irrigation and spray water with Tricontanol on the total number leafs (leaf. Plant^{-1}) Eggplant hybrid

Tricontanol / Magnetic water	T0	T1	T2	Average Magnetic water
W0	30.55	35.19	36.07	33.94
W1	33.89	38.28	38.90	37.02
W2	34.00	35.92	36.60	35.51

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Average Tricontanol	**32.81**	**36.46**	**37.19**	
L.S.D P ≤ 0.05				
W * T		**T**		**W**
3.36		**1.82**		**1.82**

Table No. (4) shows that the treatment of irrigation with magnetically treated water, the intensity of 500 kaos, may exceed the treatment of irrigation with well water, as the number of leaves reached (37.02) versus (33.94) when watering well water, the increase in the number of leaves may be due to the role of magnetically treated water in increasing the ionization of the compounds contained in ordinary water, which caused an increase in the concentration of these ions and their readiness for absorption by the root total, and may be due to the high solubility of minerals and salts in the soil as a result of magnetic treatment and thus increasing the absorption of these elements by the plant (Amin and Abdulaziz 2011). Also, spraying with a growth regulator of (15 mg. L^{-1}) gave an increase in the number of leaves of (37.19) versus (32.81) when spraying with distilled water only.. The results of bilateral interference between magnetic irrigation water treatment coefficients and tricontanol spraying had moral differences, as the treatment was recorded (magnetic treated irrigation water with a intensity of 500 kaos + spraying with tricontanol at a concentration of 15 mg / L^{-1}.) The highest moral superiority in the number of leaves was (38.90) cm, while the transaction (normal irrigation water + spraying with distilled water only) gave the minimum number of sheets (30.55).

Table (5) The effect of magnetic treatment of irrigation and spray water with Tricontanol on Dry weight of the vegetative total (g. Plant^{-1})) Eggplant hybrid

Tricontanol Magnetic water	T0	T1	T2	Average Magnetic water
W0	**120.44**	**127.68**	**128.02**	**125.38**
W1	**124.87**	**129.25**	**130.00**	**128.04**
W2	**125.08**	**129.41**	**129.95**	**128.15**
Average Tricontanol	**123.46**	**128.78**	**129.32**	
L.S.D P ≤ 0.05				
W * T		**T**		**W**
4.44		**2.10**		**2.10**

Table No. (5) shows that irrigation with magnetized water, the intensity of 1000 kaos exceeded irrigation with well water, giving the largest dry weight of the plant's total vegetative amounting to (128.15 g) versus (125.28 g) when watering in well water. Magnetic treatment increases root growth and improves their ability to absorb nutrients, as well as increasing the leaf content of carbohydrates and thus increasing plant growth (Adachi, 2007). The treatment of spraying with tricontanol also gave a

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concentration of (15 mg. L^{-1}) a significant increase in the dry weight of the vegetative total of (129.32 g) compared to (123.46 g) when spraying with distilled water only. As for the bilateral interference between them, it gave moral differences, as a treatment was recorded (magnetic treated irrigation water with a intensity of 500 kaos + spraying with tricontanol at a concentration of 15 mg / L^{-1}.) The highest moral superiority of this quality compared to the rest of the transactions was (130.00 g), while the treatment (normal irrigation water + spraying with distilled water only) gave the lowest dry weight of (120.44 g).

Table (6) The effect of magnetic treatment of irrigation and spray water with Tricontanol on Number of fruits (fruit. $Plant^{-1}$) Eggplant hybrid

Tricontanol / Magnetic water	T0	T1	T2	Average Magnetic water
W0	18.63	20.44	21.19	20.09
W1	22.58	26.89	26.23	25.23
W2	22.86	27.00	27.09	25.65
Average Tricontanol	21.36	24.78	24.84	
L.S.D P ≤ 0.05				
W * T		T		W
2.55		1.61		1.61

Table No. (6) shows that there are moral differences in the number of fruits when irrigated with magnetically treated water. The intensity of 1000 kaos compared to irrigation in well water, as the number of fruits reached (25.65) compared to (20.09) when irrigating in well water. The increase in the number of fruits may be due to the role of magnetically treated water in increasing the ionization of the compounds contained in normal water, which caused an increase in the concentration of these ions and their readiness for absorption by the root total, and may be due to the high solubility of minerals and salts in the soil as a result of magnetic treatment, thus increasing the absorption of these elements by the plant, which is reflected positively in the number of fruits (Amin 2009). Also, spraying with the growth regulator tricontanol (15 mg.L^{-1}) gave an increase in the number of fruits of (24.84) versus (21.36) when spraying with distilled water only. The results of bilateral overlap between the factors of magnetic irrigation water treatment and spraying with tricontanol had moral differences, as the treatment was recorded (magnetically treated irrigation water with a intensity of 1000 kaos + spraying with tricontanol at a concentration of 15 mg /L^{-1}.) The highest moral superiority in the number of papers amounted to (27.09) while the transaction (normal irrigation water + spraying with distilled water only) gave the lowest number of fruits (18.63).

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Table (7) The effect of magnetic treatment of irrigation and spray water with Tricontanol on Yield of one plant (kg. Plant^{-1}) Eggplant hybrid

Tricontanol / Magnetic water	T0	T1	T2	Average Magnetic water
W0	2.21	2.89	2.99	2.70
W1	2.92	3.40	3.44	3.25
W2	3.63	3.50	3.62	3.58
Average Tricontanol	2.92	3.26	3.35	
L.S.D P ≤ 0.05				
W * T		T		W
1.37		0.42		0.42

Table No. (7) shows that irrigation with magnetically treated water with a strong intensity of 1000 kaos gave a moral difference compared to irrigation in well water, as the quotient of one plant reached (3.58 kg) versus (2.70 kg) when irrigation in well water. The increase in the quotient of the plant may be due to the role of magnetically treated water in increasing the ionization of the compounds contained in normal water, which caused an increase in the concentration of these ions and their readiness for absorption by the root total, and may be due to the high solubility of minerals and salts in the soil as a result of magnetic treatment and thus increasing the absorption of these elements by the plant, which is reflected positively in the number of fruits and thus increasing the quotient of one plant (Amin 2009). Spraying with a growth regulator tricontanol is also (15 mg.L^{-1}) gave an increase in the quotient of one plant of (kg 3.35) compared to (kg 2.92) when spraying with distilled water only. The results of bilateral overlap between the factors of magnetic irrigation water treatment and spraying with tricontanol had moral differences, as the treatment was recorded (magnetically treated irrigation water with a intensity of 1000 kaos + spraying with tricontanol at a concentration of 15 mg / L^{-1}.) The highest quotient for one plant was (3.62 kg), while the treatment (normal irrigation water + spraying with distilled water only) was given the lowest quotient for one plant (2.21 kg). While the intensity of the magnetic field and the concentrations of spraying with tricontanol did not give any moral differences in this characteristic.

4. Conclusions

1- The importance of using well water as an alternative to other water sources in light of the scarcity of water in plant irrigation through its magnetic treatment, as this technology is a source of cheap energy in improving the quality of salt water for irrigation, which led to improved indicators of the growth and harvest of the eggplant plant.
2- The use of a tricontanol growth regulator to reduce the effects of saline tension in the growth and yield of the eggplant irrigated in well water that has been magnetically treated.

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3- The results of bilateral interference were given to the use of (magnetic treated irrigation water with a strength of 1000 caus + spraying with tricontanol at a concentration of 15 mg / liter-1) the highest yield of one plant.

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