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Improvement of Hyany Date Palms Production as Affected by Magnetite Soil Application and Magnetic Water at South Sinai

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ABSTRACT

At the Experimental Station at Ras Sudr Egypt's South Sinai Governorate, this study was successfully carried out during two seasons (2018 and 2019) on fourteen years – old Hyani dates palm cultivar planted at 8 X 8 meters apart grown with drip irrigation in sandy soil. (EC= 9.19 dS m^{-1}). This work included two factors first magnetite (Mag.) levels (0, 250, 500 and 750 g/tree/year) as a soil treatment second two types of water irrigation first magnetic water (MW) second non-magnetic water (non-MW) arranged in a completely randomized design. From the acquired results, it was shown that applying magnetite to the soil and irrigating with magnetic water had a substantial impact on all the analyzed attributes over both seasons. MW enhanced all studied parameters, components of the production, fruit properties, and leaf mineral content compared with non-MW irrigation during each season. Magnetite soil application at 750 g/tree with MW irrigation had the maximum yield, fruit and flesh weight, fruit length and diameter, total soluble solids, total sugars, reducing sugars and non-reducing sugars and leaves mineral contents (N, P, K, Ca and Mg) compared with the control and other treatments in the two seasons and reduce leaf proline content than the control ones.

Keywords: Date palms, Magnetite, fruit quality, Hyany, salinity, relative yield.

INTRODUCTION

The most prevalent fruit tree in dry and semi-arid regions of North Africa and the Middle East is the date palm tree (*Phoenix dactylifera* L.). In Egypt, date palm tree is among the most remarkable fruit types that may thrive in challenging environmental conditions; such extreme conditions are common in arid regions, which may not be convenient for many fruit species. The quantity of female fruiting palm trees in Egypt, is about fourteen and a half million 14,379,648 planted in just about 134126 feddan produced 1770603 million tons of soft, semi-dry and dry dates based on statistical (Ministry of Agriculture in 2020). Dates contain a variety of phytochemicals that have been connected to various biological functions. (anti-oxidants, anti-inflammatory, antibacterial, prebiotic, antitoxic, and anticancer properties), and are in charge of using them to prevent and control modern diseases like diabetes, cardiovascular, neurodegenerative, cancer, and gastrointestinal diseases in industrial countries these phytochemicals include phenolics, carotenoids, tocopherols, phytosterols, and anthocyanin. Fernández-López, *et al.*, (2022)

Only two naturally magnetic row rocks exist in the entire planet, magnetite is a natural rock with an extremely high concentration of iron. It is either black or reddish brown in appearance and has a Mohs hardness of approximately 6. (Mansour, 2007). Cation absorption capability and nitrogen uptake by stationary plants are both positively impacted by magnetite. (Eşitken and Turan, 2004). Moreover, the magnetic field could be utilized in place of chemical additives to improve food safety by lowering toxins in raw materials. (Abobatta, 2015) demonstrated that Valencia orange plants were treated with varied concentrations of magnetite and K-humate showed statistically remarkable improvements in their vegetative growth, crop output, quality of fruit, and certain leaf chemical content over both research seasons. Regarding the quality of fruit, yield production, and vegetative growth, 1000 g of magnetic iron combined with 50 g of K-humate was the most effective therapy. (Mohamed, 2017) working on Mango kiett cultivar, found that, with treatment of magnetite soil application at 250 g/tree/year and selenium 5 ppm, had the maximum yield per tree, fruit weight, reducing sugars, total soluble solids, N, P, K, and Fe content in leaves were discovered; however, the same treatment also produced lowermost leaf B, Na, and Cl content. (Abdalla, *et.al.*, 2022) detected that, when cultivated in salt, "Fagri Kalan" mango trees responded best to soil applications of K humate at 100 g/tree followed with applications of magnetite at 250 g/tree, foliar applications of Co at 15 ppm solely, or a combination. The maximum yields per tree, weight of fruit, reducing sugars, TSS and N, P, K and Fe content in leaves were achieved by these treatments.

Despite the challenges the agricultural sector faces (water scarcity, desertification, salinity, and low productivity), it is still regarded as the most significant factor that contributes to financial gain and food safety. These issues can be treated relatively by treating the water with a magnetic process.

When water is treated magnetically, it receives a magnetized field with a certain strength, stream rate and period. (Alattar *et al.*, 2019).

One of the most readily available, non-chemical, and environmentally benign techniques for watering plants is magnetized water usage, according to research that

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compared physical methods and other chemical compounds. (Bogatin *et al.*, 1999).

Depending on how the water molecules behave in a magnetic field, hydrogen bonds can form or break between molecules. This alters the characteristics of water that have an impact on electrical systems, including its surface tension, ability to polymerize, the capacity to dissolve acids and salts, moisture content, elasticity, electrical insulation, and permeability. It also affects the amount of oxygen dissolved in the water. Bring the water back in with greater vigor, power, and flow than before. Afterwards, these changes can alter physiological, chemical, physical, and metabolic processes, which will have an impact on the caliber of the building materials. (Al-Jubouri *et al.*, 2006). (Aly *et al.*, 2015) working on Valencia orange trees, in two seasons of this study, magnetized water outperformed nonmagnetic irrigation water in terms of all growth characteristics, fruit set, yield components, fruit quality, and element content in the leaves. The removal of excessive amounts of soluble salts, the lowering of pH levels, and the dissolution of slightly soluble substances like phosphates, sulfates, and carbonates are the three most notable effects of MW in soil. Mohamed and Sherif (2020).

Furthermore, according to reports, the magnetic technique for saline water has an appealing approach that is an effective method for desalinating soil and alters its qualities. As a result, it gains energy and flow, it can be viewed as the start of a brand-new field of study termed magneto biology. Mostafazadeh-Fard *et al.*, (2011a), Mostafazadeh-Fard *et al.*, (2011b) and Fanous *et al.*, (2017).

Some researches claimed that Magnetic Iron (M._Fe) might enhance organic component in soil, cation exchange capacity, water characteristics, and soil structure, which would therefore have an impact on plant growth. The "Magneto biology" of M.Fe, which is known to increase energy and vigor, helps to regulate soil temperature while enhancing capability to store water and crop nutrients. Additionally, the magnetic device isolates wholly harmful gases like chlorine of the soil, which increases salt growth and nutrient dissolvability. Abo-Gabien *et al.*, (2020) and Mohamed and Sherif (2020).

There hasn't been much research done on synergistic effect and grouping between magnetic water and magnetic iron as a soil adjustment on plants and soils. Therefore, this research trial was striped to assess the prospect effects of combination of them on changes in some soil characteristics and production in salty environments at South Sinai, Egypt.

The purpose of this investigation was to evaluate the results of applying magnetite soil treatment to date palms Hyani cultivar cultivated under salinity stress in the South Sinai Governorate of Ras Sudr, with both MWI and non-MWI.

