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ORIGINAL ARTICLE

Response of Young *Phoenix dactylifera* L. Date Palm Trees to Irrigation with Magnetized Water

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KEYWORDS

Phoenix dactylifera L.; Salt stress; Magnetized water; Total chlorophyll; Total protein; Amino acid proline

ABSTRACT: Date palm (*Phoenix dactylifera* L.) is one of the most important crops for which Iraq is famous. As a result of increased water salinity and the lack of rain in recent years. The technique of magnetizing water has been tried to irrigate palm trees. For the purpose of studying the effect of magnetization on leaf content of some biomarkers. The research was carried out during the years 2019 and 2020, when sixty-three-year-old date palm trees were selected from the variety (Barhi), which are densely textured and planted in the orchard of the tissue date palm station / Ministry of Agriculture located in the desert region of Najaf Governorate. As (well water and river water) were used before and after magnetization by watering the soil around the palm on a weekly basis for sixteen consecutive periods starting from 2/6/2019, results measurements were made for total chlorophyll, total protein, amino acid proline and carbohydrates. The results showed that the magnetization of the water caused significant increases in the leaf content of total chlorophyll, carbohydrates and total protein, and a significant decrease in its content of the amino acid proline. The results indicate that the magnetization of irrigation water increases the efficiency of the palm plant in tolerance saline water and increases its vital properties in the case of irrigation with magnetized river water. These results improve the process of cultivation and management of date palm farms and contribute to increasing production.

INTRODUCTION

The date palm L. Phoenix dactylifera belongs to the family Palmaceae. It is a monocot plant that grows in tropical and subtropical regions between latitudes 10 degrees (in Somalia) and 39 degrees (in Turkmenistan) north [1], it is believed that Iraq and The Arab Gulf regions are the original home of the date palm, from which its cultivation has spread globally, as Iraq occupied the first place among the countries of the world in its cultivation. But it declined in the past six decades due to many factors, including the salinization process in the Iraqi lands and the high percentage of salts in irrigation water, especially desert areas that depend on well water for irrigation. Which negatively affected the growth of the date palm, it was noticed that the vegetable tissue content of chlorophyll, carbohydrates, protein, proline and others is affected by the properties and salinity of the soil and irrigation water [2, 3, and 4]. As a result of the toxic effects and the aggregation of sodium and chloride ions resulting from the increased salinity, the osmotic effect in inhibiting the readiness of mineral elements for absorption, causing this to disturb the biological activities, the nutritional, hormonal and enzyme balance in the plant tissue [5, 6, and 7]. Magnetization of water leads to the breakdown of

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saline compounds in the water and converting them into ions, which eliminates the harmful effect on plants. It also

improves soil and reduces its salinity by increasing the speed of washing salts from the soil [5]. indicated in a study of the sunflower plant that magnetization of saline water (5.81 dS/m) using a magnetizer in 5 cm diameter led to reduced crop damage from 56% to 32% [8].

In order to reduce the effects of salt stress, the response of the *Phoenix dactylifera* plant was studied in this research the effects of magnetization of salt and fresh water on the content of chlorophyll, carbohydrates, protein and proline. And to study the possibility of improving the ability of *Phoenix dactylifera*. They can be used for land reclamation and use in phytoremediation and phytodesalination.

MATERIALS AND METHODS

Experiment design and plant treatments

The research was carried out in the years 2019 and 2020, when sixty date palm trees, three years old, were selected from the variety (Barhi), which were densely textured, brought their seedlings from the United Arab Emirates. Homogeneous in the size of their vegetation and planted in straight lines with dimensions of 5 x 5 meters in the orchard of the palm plant. Textile in Najaf Governorate / Ministry of Agriculture located in the desert region northwest of the province (36 ° 52'39 "N 39 ° 02'02" E) in Iraq. The drip irrigation method was used by four networks of 1 m of well water without magnetization, 2 m of well water with no magnetization, 3 m of river water without magnetization, and 4 m of river water with magnetization. Circular basins were made around each palm with a diameter of 1.5 meters and two dots were allocated to drain the water from the network for each basin by 8 L / h per dripper. For a period of sixteen consecutive months from 6/2/2019 to 6/5/2020. Measurements of the characteristics under study were carried out on three dates after carrying out the research on 1/6/2019, 1/11/2019 and 1/6/2020 on leaves (fronds) and (wicker) leaves of one year old, taken from the third line after the growing apical leave. Palm fronds reaches its maximum activity at this stage as follows:

1- Total chlorophyll in leaves (mg. g^{-1} soft tissue): method was used [6].
2- The percentage of total dissolved carbohydrates: Calculated by a spectrophotometer at a wavelength of 560 nm according to the method of [7, 9-13]
3- Protein percentage: It was calculated on the basis of dry weight according to the method mentioned in Abu Dahi (1989) [14, 15].
4- Proline content of leaves (parts per million parts): calculated by spectrophotometer at a wavelength of 520 nm according to the method of [16].

