MISR JOURNAL OF AGRICULTURAL ENGINEERING
https://mjae.journals.ekb.eg/

ISSN-Print: 1687-384X
ISSN-Online: 2636-3062

Misr J. Ag. Eng., 40 (4): 331 – 350

DOI: 10.21608/mjae.2023.232247.1115

EFFECT OF MAGNETIZM ON SALINE IRRIGATION WATER PROPERTIES

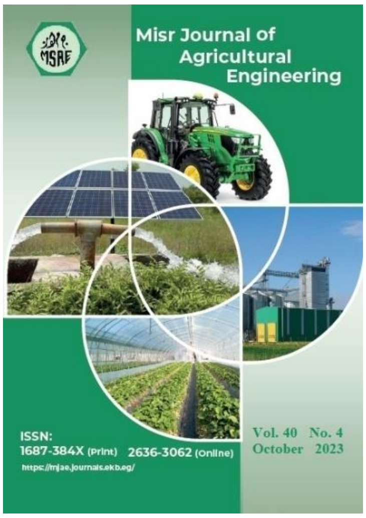
Abdalla M. Zain Eldin [1], Mahmoud E. Attia [2], T.K. Zien El-Abedin [1], A.E. Ahmed[1] and Abdelaziz I. Omara [3&*]

[1] Prof., Dept. of Ag. & Biosystems Eng., Fac. of Ag., Alex. U., Alex., Egypt.

[2] Demon., Dept. of Ag. & Biosystems Eng., Fac. of Ag., Alex. U., Alex., Egypt.

[3] Assoc. Prof., Dept. of Ag. & Biosystems Eng., Fac. of Ag., Alex. U., Alex., Egypt.

* E-mail: abdelaziz.omara@alexu.edu.eg



Keywords:

Magnetic water; Saline irrigation water properties; Seedling; Germination Rate.

ABSTRACT

Egypt government's strategy for horizontal expansion and overcoming difficulties in the agriculture sector, the salinity of irrigation water and soil are the major challenge factors. Moreover, salt concentrations cause the clustering of soil aggregates. As a result, this leads the soil to form a thin, surface layer that prevents the growth of seedlings and affects the soil's hydrological characteristics. However, researchers demonstrated that there is debate about the usage of magnetic water treatment. A magnetic device was used to treat saline water to answer these questions. This consideration was made to study the effect of magnetization on saline water, as well as to study the re-magnetization effect 'bypass' on saline water. Additionally, different levels of re-magnetization were applied up to five times, with saline water and standard water treatments as a reference. It was found that magnetization affects dynamic viscosity, dissolved oxygen and pH. Also found a positive effect of magnetization under transmission electron microscopy, and on the formation of fungi. On the other hand, magnetization does not affect electrical conductivity. Besides that, laboratory experiments on the stability of magnetization show that it lasts for 48 hours. For the germination and growth rates on maize and pumpkin, results were 85% for treated saline water instead of 48.86%, and 57.14% for saline water without treatment, i.e., the magnetization of saline water showed a significant effect. Lastly, there is no significant effect between the levels of re-magnetization of saline water. Therefore, it was recommended using the magnetic treatment once for saline water.

1. INTRODUCTION

The northwest region of Egypt has become a major site for extensive and diverse economic activities. To meet the demands of an increase in the population with limited recourses, land reclamation, and sustainable development have been serious issues in the Egyptian agenda. In addition, reclaimed areas on the northwest coast suffer from limitations in agricultural activities, for example, soil surface crust formation (Ezzeldin et al., 2018).

Corporations of Remote Sensing (RS), Geographic Information Systems (GIS), field survey, and laboratory analysis for soil profiles provided that most of the soils in the study area are saline to strongly saline, texture class sandy loam, and the percentage range of $CaCO_3$ about from 20% to more than 50% (Mohamed, 2002). Significant Na^+, Mg^{+2}, Ca^{+2}, Cl^-, and/or SO_4^{-2} concentrations are frequently found in saline soils. These ions evaporate and leave behind salt efflorescence (Howari et al., 2002).

High salinity in the soil has consequences since irrigation in the area is mostly done with saline water. Soil degradation and desertification control have a great reputation for protecting ecological balance and agricultural development in desert regions (Niu et al., 2017). These lead to form a dense coating that obstructs the development of seeds and plants, especially in the presence of high salt levels (Zein El-Din et al., 2021).