MATERIALS AND METHODS

This investigation's goals were to ascertain the impacts of using magnetite as a ditch application both with and without watering of magnetic water on Hyani date palms cultivar yield and fruit quality. It was conducted at the Ras Sudr Experimental Station, in Egypt's South Saini Governorate, during the 2018 and 2019 growing seasons. The date palm trees of Hyani were chosen for planting at a distance of 8 X 8 meters in sandy soil based on their likeness in age (about 14 years), regular growing strength, and strong fruits and flowered characteristics. They also have drip irrigation systems to water them. On each test tree, there were just 8 remaining bunches. Magnetite (Mag.) was acquired from "Al-Ahram Company for Mining and Natural Fertilizers" (ECMNF), Giza, Egypt. The study was implicated four magnetite (Mag.) treatments (Mag.1= 0, Mag.2=250, Mag.3=500 and Mag.4=750 g/tree/year) and two types of water irrigation MWI=magnetic water irrigation and non-MWI=non-magnetic water irrigation. This experiment was arranged in a completely randomized design with three replicates (1replicate = 1 palm) per treatment (i.e. 4 X 2 X 3 = 24 Palms). Around the trees in the two seasons, various magnetite levels were applied once in the winter (January). Water for irrigation was provided by the well's trickle irrigation system. A passing magnetic field magnetized the irrigation water source. Permanent magnets with 88 cascaded magnetic fields made by Magnolith (EWL umelttechnick GMBH, Germany). this magnetic field's strength ranges from 2000 to 4000 Gauss. The gadget comprises of two pieces, which are joined together by a 3-inch irrigation pipe. The approach of Chapman and Pratt (1961) was used to examine the soil and magnetic irrigation water utilized for irrigation. In each season, in the second half of September, the test palm trees were harvested. The following research was done to determine the impact of magnetite with and without irrigation by magnetic water on productivity, fruit attributes, and minerals in leaves of the Hyani date palms variety during both seasons under consideration as following:

1- The averages of bunch weight and yield (kg):

At harvest time mean bunch weight measurements were taken in September's second half, and palm crop calculations were made.

2- Fruit physical properties:

Samples of 80 fruits per tree (10 fruits each bunch) were taken in order to measure the following fruit physical properties**;** fruit weight (g), fruit flesh weight (g), seed weight (g), fruit length (cm), fruit diameter (cm), were measured by means of a caliper and fruit shape was calculated according to the following equation: fruit shape =fruit length / fruit width.

3- Fruit's chemical composition: The moisture content was measured by drying the sample in an air oven at 70◦c until it attained a fixed weight according to AOAC (1990). Each treatment's ten date fruits were cut into pieces and the seeds were removed. Using a special electric mixer, 50g of bits were combined with 100 ml of purified water for extraction. After filtering the mixture, the filtrate was utilized to determine total soluble solids was determined by hand refractometer, as a percentage acidity % as malic acid content was calculated using a titration according to (A. O. A. C., 2005), determination of total sugars % content and reducing sugars using 3, 5-dinitrosalisylic acid (DNS) according to James (1995) then non-reducing sugars was calculated.

4- Leaf mineral content: Three palms of the Hyani cultivar were used for the analysis. A newly emerging leaves were selected from every palm in order to remove the dust and any chemical spray residues, leaflet samples collected in the early October period and rinsed twice in water: once with tap water and once with distilled water. Following washing, they were kept at a constant weight by Getting dried at 70 °C in an electric oven. To prepare the dry material for analysis, it was pulverized within an electric mill. And kept in paper bags. We crushed up dry leaves and digested according to (Jackson, 1973).

A modified version of the micro-Keldahl method, as described in Bremner's method (Bremner, 1996), was used to determine the total nitrogen content. As stated by Chapman and Pratt (1961), phosphorus was measured calorimetrically by the molybdenum blow technique. According to (Irri, 1976), potassium was measured using a flame photometer. According to (Wilde *et al*. 1985), the percentages of calcium and magnesium were calculated. According to (Bates *et al*. 1973), proline was calculated. The means of the various treatments were compared using LSD at 0.05 in accordance with (Snedecor and Cochran 1980) after the data were subjected to computerized statistical analysis using the Statistics 9 tool for analysis of variance (ANOVA).

5- Soil sampling and analysis:

By using a soil auger, from a selection of trees, soil samples were collected in triplicate at a depth of 0 to 30 cm. These disturbed soil samples were processed for soil analysis by being air dried, being crushed, and going through a 2 mm sieve. The applicable standard procedures outlined by Klute (1986) and Page *et al*. (1982) were used to determine the chemical and physical parameters of the undisturbed soil samples. These characteristics included the dispersion of particle sizes; Total calcium carbonate ($CaCO_3$), Soil bulk density (BD), Soil pH of the 2:1 soil extract, salinity of the soil (ECe), estimated SAR (sodium adsorption ratio), SOC (organic matter), TN (total nitrogen), P (available phosphorus), and (Av.K) available potassium, as well as soluble cations and anions,. Furthermore, the technique of Soltanpour (1991) was used to extract the readily accessible microelements Fe, Zn, Mn, - and Cu. Table 1 displays a few of the initial soil's physical characteristics. The soil is a sandy loam with a high calcium carbonate content.

Table 1. Some of the physical characteristics of the soil surface (0 – 30) in the Ras Sudr neighborhood, South Sinai governorate.

Soil depth	Particle Size distribution			Texture Class	$CaCO_3$ (%)	BD
	Sand	Silt	Clay			
0 - 30	73.3	14.8	11.9	Sandy loam	47.7	1.52

BD: Bulk Density.

Water analysis:

Water for irrigation came in trickles from a well. Magnolite (EWL umelttechnick GMBH, German) permanent magnets with 88 cascaded magnetic fields were used to magnetize the irrigation water source. This magnetic field has a 2000–4000 Gauss intensity range. The gadget comprises of two pieces, which are joined together by a 3-inch irrigation pipe. Table 2 lists a few water chemical characteristics of irrigation water.

Table 2. Some water chemical properties of the studied water

Treatments	PH	EC	Cations (m/L)				Anions (m/L)				SAR
			Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	
Non-magnetic Water	7.3	9.18	16.65	10.23	82.14	2.3	0	2.23	90.22	19.20	2.14
Magnetic Water	7.0	8.15	14.18	11.8	70.04	3.1	0	1.26	87.25	1.22	1.92

(SAR): Sodium adsorption ratio.

Statistical Analysis:

Data were gathered from both seasons and submitted for analysis of variance as per (Snedecor and Cochran 1980), SAS 2003 was used for the statistical analysis, and the Duncan multiple range test at the 5% level was used to separate the means. (Duncan, 1955).

RESULTS AND DISCUSSION

1- Bunch and yield weight (Kg):

Result in Table 3 revealed that, magnetite, and magnetic water irrigation and their interaction significantly affected bunch weight and harvest (kg/tree) in both seasons. Concerning of Mag. it could be notice that, adding the Mag. at 500 or 750g/tree/year gained the highest Bunch weight and yield (Kg/tree) in the first season while just the top level of Mag. 750g/tree/year proved to give highest significant values during the second season. Regarding to MWI it could be observed that using treated water with magnetic field recorded highest significant bunch weight and yield at both seasons. With respect to interaction between the two factors there were insignificant differences in most cases, treated with Mag. levels with or without MWI increased bunch weight and yield (Kg/tree) compared to trees that weren't treated in the first season. Whereas treatment of Mag. at the high level 750 g/tree/year in a combination with MWI gave more stimulating effects on bunch weight and yield (kg/tree) compared with other treatments. As well as the combination between (Mag. 750g/tree/year) and using of MWI had the heist significant bunch weight and yield in the second season. In contrast, the untreated date palm trees showed the lowest values in both seasons.