The experiment was designed by designing the complete random sectors according to the split panels system.

Water treatments

The study included irrigation of plants with three levels of salinity water and treated with magnetron 2cm in diameter and the magnet pole intensity is4000 gauss to magnetize water. Its electrical conductivity as follows:

Mo = 1.308 ds/m (river water)

M1= 0.728 ds/m (river water)

M2= 3.828 ds/m (well 1)

M3= 2.83 ds/m (well 2)

M4= 4.07 ds/m (well 3)

M5=3.8 ds/m (well 4)

Table1. Some physical and chemical characteristics for saline well water before and after magnetization

Parameter	unit	Tab water		Saline water		Percentage change %	Saline water		Percentage change %
		Before M0	After M0	Before M1	After M2		After M3	After M4	
pH	-	7.56	7.37	7.37	7.55	2.44	7.54	7.6	0.80
Electrical conductivity (EC)	dS/m	1.308	0.728	3.828	2.83	0.14	4.07	3.8	17.94
Total Dissolved Solids (TDS)	mg. l^{-1}	495	455	433	397.0	-12.75	2.45	2.43	-0.82
Turbidity	NTU	698	620	640	487.0	-21.45	950	750	-21.05
Hardness (TH)	mg. l^{-1}	179.9	176.7	166.7	156.4	-11.49	243.4	223.6	-8.13
Nitrate(NO_3^{-2})	mg. l^{-1}	3.14	3.04	3.05	3.03	-0.33	6.4	6.3	-1.56
Phosphate(PO_4^{-2})	mg. l^{-1}	0.3	0.3	0.34	0.40	33.33	0.7	0.9	28.57
Chloride(Cl^{-1})	mg. l^{-1}	114.03	103.53	101.23	87.43	-15.55	167.1	156.4	-6.40
Potassium(K^{+1})	mg. l^{-1}	1.01	1.81	1.91	1.73	-4.42	3.23	3.24	0.31
Bicarbonate (HCO_3^{-2})	mg. l^{-1}	123.4	112.7	110.7	96.80	-14.11	102.2	87.6	-14.29
Sulfate(SO_4^{-2})	mg. l^{-1}	174.5	153.5	164.5	143.6	-17.71	225.6	204.5	-9.35
Sodium (Na^{+1})	mg. l^{-1}	45.3	50.3	52.3	56.70	12.72	945.6	954.7	0.96
Calcium (Ca^{+2})	mg. l^{-1}	67.5	67.5	67.3	67.50	0.00	98.4	90.3	-8.23
Magnesium(Mg^{+2})	mg. l^{-1}	28.04	28.76	28.56	28.79	0.10	61.5	60.9	-0.98

Statistical analysis

The results were analyzed statistically using the ready-made program (Genstat 12thedition) and the averages were compared by the L.S.D. (Least Significant Difference) test at a probability level of 5%.

RESULTS AND DISCUSSION

The effect of irrigation on Total chlorophyll contents

The results of table 1 of total chlorophyll content of leaves (mg. g^{-1}), that the magnetized water irrigation had an effect on increasing the total chlorophyll content in all the measurement periods, and it was significant in all treatments compared to the comparison tree leaf content when it was measured on the third date. Significantly increased in the transactions of magnetized river water. As for the quality of water, its effect was significant in the three measurement stages by the greater than the content in the leave of the magnetized well water treatment. The highest value was 6.22 mg. g^{-1} in M3 treatment, which was significantly superior to the leave of the magnetized river water treatment, in which the total amount of chlorophyll was 4.12 mg. g^{-1} in M0 treatments at the first date. The same table also indicates the results of the effect of the overlap between the treatments. It is noticed that there were no significant differences in the content of palm leaves with the use of river water compared to their use with well water at the first date, and that all of them exceeded the chlorophyll content in the comparison treatment leave at the third date. Also, the use of magnetism with the well water, it led to an increase in the total chlorophyll content of leaves with the advancement of the measurement period, as it reached its maximum at the third date. All of them significantly exceeded the chlorophyll value in trees that were watered with non-magnetized water.