Magnetic field (MF)-treated water, so-called “magnetized water (MW)”, has been a challenging subject over the last several decades in both academia and industry, despite the controversy and the lack of a complete understanding. While many groups have confirmed the effects of MFs on water, some researchers still refute this effect (Algarra et al., 2008). Sophie (1953) reported the first attempt for the magnetic treatment of a liquid. Since then, the water magnetizing technique has developed rapidly in many areas, such as irrigation (Da Silva and Dobranszki, 2014), plant growth (Da Silva and Dobranszki, 2016), plant productivity (Hozayn et al., 2016), wastewater treatment (Zaidi et al., 2014), water purification (Ambashta and Sillanpaa, 2010).

Magnetic water treatment is considered as one of many techniques used worldwide that affects plant growth and development (Abdel Kareem, N. S. 2018). The effects of magnetic field (MF) action on the physical properties of water and aqueous solutions have been the most contentious issue for at least 50 - 60 years. Russian authors published many papers on this subject in the 1960s and 1970s (Chibowski & Szcześ, 2018). The productivity of irrigation water can be increased by magnetic treatment (Maheshwari & Grewal, 2009). Magnetic treatment of saline water is an environmentally friendly technique for water treatment and crop irrigation. The washing of salts from the soil provider caused by the magnetization of water increases the nutrients' readiness by breaking salt crystals, which in turn encourages roots to penetrate the soil and accelerates plant growth (Fayed et al., 2021; Suhail & Mahdi, 2013).

Several studies focus on treating the basic cause of the salinity issue through technologies including water treatment, salt precipitation, magnetic irrigation water treatment, and other methods. Due to the high expenses associated with alternative water treatment methods, it has concentrated on magnetic water treatment in this situation. In this regard, most of the studies across several disciplines supported the presence of a water magnetization effect (Pang, 2014; Abdel Kareem N. S, 2018; Wang et al., 2018; Said et al., 2022). However, other researchers were not in agreement (Chibowski & Szcześ, 2018).

Mosin and Ignatov (2014) said that in water exposed after magnetic treatment is possible the change of the hydration of ions, salts solubility, pH value, which results in changing the rate of corrosion processes. Thus, magnetic water treatment causes a variety of related physical and chemical effects. Magnetic water treatment method requires no chemical reagents, and is therefore environmentally friendly.

The study aims to reduce hinders the growth of seedlings to maximize land use and productivity in saline and semi-arid lands. Enhance the quality of the agricultural process, by using magnetic water. On the other hand, the specific objective was to assess the effects of magnetization on water parameters and quality, as well as seedling, and plant growth.

2. MATERIALS AND METHODS

1. Magnetic Device Setup

The magnetization device is a water treatment product made by Delta Water Co. with the specifications: water flow rate of up to 25 m^3/h, a magnetic capacity of 14500 Gauss (1.45 Tesla), and the ability to treat saline water up to 8000 ppm. Figure (1) illustrates the magnetic water device and its dimension.

Fig. (1): Magnetic water device (Delta Water Co.)

According to Coey & Cass, (2000), all other connections, piping, fittings, and pump used in the experiments are made of smooth surfaces to avoid an increase in turbidity. The test setup is illustrated in (2), contains a 30-liter glass tank, while a 0.5 hp pump draws water from the tank via a PVC pipeline and discharges through a plastic hose followed by a magnetic device, after that the pipe is fitted with gate valve, the discharged water is collected into another tank for further measurements. The test setup performs an open loop of circulation, while the magnetic water device is placed before the valve and over the PVC pipe.

Fig. (2): Experiment setup in the laboratory for pre-studies

Samples were collected from Bahig Drain at “EL-Hammam Agricultural Experiment Station” El Hamam, Matrouh Governorate (30.8421° N, 29.3941° E °), Egypt. After treatments, physical, and biological analyses took place.