The impact of magnetite water on salt leaching and soil nutrient availability is what causes it to be evident. Al-Ghamdi (2014) hence improving the 'Valencia' orange's fruit set, plant growth traits, leaf mineral levels, yield, and quality. Aly *et al*., (2015). These results also conformed to El-Kholy *et al*., (2015) on banana plant Williams cultivar. Hamdy *et al*., (2015) on some mandarin varieties. And Okba *et al*., (2022) on pomegranate.

Also, the increase in yield due to use the Magnetite treatments as a soil application can be attributed to promote soil structure, capability for exchanging cations, organic matter, Water characteristics and how they impact the growth of plants (Abo-Gabien *et al*., 2020 and Mohamed and Sherif 2020). These outcomes matched those that were shown by (Abobatta, 2015) at Valencia orange trees, (Mohamed, 2017) and (Abdalla, *et .al*, 2022) on Mango trees.

Table 3. Effect of magnetite (mag.) soil treatment both with and without watering with magnetic water on bunch weight and yield of "Hyani" date palm trees throughout seasons of 2018 and 2019

Treatments	Bunch weight (Kg)			Yield (Kg/tree)		
Mag. (g/tree/year)	**(MW)I***	**Non –(MWI)***	**Mean**	**(MW)I***	**Non –(MWI)***	**Mean**
			2018			
0 (Mag.$_1$)**	13.56 a	10.80 b	12.18 C	108.50 a	86.40 b	97.45 C
250 (Mag.$_2$)**	15.52 a	14.58 a	15.05 B	124.18 a	116.67 a	120.42 B
500 (Mag.$_3$)**	16.54 a	14.60 a	15.57 AB	132.33 a	116.83 a	124.58 AB
750 (Mag.$_4$)**	17.80 a	15.25 a	16.52 A	142.40 a	121.97 a	132.18 A
Mean	15.86 A\	13.81 B\		126.85 A\	110.47 B\	
			2019			
0 (Mag.$_1$)**	14.44 b	10.70 c	12.57 C	115.50 b	85.63 c	100.57 C
250 (Mag.$_2$)**	15.26 b	14.41 b	14.84 B	122.10 b	115.30 b	118.70 B
500 (Mag.$_3$)**	16.49 b	14.80 b	15.64 B	131.90 b	118.40 b	125.15 B
750 (Mag.$_4$)**	19.03 a	15.06 b	17.04 A	152.20 a	120.48 b	136.34 A
Mean	16.30 A\	13.74 B\		130.43 A\	109.95 B\	

***MWI: Magnetic irrigation water** ****Mag.: Magnetite**

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

2- Fruit physical properties:

Data in Tables 4 and 5 depict the impact of magnetite soil application and magnetic water irrigation on some fruit physical properties of Hyani date palms during 2018 and 2019 seasons.

Concerning fruit and flesh weight (g) they were affected significantly by Mag. in both seasons where Mag. at 750 g/tree exhibited the highest values in both seasons. As for water irrigation data obvious that using treated water with magnetic field gained significantly the heaviest fruit and flesh in both seasons. It is abundantly obvious from the combination of the two factors that trees ingested Mag. soil application at 750 g/tree and irrigated with MWI had greatest fruit weight (19.76 &20.83g) and flesh weight (17.60 & 18.27g) in seasons one and two, respectively opposite to the regulator treatment.

As observed in Table 4, the lowermost significant seed weight was obtained by the untreated trees in both seasons. But there were no specific trend in other treatment.

Regarding to fruit length and fruit diameter (cm) the result in table (5) clarified that, Mag. at 750g/tree significantly achieved the highest fruit length and diameter (cm) in both seasons. Also using MWI had the highest significant values of fruit length and diameter (cm) in the first and the second seasons. Concerning interaction, it could be observing that palms received 750g/tree Mag. soil treatment and watered by magnetite water delivered the largest fruit in terms of length and diameter. (5.42&2.60 cm) in the first season respectively.

Table 4. Effect of magnetite (Mag.) soil treatment both with and without watering of magnetic water on fruit, flesh and seed weight of "Hyani" date palm trees throughout seasons of 2018 and 2019

Treatments	Fruit weight (g)			Flesh weight (g)			Seed weight (g)		
Mag. (g/tree/year)	**(MW)I***	**Non –(MWI)***	**Mean**	**(MW)I***	**Non –(MWI)***	**Mean**	**(MW)I***	**Non –(MWI)***	**Mean**
					2018				
0 (Mag.$_1$)**	14.29 d	12.63 e	13.96 D	12.74 cd	11.31 d	12.03 D	1.55 b	1.32 b	1.43 C
250 (Mag.$_2$)**	15.41 cd	14.41 d	14.91 C	13.52 c	12.73 cd	13.13 C	1.76 ab	1.69 ab	1.73 B
500 (Mag.$_3$)**	17.72 b	15.46 cd	16.59 B	15.55 b	13.74 c	14.65 B	2.17 a	1.72 ab	1.95 A
750 (Mag.$_4$)**	19.76 a	16.57 c	18.17 A	17.60 a	14.71 bc	16.15 A	2.16 a	1.86 ab	2.01 A
Mean	16.79 A\	14.77 B\		14.85 A\	13.12 B\		1.91 A\	1.65 B\	
					2019				
0 (Mag.$_1$)**	13.28 d	12.40 d	12.84 D	11.71 d	11.01 d	11.36 D	1.56 de	1.39 e	1.48 D
250 (Mag.$_2$)**	18.04 b	15.73 c	16.88 C	16.29 b	14.03 c	15.16 C	1.74 cd	1.69 cd	1.72 C
500 (Mag.$_3$)**	18.88 b	17.79 b	18.34 B	16.68 b	15.98 b	16.33 B	2.21 b	1.82 cd	2.01 B
750 (Mag.$_4$)**	20.83 a	18.49 b	19.66 A	18.27 a	16.57 b	17.42 A	2.56 a	1.92 c	2.24 A
Mean	17.76 A\	16.10 B\		15.74 A\	14.40 B\		2.02 A\	1.71 B\	

***MWI: Magnetic irrigation water** ****Mag.: Magnetite**

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

Table 5. Effect of magnetite (Mag.) soil treatment both with and without watering of magnetic water on fruit length, fruit diameter and fruit shape of "Hyani" date palm trees throughout seasons of 2018 and 2019

Treatments	Fruit length (cm)			Fruit diameter (cm)			Fruit shape		
Mag.(g/tree/year)	**(MW)I***	**Non –(MWI)***	**Mean**	**(MW)I***	**Non –(MWI)***	**Mean**	**(MW)I***	**Non –(MWI)***	**Mean**
					2018				
0 (Mag.$_1$)**	4.52 c	4.16 d	4.34 C	2.33 b	2.12 b	2.23 B	1.94 ab	1.97 ab	1.95 B
250 (Mag.$_2$)**	5.22 b	4.08 d	4.65 B	2.38 ab	2.12 b	2.25 B	2.20 a	1.92 ab	2.06 A
500 (Mag.$_3$)**	5.22 b	4.13 d	4.67 B	2.38 ab	2.11 b	2.25 B	2.19 a	1.95 ab	2.07 A
750 (Mag.$_4$)**	5.42 a	4.23 d	4.83 A	2.60 a	2.28 b	2.44 A	2.09 ab	1.85 b	1.97 B
Mean	5.10 A\	4.15 B\		2.42 A\	2.16 B\		2.11 A\	1.92 B\	
					2019				
0 (Mag.$_1$)**	4.57 bc	3.74 d	4.15 C	2.36 bc	2.23 d	2.29 C	1.94 ab	1.39 e	1.81 B
250 (Mag.$_2$)**	5.18 a	4.00 cd	4.59 B	2.40 ab	2.22 d	2.31 C	2.17 a	1.69 cd	1.99 A
500 (Mag.$_3$)**	5.32 a	4.14 b-d	4.73 B	2.47 a	2.22 d	2.35 B	2.15 a	1.82 cd	2.01 A
750 (Mag.$_4$)**	5.52 a	4.45 bc	4.99 A	2.48 a	2.31 cd	2.40 A	2.23 a	1.92 c	2.08 A
Mean	5.15 A\	4.08 B\		2.43 A\	2.24 B\		2.12 A\	1.82 B\	