The increase in the chlorophyll content of leaves is attributed to the role of water magnetization in organizing water molecules and making solubility

process elements better and this has a role in preparing the mineral elements necessary to build chlorophyll and improving the roots ability to absorb them [17], especially nitrogen, phosphorous and potassium, as they have An important role in building chlorophyll through its role in the synthesis of protein and amino acids and in activating the enzymes that enter into its construction, as the increased salinity of the soil solution impedes the absorption of water and nutrients, which causes a disruption of vital processes within plant tissues [18] and may cause deterioration of the products. Metabolism or breakdown of the chlorophyll pigment in addition to the role of magnetizing water in increasing the ability of the roots to absorb water, which is necessary in the activity of enzymes, especially those responsible for building the chlorophilled substance, which is essential for building chlorophyll [19]. These results are consistent with the results of Abdul Wahid (2011). In the date palm.

Table 2. The effect of irrigation with magnetized water on the average leaf content of total chlorophyll (mg. g^{-1}) in date palms, Barhi variety

Water Type	1/ 6 /2019		1 / 11/ 2019		1/ 6 /2020	
	Before	After	Before	After	Before	After
M0	4.12	4.16	5.81	5.84	4.18	5.84
M1	4.17	4.21	5.77	5.77	4.27	5.77
M2	5.23	5.41	5.90	5.84	5.75	5.93
M3	5.94	6.02	6.07	5.97	6.21	6.22
M4	5.70	5.86	5.83	5.79	5.91	5.92
M5	5.78	6.05	6.01	5.93	6.14	6.10
L.S.D 5 %	0.07	0.02	0.10	0.06	0.05	0.09

The effect of irrigation on the dissolved total carbohydrates percentage in the leaves

Table (2) results showed an increase in the percentage of total dissolved carbohydrates in the leaves. The superiority of tree leaves was observed, and it was the highest at the third date, as the percentage rate in them was 6.52% and 6.55%, respectively, and the percentage of carbohydrates in the leave of the use of magnetized well water increased and their value significantly exceeded the percentage in the leave of the magnetic river water treatments at all measurement dates. It was maximum by the third date of measurement, as it reached 6.15%. The percentages were significantly higher on the third date in the transaction leave with the use of well water M3 than the rest of the treatments, reaching 4.50%, 6.25% and 6.55%, respectively, which did not differ significantly between them.

The effect of magnetizing water in increasing the chlorophyll content of leaves and its role in improving the absorption of the necessary mineral elements in the nutrition led to an increase in the efficiency of the photosynthesis process in the leaves and an increase in the manufacture of carbohydrates [20]. In addition to increasing the absorption of water, which is a source of hydrogen atoms necessary for the process of reducing carbon dioxide in the process of photosynthesis. As for the increased salinity of irrigation water, it was the reason for the increase in the percentage of carbohydrates in the leaves because it caused an imbalance in the completion of vital processes in plant tissues and impeded the conversion of simple dissolved sugars (monosaccharaides) into starch or reduced their consumption, which led to their accumulation. Plant tissue to withstand salt stress conditions by raising the osmotic potential of cellular juice [21]. This was supported in [22] date

palm where it was shown that slow growth leads to accumulation of carbohydrates in fronds as a result of reduced respiration and other vital processes.

Table 3. The effect of irrigation with magnetized water on the average leaf content of total chlorophyll (mg. g^{-1}) in date palms, Barhi variety

Water Type	1/ 6 /2019		1 / 11/ 2019		1/ 6 /2020	
	Before	After	Before	After	Before	After
M0	4.10%	4.12%	5.41%	5.54%	5.18%	٦.١٥%
M1	4.22%	4.31%	5.37%	5.67%	5.27%	5.67%
M2	4.13%	5.01%	5.20%	5.34%	5.75%	6.01%
M3	4.90%	4.50%	5.07%	6.25%	6.42%	6.55%
M4	5.20%	5.36%	5.53%	5.79%	5.91%	5.82%
M5	4.78%	5.05%	5.41%	5.93%	5.14%	6.52%
L.S.D 5 %	0.07	0.02	0.10	0.06	0.05	0.09