2. Magnetic Water Quality Parameters

Magnetic effect on water parameters and quality, by repeating the process (bypass) was assessed. In simple terms, saline water passing through a magnetic device is referred to as a single loop "one-time treatment" (M1) and it repeats five times (M5) to determine the bypass effect on treated water parameters. Parameters that are frequently sampled or monitored for water quality include electrical conductivity (EC), dynamic viscosity, dissolved oxygen (DO), pH, and transmission electron microscope (TEM) as well as microbiological analysis, such as total bacterial count, fungi count, and E. coli bacteria.

2.1. Physical and Chemical Analysis

2.2.1. Electrical Conductivity (EC)

The electrical conductivity (EC) measurements were performed with (InoLab cond 720, WTW GmbH, Weilheim, Germany), using the (Rhoades & Van Schilfgaarde, 1976) method. Water was treated with different levels of magnetic treatments device (M1, M2, M3, M4, M5), saline water (S), and control water ‘tap water’ (T) on electrical conductivity (EC) in (dS/m), considering temperatures (^{o}C) values in the reading time.

2.2.2. Dynamic Viscosity

Harrison & Barlow, (1981) method was used to measure the dynamic viscosity. The measurements were performed using a Brookfield DV-II Pro Viscometer with a spindle (RV2). During the measurements, the temperature was measured and maintained at room temperature with an accuracy of 0.1 ^{o}C, as shown in the following Figure (3). Dynamic viscosity of saline water treated with different levels of magnetic treatments (M1, M3, M5), saline water untreated (S), and tab water (T) were measured with a unit of (cP), considering fixed values of speed, torque percentage, temperature, and spindle.

Fig. (3). Brookfield DV-II Pro Viscometer with a spindle (RV2)

2.2.3. Dissolved Oxygen (DO)

Dissolved O_2 was monitored during the study period at the lab using a dissolved O_2 portable meter (98719PT, Aqua Water Quality, Meter Industrial Company (MIC), Taiwan). The probe was calibrated according to the manufacturers’ instructions before deployment (Marsh, 1951). To account for variation between instruments and possible instrument drift, all probes were checked routinely against Winkler titrations (King, 2011). Regardless of the instrument, saline water treated with different levels of magnetic treatments (M1, M3, M5), saline water (S), and control water ‘tap water’ (T) were measured in regard to dissolved oxygen (DO) in a unit of (mg/l) and (%), considering temperatures (^{o}C), as shown in the following Figure (4).

2.2.4. The Potential of Hydrogen (pH)

Saline water treated with different levels of magnetic treatments (M1, M3, M5), saline water (S), and control water ‘tap water’ (T) were collected to measure the pH using the (Schofield & Taylor, 1955) method, using a pH meter (INOLAB pH 720; WTW, Weilheim, Germany).

Fig. (4): Dissolved O2 portable meter (98719PT)

2.2.5. Transmission Electron Microscope (TEM)

Saline water treated with the magnetic field (M), and saline water without treatment (S), samples were transferred immediately after treatment to Central Lab, Faculty of Agriculture, Alexandria University, Alexandria, Egypt. The sample's concentrated extract was lyophilized using a freeze-dried (VirTis AdVantage Plus EL-85 benchtop freeze dryer, SP Scientific Inc., Gardiner, NY, USA), for 48 hours until became powder. The final weight of the sample was measured and stored.

Secondly, powders were brought to the Electronic Microscopy Unit, Faculty of Science, Alexandria University. The powder was suspended in ethanol and dried over the TEM grids. The sample was examined by transmission electron microscopy (TEM) using a JEOL JEM-1400 PLUS microscope at 100 kV (JEOL Ltd., Japan). Operated at 120 kV acceleration voltage. The TEM images were located for confocal imaging using marked TEM grids (Prabhakar et al., 2018). Micrographs were recorded with a JEOL Matataki CMOS camera using TEM Centre for JEM1400 Plus software. The particle size distribution was later analyzed from the images using ImageJ image processing and analysis software.

2.3. Microbiological Analysis

The total viable bacterial count was enumerated on plate ager medium at 32 ^{o}C for 48 hours (Palmas et al., 1999). Coliform bacteria were enumerated on Mackonkey ager medium for enumerated of coliform at 37 ^{o}C for 24 hours according to (Palmas et al., 1999). Molds and yeasts count were enumerated of sabourat medium and plates were incubated 25 ± 2 ^{o}C for 5 days according to (Apha, 1985). In saline water treated with the magnetic device (M1), saline water (S), and control water 'tap water' (T), the total bacterial, fungi, and E. coli Bacteria were counted.