***MWI: Magnetic irrigation water** ****Mag.: Magnetite**

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

Whereas in the second season all the levels of Mag. soil application with MWI treatments recorded the better values of fruit length and diameter as compared with the other treatments. Concerning fruit shape, all Mag. treatments achieve the highest values in both seasons except treatment of magnetite at 750g/tree in the first season. As for MWI it significantly affected on fruit shape in both seasons that gained the highest values. With respect to interaction between the first and second factors there were lack significant differences on fruit shape.

Fruit chemical characteristics:

Data in Tables 6 and 7 illustrated the result of magnetite as a ditch treatment both with and without watering of magnetic water on some of the Hyani date palm's fruit chemical qualities throughout the 2018 and 2019 growing seasons. As observed in Table 6, concerning to moisture content (%) data revealed that mag. as a soil application and MWI and their interactions gained insignificant effect on fruit moisture percentage. In regard to total soluble solids content it was greatly impacted by adding mag. to the soil in both seasons. Where, the treatment of Mag. at 750g/tree exhibited the greatest values in both seasons. Moreover total soluble solids (%) were affected significantly by MWI in both seasons and the highest significant value was recorded by MWI. As for the interaction one can notice that there was lack significant on total soluble solids meanwhile treatment of Mag. soil application at 750g/tree followed by irrigation by magnetic water recorded the highest total soluble solids (35.65&36.63%) during the two seasons of the experiment, respectively. Regarding total acidity Mag. at 750g/tree achieved the season's first and second lowest acidity percentage. Meanwhile using MWI was least significant values in the second season only thus in the first season there were insignificant effect between Mag. and non-MWI. As for interaction on can notice that trees received Mag. at 750g/tree and irrigated with magnetic water gave the smallest proportion of total acidity (0.080&0.080 %) in the first and second season respectively.

Data in Table 7 shows the effect of applying magnetite to the soil and using magnetic irrigation on total sugars, reducing sugars and non-reducing sugars in fruits of Hyani date palm throughout the seasons of 2018 and 2019.

Values of total sugars, reducing sugars, and non-reducing sugars were all strongly impacted by magnetite, magnetic irrigation water, and their interaction in the two seasons. The high levels of Mag. 500 or 750g/tree gained the largest percentage of total sugars during either season. While Mag. at 750g/tree exhibited the greatest proportion of reducing sugars% across both seasons. On the contrary non-reducing sugars was insignificantly affected with mag. application at first season whereas in second season mag. at 500 or 750g/tree had highest values. Regarding MWI it is illustrated that total sugars, reducing sugars and non-reducing sugars, were improved gradually by using MWI on the other hand using non-MWI gained least significantly values in both seasons. With respect to the interaction in most cases trees received the high levels of Mag. 500 or 750g/tree and received MWI gave the highest amounts of both reducing and non-reducing sugars as well as total sugars. With the same statistical vantage point, other treatments produced values that were more or less comparable.

Table 6. Effect of magnetite (Mag.) soil treatment both with and without watering of magnetic water on Moisture content, total soluble solids and total acidity of "Hyani" date palm trees throughout seasons of 2018 and 2019

Treatments	Moisture content (%)			Total soluble solids (%)			Total acidity (%)		
Mag. (g/tree/year)	(MW)I*	Non –(MWI)*	Mean	(MW)I*	Non –(MWI)*	Mean	(MW)I*	Non –(MWI)*	Mean
				2018					
0 (Mag.1)**	68.86 a	68.47 a	68.67 A	31.87 b	30.21 b	31.04 D	0.083 bc	0.084 a	0.084 A
250 (Mag.2)**	68.79 a	66.50 a	67.65 A	34.38 a	31.31 b	32.85 C	0.084 b	0.083 bc	0.084 A
500 (Mag.3)**	68.88 a	68.11 a	68.50 A	34.87 a	33.80 a	34.34 B	0.081 cd	0.083 bc	0.082 B
750 (Mag.4)**	69.77 a	67.95 a	68.86 A	35.65 a	34.65 a	35.15 A	0.080 d	0.082 b-d	0.081 B
Mean	69.08 A\	67.76 A\		34.19 A\	32.49 B\		0.082 A\	0.083 A\	
				2019					
0 (Mag.1)**	68.47 a	68.07 a	68.27 A	31.50 d	30.24 d	30.87 D	0.081 cd	0.083 ab	0.082 B
250 (Mag.2)**	69.19 a	68.71 a	68.95 A	33.56 bc	31.01 d	32.28 C	0.082 bc	0.084 a	0.083 A
500 (Mag.3)**	69.92 a	68.26 a	69.09 A	35.87 a	32.17 cd	34.02 B	0.081 cd	0.084 a	0.082 AB
750 (Mag.4)**	69.00a	69.21 a	69.10 A	36.63 a	34.34 b	35.48 A	0.080 d	0.081 cd	0.081 C
Mean	69.15 A\	68.56 A\		34.39 A\	31.94 B\		0.081 B\	0.082 A\	

***MWI: Magnetic irrigation water** ****Mag.: Magnetite**

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

Table 7. Effect of magnetite (Mag.) soil treatment both with and without watering of magnetic water on total sugars, reducing sugars and non-reducing sugars of "Hyani" date palm trees throughout seasons of 2018 and 2019

Treatments	Total sugars (%)			Reducing sugars (%)			Non-reducing sugars (%)		
Mag. (g/tree/year)	(MW)I*	Non –(MWI)*	Mean	(MW)I*	Non –(MWI)*	Mean	(MW)I*	Non –(MWI)*	Mean
				2018					
0 (Mag.1)**	28.71 b	20.96 c	24.84 B	19.58 ab	16.27 b	17.92 B	9.13 a	4.73 b	6.93 A
250 (Mag.2)**	29.54 b	21.41 c	25.48 B	20.34 ab	16.60 b	18.47 B	9.20 a	4.81 b	7.01 A
500 (Mag.3)**	32.57 a	21.91 c	27.24 A	21.18 ab	17.03 b	19.11 AB	11.39 a	4.88 b	8.13 A
750 (Mag.4)**	32.05 a	22.02 c	27.04 A	22.20 a	17.89 ab	20.02 A	9.85 a	4.13 b	6.99 A
Mean	30.72 A\	21.58 B\		20.83 A\	16.95 B\		9.89 A\	4.64 B\	
				2019					
0 (Mag.1)**	28.59 b	20.84 d	24.71 C	18.49 cd	16.77 d	17.63 D	10.10 a	4.07 b	7.08 B
250 (Mag.2)**	29.50 b	21.98 cd	25.74 B	19.78 bc	17.18 d	18.48 C	7.92 a	4.67 b	7.20 B
500 (Mag.3)**	32.97 a	24.11 c	28.54 A	20.19 b	18.44 cd	19.32 B	12.97 a	5.13 b	8.95 A
750 (Mag.4)**	33.67 a	24.32 c	29.00 A	22.96 a	17.70 d	20.33 A	10.71 a	6.63 b	8.67 A
Mean	31.18 A\	22.81 B\		20.36 A\	17.52 B\		10.83 A\	5.12 B\	