The effect of irrigation on the dissolved total protein percentage of in the leaves

The results in Table 3 show that all the treatments caused a significant increase in the percentage of protein in the leaves when measured on the third date. The highest percentages at this date reached 9.57%. Table 3 shows that there was no significant effect on the quality of irrigation water in the ratio at the first date, while the measurement on the second and third dates showed significant differences between the two types of water used in irrigation, as the percentage was higher in leaves of trees irrigated with well water than the percentage in leaves of trees irrigated with river water. It rose on the third date to 5.83%. While it reached 9.57% in well water treatment leave when measured at the same date. It is also noted that the overlap in the effect of the treatments showed significant differences between them, as the effect of magnetized water treatments when used with river water significantly exceeded the parameters of their use with well water at the three measurement dates. The highest rates reached on the third date in the treatment leave with the use of magnetized river water, which is 6.05%.

The role of magnetized water in increasing the plant's ability to absorb water and the elements necessary to build amino acids such as nitrogen, phosphorous and sulfur led to an increase in the protein content of leaves, which is one of the most important components of cell protoplasm [23], as the increased salinity in the soil or well water causes a decrease in the protein content of the leaves. [24] in addition to the role of magnetizing water in regulating the permeability of cellular membranes and reducing the absorption of saline ions such as sodium and chloride, which led to a reduction in their harmful effects on metabolic processes [25]. This is consistent with what [3].

Table 4. The effect of irrigation with magnetized water on the average leaf content of total chlorophyll (mg. g^{-1}) in date palms, Barhi variety.

Water Type	1/ 6 /2019		1 / 11/ 2019		1/ 6 /2020	
	Before	After	Before	After	Before	After
M0	4.10%	4.12%	5.41%	5.54%	5.22%	5.83%
M1	4.22%	4.31%	5.37%	5.67%	5.86%	6.05%
M2	4.43%	5.01%	5.20%	5.34%	6.75%	7.83%
M3	4.50%	4.50%	5.07%	6.25%	7.42%	8.21%
M4	5.30%	5.36%	5.53%	5.79%	7.91%	8.05%
M5	4.68%	5.05%	5.41%	5.93%	7.14%	9.57%
L.S.D 5 %	0.02	0.05	0.12	0.22	0.15	0.19

The effect of irrigation on the leaf content of proline

The results of table 4 show that the significant effect occurred since the date of the first measurement in all transactions, and that the lowest value was in the leave treated with magnetized river water. At the third date, it reached 0.78 parts per million, followed by non-magnetized river water leaves, reaching 0.79 parts per million at the same date. Irrigation with well water caused a significant increase in the amount of proline in leaves compared to river water on the three dates, as the highest rate reached 1.22 parts per million at the first date, while the lowest rate was in palm tree leaves irrigated with magnetized river water, 0.85 ppm at the third date. The effect of water magnetization in reducing the harmful effects of salt stress that palm trees were exposed to due to increased salinity in the soil and irrigation water was through its role in increasing the efficiency of biological processes in the plant tissue and reducing the accumulation of proline in them. Salinity causes an imbalance in protein synthesis, increases its breakdown, and inhibits the activity of proline oxidizing enzymes [26]. Therefore, its levels increased in well water use treatments and this supports what he mentioned. that proline collects in plant tissues in quantities commensurate with the amount of stress to which it is exposed and in agreement with What [27-28] found in date palms were classified as Al-Barhi and Halawi irrigated with salt water.

conclude from the research that the use of water magnetization on river or well water improved the nutritional content of the leaves of young date palm trees planted in desert areas and increased their ability to resist salt stress.

Table 5. The effect of irrigation with magnetized water on the average leaf content of total chlorophyll (mg. g^{-1}) in date palms, Barhi variety

Water Type	1/ 6 /2019		1 / 11/ 2019		1/ 6 /2020	
	Before	After	Before	After	Before	After
M0	0.87	0.85	0.81	0.75	0.79	0.78
M1	0.86	0.85	0.97	0.77	0.80	0.79
M2	0.97	0.91	0.90	0.88	0.85	0.8
M3	0.99	0.82	1.07	0.97	0.84	0.8
M4	1,07	0.87	0.93	0.99	0.97	0.82
M5	1.22	0.89	0.91	0.93	0.91	0.83
L.S.D 5 %	0.03	0.01	0.9	0.12	0.14	0.15

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Conflict of interest

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