***MWI: Magnetic irrigation water** ****Mag.: Magnetite**

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

The exceedingly efficient stimulation of growth parameters by Mag. treatments could account for these outcomes. Additionally, there was a rise in chlorophyll, the mineral content of grapevine leaves, and total carbohydrates in the canes. which could enhance the fruit's quality, according to Mervat *et al*., (2013). However, Mohamed, (2017) noted that the Kiett mango trees had the maximum yield per tree, fruit weight, total soluble solids, reducing sugars, and leaf N, P, K, and Fe contents when magnetite soil application was made at a rate of 250 g/tree and selenium was applied at a rate of 5 ppm.

3- Leaf mineral content

Data in Table 8 observed the effect of magnetite and magnetic water irrigation and their interactions on N, P and K content of Hyani date palm throughout the seasons of 2018 and 2019.

Data revealed that magnetite, magnetic irrigation water, and their interactions in the two seasons greatly impacted the nitrogen, phosphorus, and potassium content of the leaves. As for leaf nitrogen content data cleared that, regarding to Mag. soil application it could be noticed that, during the two growth seasons, the high amount of Mag. 750g/tree produced the greatest values of N%. Concerning MWI it obvious that, using magnetic water to irrigate, N% was dramatically raised on the contrary non-magnetic water gained the least significant values. Regarding the interaction, it worth mention that trees received Mag. at 750g/tree and irrigated with magnetic water exhibited the highest leave N % conversely, untreated trees produced the lowest results over the course of the two seasons. With respect to leaf phosphorus content it is obvious that concerning magnetite in the first season Mag. at 500 or 750g/tree had the highest leaf P% whilst just during the second season the high level of magnetite 750g/tree recorded the highest significant values. In regard to MWI it showed that, irrigated with magnetic water enhance significantly leaf P% in the both seasons. Regarding the interaction, it illustrated that, trees treated with Mag. at 750g/tee and watered with magnetic water acquired the maximum P%. On the contrary untreated trees had the lowest values during the two growing seasons. Concerning to leaf potassium content data indicated that, as for magnetite soil application it could be observed that, Mag. at 750g/ tree provided the top K% values in both seasons.

With respect to magnetic irrigation water it revealed that, K % was significantly enhanced by using MWI on the contrary non-magnetic water gained the least significant values. Concerning the interaction it was observed that, trees received Mag. at 500 or 750g/tree and irrigated with magnetic water or treated only by Mag. at 750g/tree gained highest leave K % in the first season. Whilst within the second season trees received Mag. at 750g/tree and with MWI only had the highest value.

Data in Table 9 display the results of magnetite and magnetic irrigation water and their interactions on leaf Ca, Mg content of Hyani date palm during 2018 and 2019 seasons.

Data revealed that, leaf calcium and magnesium content significantly affected with magnetite, magnetic irrigation water and their interaction in the two seasons.

Regarding to calcium content data revealed that, concerning Mag. soil application it obvious that, treatment of Mag. at 750g/ tree gained the highest values of Ca% in both seasons. Concerning MWI it could be observed that, Ca % was significantly improved by using MWI. As opposed to that, non-magnetic water gained the least significant values. Concerning interaction, it could be noticed that, trees received Mag. at 750g/tree and MWI recorded highest leave Ca % meanwhile untreated trees had the lowest values in the two seasons. With respect to leaf magnesium content it is showed that regarding to Mag. in the two seasons Mag. at 500 or 750g/tree exhibited the highest leaf Mg%. As for MWI it cleared that, using MWI enhance significantly leaf Mg% in the first and second seasons. Regarding the interaction, it showed that, trees treated with Mag. at500 or 750g/tee and irrigated with MWI gained the highest Mg%. On the contrary untreated trees had the lowest values during the both seasons.

These outcomes may be attributable to magnetite, which has been shown to increase cation absorption capacity and improve nutrient uptake by stationary plants (Eşitken and Turan, 2004). In contrast, irrigation with magnetite water, which is less viscous and less tense on the surface, promoted carbon deposition, increased levels of phosphate (P) and potassium (K) in the soil solution, and boosted soil microbial activity (Mostafazadeh-Fard, *et al*., 2012).

Table 8. Effect of magnetite (Mag.) soil treatment both with and without watering of magnetic water on leaf nitrogen, phosphorus and potassium percentage of "Hyani" date palm trees throughout seasons of 2018 and 2019

Treatments	Nitrogen (%)			Phosphorus (%)			Potassium (%)		
Mag.(g/tree/year)	(MW)I*	Non –(MWI)*	Mean	(MW)I*	Non –(MWI)*	Mean	(MW)I*	Non –(MWI)*	Mean
				2018					
0 ($Mag._1$)**	1.67 b	1.66 b	1.67 C	0.34 ab	0.31 b	0.33 B	1.52 c	1.51 c	1.52 D
250 ($Mag._2$)**	1.69 b	1.67 b	1.68 BC	0.36 ab	0.32 b	0.34 B	1.56 bc	1.53 c	1.55 C
500 ($Mag._3$)**	1.71 b	1.68 b	1.69 B	0.39 ab	0.34 ab	0.37 A	1.68 a	1.60 b	1.64 B
750 ($Mag._4$)**	1.76 a	1.70 b	1.73 A	0.43 a	0.35 ab	0.39 A	1.72 a	1.67 a	1.70 A
Mean	1.71 A\	1.68 B\		0.38 A\	0.33 B\		1.62 A\	1.58 B\	
				2019					
0 ($Mag._1$)**	1.68 b	1.65 b	1.67 C	0.35 bc	0.32 c	0.33 C	1.56 d	1.52 e	1.54 D
250 ($Mag._2$)**	1.70 b	1.67 b	1.68 C	0.37 bc	0.33 bc	0.35 C	1.62 c	1.57 d	1.60 C
500 ($Mag._3$)**	1.76 ab	1.69 b	1.72 B	0.40 b	0.35 bc	0.38 B	1.70 b	1.61 c	1.66 B
750 ($Mag._4$)**	1.83 a	1.70 b	1.77 A	0.45 a	0.36 bc	0.41 A	1.76 a	1.68 b	1.72 A
Mean	1.74 A\	1.68 B\		0.39 A\	0.34 B\		1.66 A\	1.60 B\	

***MWI: Magnetic irrigation water** ****Mag.: Magnetite**

Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

Table 9. Effect of magnetite (Mag.) soil treatment both with and without watering of magnetic water on leaf calcium and magnesium of "Hyani" date palm trees throughout seasons of 2018 and 2019

Treatments	Calcium (%)			Magnesium (%)		
Mag. (g/tree/year)	(MW)I*	Non –(MWI)*	Mean	(MW)I*	Non –(MWI)*	Mean
			2018			
0 (Mag.1)**	1.81 b	1.88 b	1.80 C	0.41 bc	0.39 c	0.40 C
250 (Mag.2)**	1.91 b	1.81 b	1.86 C	0.43 a-c	0.41 bc	0.42 B
500 (Mag.3)**	2.03 b	1.87 b	1.95 B	0.45 ab	0.41 bc	0.43 B
750 (Mag.4)**	2.34 a	1.94 b	2.14 A	0.46 ab	0.42 bc	0.44 A
Mean	2.02 A\	1.86 B\		0.44 A\	0.41 B\	
			2019			
0 (Mag.1)**	1.86 d	1.83 d	1.85	0.42 a	0.39 a	0.41 C
250 (Mag.2)**	2.12 bc	1.93 cd	2.03 C	0.43 a	0.41 a	0.42 BC
500 (Mag.3)**	2.22 b	2.00 b-d	2.11 B	0.46 a	0.42 a	0.44 AB
750 (Mag.4)**	2.44 a	2.14 bc	2.29 A	0.46 a	0.43 a	0.44 A
Mean	2.16 A\	1.97 B\		0.44 A\	0.41 B\	

***MWI: Magnetic irrigation water **Mag.: Magnetite**
Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

5-Leaf proline content

Data in Table 10 clear the effect of magnetite and magnetic irrigation water and their interactions on leaf proline content of Hyani date palm during 2018 and 2019 seasons. As for Mag., one can notice that, in most cases the Mag. treatments were decreased leaf proline content in comparison to untreated trees in the two seasons. As for MWI it obvious that, in both seasons leaf proline content was significantly decreased by using MWI. Regarding the interaction it worth mention that, untreated trees recorded the highest significant value in both seasons while trees received 750g/tree Mag. and irrigated by magnetite water gained the lowest values in the first season whereas in the second season treatment of 500g/tree Mag. with non-magnetic water had the lowest values. The previous results are in agreement with those maintained by (Dhawi & Al-Khayri 2008) on in vitro date palm who observed that, even as little as a minute of exposure, oscillating magnetic field drastically decreased proline concentration.

Table 10. Effect of magnetite (Mag.) soil treatment both with and without watering of magnetic water on leaf proline content of "Hyani" date palm trees throughout seasons of 2018 and 2019

Treatments	Proline (ppm)		
Mag. (g/tree/year)	(MW)I*	Non –(MWI)*	Mean
	2018		
0 (Mag.1)**	1.71 de	2.08 a	1.89 A
250 (Mag.2)**	1.72 de	1.75 cd	1.73 C
500 (Mag.3)**	1.84 b	1.82 b	1.83 B
750 (Mag.4)**	1.66 e	1.79 bc	1.72 C
Mean	1.73 B\	1.860 A\	
	2019		
0 (Mag.1)**	1.78 b-d	2.04 a	1.91 A
250 (Mag.2)**	1.80 bc	1.78 b-d	1.79 B
500 (Mag.3)**	1.85 b	1.70 d	1.77 B
750 (Mag.4)**	1.71 cd	1.83 b	1.77 B
Mean	1.78 B\	1.84 A\	

***MWI: Magnetic irrigation water **Mag.: Magnetite**
Means followed by the same letter (s) in each row, column or interaction are not significantly different at 5% level.

5.Soil salinity (ECe) and soil sodicity:

The use of magnetite alone or in conjunction with magnetic water under drip irrigation had a highly significant impact on reducing salinity and sodicity of the soil. According to the treatments shown in figs. 1 and 2, soil salinity, as measured by electrical conductivity (ECe) dS/m, and soil sodicity, as measured by sodium adsorption ratio (SAR), were both extremely significant. Similar results to those published by Sarwar *et al.* (2008) and Amer *et al.* (2016) have been observed. The effects of treatments on soil salinity and sodicity can be sorted in descending order: control > 250 > 500 > 750 gm/tree. Due to the magnetic water's ability to boost soil salt leaking and decrease soil salt concentricity, as according to Mostafazadeh-Fard *et al.* in 2011, Mostafazadeh-Fard *et al.* in 2012, and Fanous *et al.* in 2017, it has a strong chance of lowering the salinity and acidity of the soil. Additionally, Fanous *et al.* (2017) showed that Na is an element that exhibits paramagnetic properties and a tiny positive sensitivity to magnetic fields, which causes the decreasing effect. Additionally, it could be caused by how easily NaCl and Na2CO3 salts dissolve in magnetized water, which Hilal *et al.* (2012) suggested could be used to leach the salts away from the roots zone. Alternatively, as according to Abobatta (2015) and Abo-Gabien *et al.* (2020), the result of magnetic iron reason for more decrease in soil salinity due to absorb salts and mitigate of salt stress of the soil and simultaneous rise in oxygen concentration through its influence-on hydrogen bonds.

PH and cation exchange capacity (CEC) of the soil:

As can be shown in Figs. 3 and 4, the soil pH and CEC results were extremely significant decreases with pH and treatments, and vice versa with CEC. The best treatment resulted in a pH drop of around 40% and a rise in CEC of about 20% when 750 gm/tree magnetic iron was combined with magnetic water. This result agreement with Mohammed (2013), Fanous *et al* (2017), Zlotopolski (2017), Abo Gabien *et al* (2020) and Mohamed and Sherif (2020).

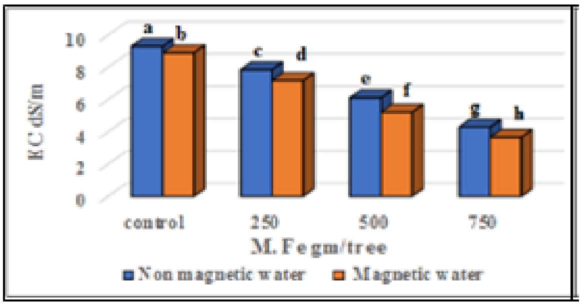

Fig. 1. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on EC dS/m Values followed by different letters are significantly at $p < 0.05$.

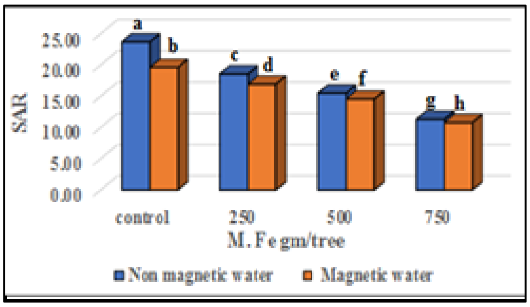

Fig. 2. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on SAR Values followed by different letters are significantly at $p < 0.05$.

According to Fanous *et al.* (2017), this outcome is caused by an increase in the magnetic field's impact on soil organic matter, which releases considerably more organic acids into the rhizosphere. According to Sparks (2003), the source of the CEC results was a decrease in pH as the surfaces with changing charge became more strongly energized as a result of the protonation of functional groups. As a result, CEC helps to reduce the acidity of numerous temperate soils. According to William *et al.* (2020), once H^+ is supplied to the soil solution, it swaps for cations on soil elements and organic material.

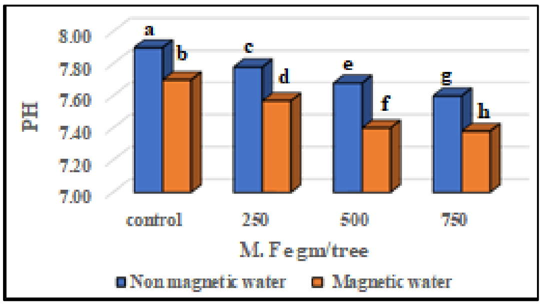

Fig. 3. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on pH, values followed by different letters are significantly at $p < 0.05$.

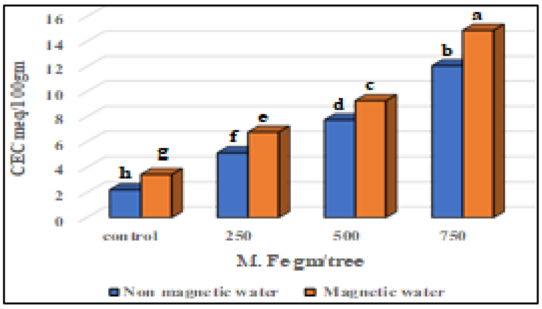

Fig. 4. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on CEC meq/100g, values followed by different letters are significantly at *p* < 0.05.

Organic matter and soil macronutrients:

Figures 5, 6, 7 and 8 show the effects of application on soil organic material (SOM) and macronutrients (N, P, and k). The statistical analysis results were highly significant increased with treatment compared with the control. The best application was 750 gm/tree. Moreover, effect of magnetite and MWI has effect to raise soil organic material and macronutrients. These outcomes were brought on by higher oxygen levels. This is accomplished through van der Waals forces and hydrogen bonds affected by magnetic fields, which result in defects in both hydrogen and non-hydrogen bonds. As a result, the hydrogen bonds become more tightly packed and spaced out, which causes gases to dissolve in water and increase in volume, particularly oxygen gas. According to Sarwar *et al.* (2008), Abobatta (2015), Neira *et al* (2015), Amer (2016), Sierra *et al* (2017), and Abo-Gabien *et al* (2020), increasing oxygen concentration, soil humidity, and soil temperature have a considerable impact on the average of soil organic matter (SOM) decomposition and, as a result, decrease pH and increase the amount of available macronutrients in soil by increasing the acid. According to Hilal *et al.* (2012), magnetic water blocks hazardous metals like lead and nickel reaching fruits after being absorbed by roots. Nevertheless, it boosts the proportion of nutritional substances like phosphorus and potassium.

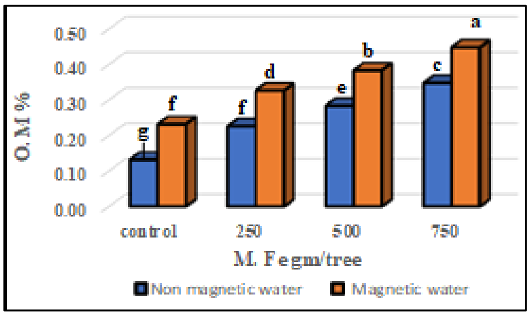

Fig. 5. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on OM%, values followed by different letters are significantly at *p* < 0.05.

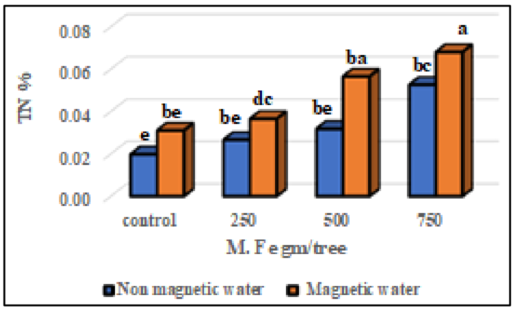

Fig. 6. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on TN%, values followed by different letters are significantly at *p* < 0.05.

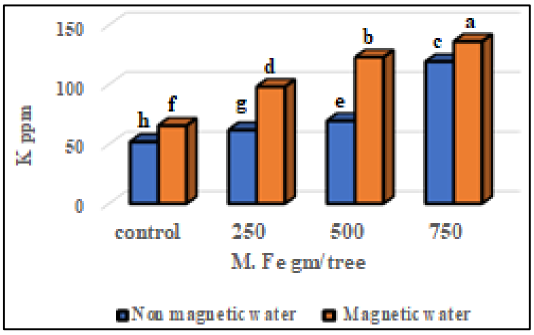

Fig. 7. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on K ppm, values followed by different letters are significantly at $p < 0.05$.

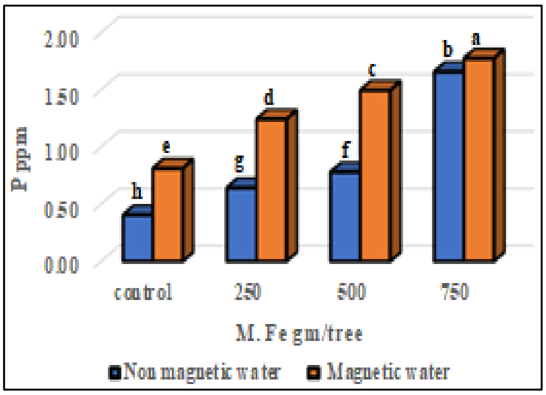

Fig. 8. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on P ppm, values followed by different letters are significantly at p < 0.05

Soil Micronutrient:

Results for Fe, Zn, Mn and Cu mg/kg in trial soil in both seasons are shown in Figs. 9, 10, 11, and 12. Of all the micronutrient effects, MW and M Fe had the most significant results. The results were presented in the following order, from lowest to highest: 750>500>250>0 g/tree with MW in comparison to untreated trees and watering of non-magnetic water. These results agreement with Hilal *et al*. (2012) and Mohamed and Sherif (2020).

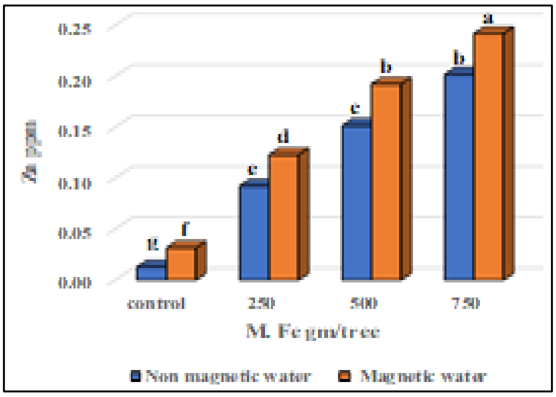

Fig. 9. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on Zn ppm, values followed by different letters are significantly at p < 0.05.

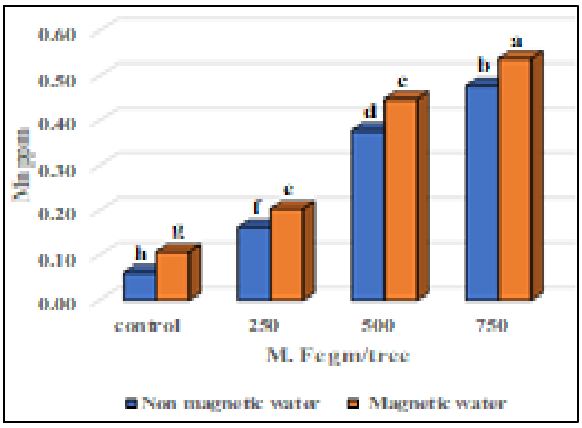

Fig. 10. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on Mn ppm, values followed by different letters are significantly at p < 0.05.

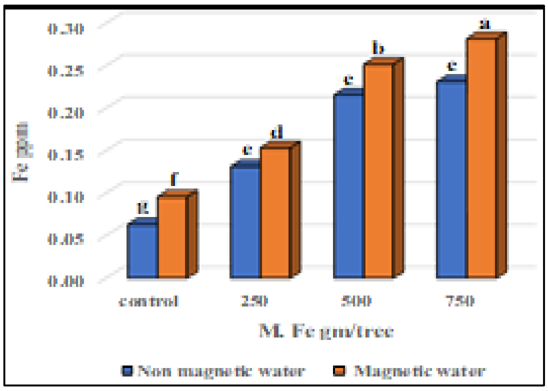

Fig. 11. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on Fe ppm, values followed by different letters are significantly at p < 0.05.

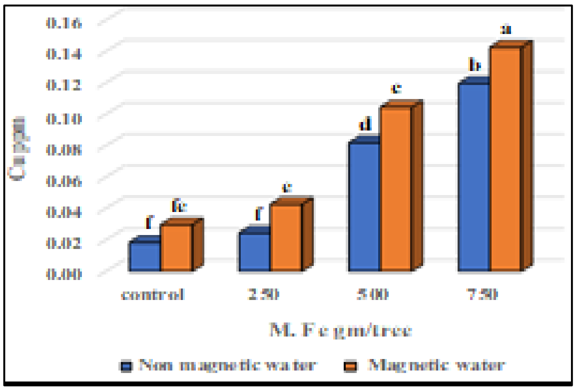

Fig. 12. Effect of magnetite (Mag.) as a soil treatment both with and without watering of magnetic water on Cu ppm, values followed by different letters are significantly at p < 0.05.

These findings demonstrated that using M Fe as soil amendments with MW improved soil function by lowering nutrient loss below the root zone and raising plant nutrient bioavailability while also retaining and mobilizing existing nutrients for uptake.

Soil characteristics and relative yield (RY) of Hayany date palms:

The preceding amendments' improving effects on salt-affected soils can be linked to the materials' improved soil characteristics, which allow plants to be more tolerant of salinity during physiological growth stages. Amer (2016) and Abo-Gabien *et al.* (2020) presented comparable findings. As opposed to that, it can be inferred from the aforementioned that organic matter influences the availability of nutrients and a number of soil activities in a favorable way. According to Wassif (2010), it is the most significant measure of crop productivity. As can be seen in Figure 13, there was a correlation between organic matter, soil salinity, and Hayany Date Palm tree yield or crop production. Relative yield (RY%) and ECe% had a negative association, while RY% and OM% had a significantly significant positive link. In addition, there is indirect positive effect of treatments of magnetic iron and magnetic water on crop production of Hayany date palm tree through its positive effect on soil salinity and organic matter and thus follows positive effect on improving availability of nutrients to plants as shown in Fig. 14. These results agreement with Hamdy *et al* (2015), Fanous *et al* (2017) and Abo-Gabien *et al* (2020).

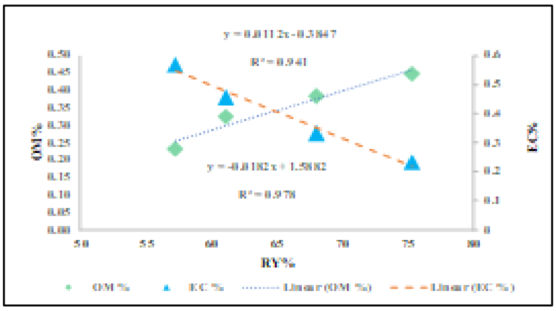

Fig. 13. Relationship between soil organic matter (SOM %), Electric conductivity (EC%) and Relative yield (RY%) calculated based on effect of treatment of magnetite iron (control, 250,500,750 g/tree) with magnetic water.

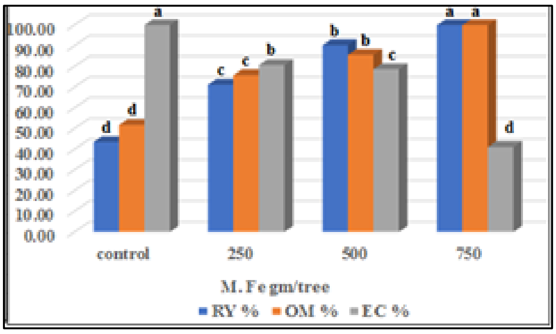

Fig. 14. Effect of OM % and EC% under treated by magnetic water (MW) and Magnetic Fe (M.Fe) (g/tree) - on relative yield (RY%), - values followed by different letters are significantly at $p < 0.05$.

CONCLUSION

From the findings of the current work it is quite obvious that, magnetic iron and magnetized water under drip irrigation has the ability to enhance soil qualities and minimize soil salinity under salt affected soil conditions consequently enhance yield and fruit quality. The greatest values in terms of bettering soil qualities were obtained while treating trees with magnetic iron at a rate of 750 g/tree with magnetic water irrigation. In addition, the same treatment was superior to the control and other treatments for the Hyani date palm cultivar in South Sinai in terms of enhancing punch weight, yield, fruit quality, and improved leaf mineral content. Therefore, given the same soil conditions, this can be suggested dosages.

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تحسين إنتاجية نخيل البلح الحياني المتأثر بالإضافة الأرضية للماجنتيت والماء الممغنط بجنوب سيناء

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الملخص

أجريت هذه الدراسة خلال موسمي ٢٠١٨ و ٢٠١٩. لدراسة تأثير اربعة مستويات من الماجنتيت (٠ ، ٢٥٠ ، ٥٠٠ ، ٧٥٠ جم / شجرة) كإضافة أرضية مع وبدون الري بالمياه الممغنطة على جودة الثمار وثمار صنف نخيل البلح الحياني المزروع تحت ظروف الإجهاد الملحي في محطة التجارب برأس سدر ، محافظة جنوب سيناء ، مصر. أظهرت النتائج أن جميع الصفات المدروسة قد تأثرت معنويا بالري بالماء الممغنط والإضافة الأرضية لخام الماجنتيت في كلا الموسمين. حسن الري بالماء الممغنط جميع خواص النمو المدروسة ومكونات المحصول وصفات الثمار ومحتويات الأوراق من العناصر مقارنة بالري بالماء الغير ممغنط في موسمي هذه الدراسة. أظهرت المعاملة ٧٥٠ جم / شجرة ماحنتيت مع الري بالماء الممغنط أعلى محصول ، ووزن الثمار واللحم ، وطول الثمرة وقطرها ، وإجمالي المواد الصلبة الذائبة ، والسكريات الكلية ، والسكريات المختزلة والسكريات غير المختزلة ومحتويات الأوراق من العناصر (N، P، K، Ca، Mg) مقارنة بالاشجار الغير معاملة والمعاملات الأخرى في الموسمين كما أدت إلي تقليل محتوى البرولين في الأوراق.وبناء على هذه النتائج المتحصل عليها من تلك الدراسة فأنه يمكن التوصية بإضافة ٧٥٠ جم من خام الماجنتيت المغناطيسى مع الرى بالماء الممغنط للتغلب على مشكلة ملوحة مياه الرى وللحصول على محصول مناسب وثمار ذات جودة عالية.