3. Preliminary Experiments

Magnetized water validation applications were occurred in the Soil Mechanics Laboratory, Department of Agricultural and Biosystems Engineering, Faculty of Agriculture, Alexandria University. This step aims to determine the optimal magnetization treatments of seedling and vegetative parameters, where several numbers of treatment times (bypass).

3.1. Magnetic Water Stability Test

Stability is proposed as 'magnetic memory of water', the long-term effects of which persist for hours or days after water treatment with the magnetic fields. Dynamic viscosity was measured before the circulation (bypass) of water from a single loop to five loops, saline water treated with the magnetic field (M), untreated saline water (S), and tab water as control (T). Samples were collected to measure the dynamic viscosity using the (Harrison & Barlow, 1981) method. The measurements were performed using a Brookfield DV-II Pro Viscometer with a spindle (RV2). During the measurements, the temperature was measured and maintained at room temperature with an accuracy of 0.1 ^{o}C. The measurement was made with variable periods to follow the magnetization behavior of the water and to know when the return to normal occurs again.

3.2. Seedling Experiment (Seed Germination Test)

Germination tests took place on rooftops of the Department of Agricultural and Biosystems Engineering, Faculty of Agriculture, Alexandria University. On the other hand, the soil was brought from the experimental site, and placed in plant black plastic pots with 25 cm diameter for the experiment. Moreover, all pots were under natural conditions of light and temperature. The effect of magnetized water on germination and emergence of Maize (*Zea mays L.*) and Pumpkin (*Cucurbita pepo*) seeds were investigated according to (Mahmood & Usman, 2014).

In the current investigation, three types of irrigation water were used: tap water (T), saline water (S), and treated saline water (M). Saline water of 4.71 dS/m was brought from the "EL-Hammam Agricultural Experiment Station". Water was treated with a magnetic device setup before applying it to the seeds.

The experiments for each seed type were as follows: 147 seeds were used experimentally, 21 seeds per treatment. All seeds were soaked in their correlating water for 1 hour before planting. The seeds were planted in seedling containers (plant pots) with 7 seeds each. There was 3 seedling container per water sample. Before sowing, all containers were soaked in their correlating water to saturation point. All seeds were planted at a 2 cm depth from the soil surface.

3.3. Plant Growth Test

For growth testing, all pots were placed under natural light and temperature conditions. The effect of magnetized water on plant growth of Maize (*Zea mays L.*) and Pumpkin (Cucurbita pepo) were studied as stated by (Mahmood & Usman, 2014).

In experiments, each pot contained a mix of the amount of fertilizer NPK. There was a total of 7 pots, each pot containing 3 plants. Each pot was irrigated once every 2-3 days for irrigation calculations. Plants were covered with plastic shade during rain. The plants were grown for 35 days, each being irrigated 10 times.

4. Statistical Analysis

Results of this study were subjected to a one-way ANOVA analysis of variance by IBM SPSS statistics version 25 computer program according to (Gomez & Gomez, 1984) and the means were compared by Duncan's Multiple Range Test (Duncan, 1965).

Statistical analysis was carried out with the SPSS software. The significant differences between the control (T), saline (S), and the five treatments (M1, M2, M3, M4, M5) were determined. The variances of the difference between the measurements (M's, T, S) were calculated using Duncan at a 0.05 significant level. The comparison that did not show significantly different at $P \leq 0.05$ is indicated by the same letter.

3. RESULTS AND DISCUSSION

1. Magnetic Water Quality Parameters

The magnetic influence on water parameters and quality was evaluated using variable treatments such as process repetition (bypass). Magnetic treatments presented as the following: M1= one-time pass-through Delta Water device, M2= two times pass through Delta Water device, M3= three times pass through Delta Water device, M4= four times pass through Delta Water device, and M5= five times pass through Delta Water device. Depending on the intended water parameters of concern, tests or monitoring were done for the physical, and biological characteristics that form water quality parameters.

1.1. Physical and Chemical Analysis

1.1.1. Electrical Conductivity

The effect of different levels of magnetic treatments (M1, M2, M3, M4, M5), saline water (S), and control water 'tap water' (T) on electrical conductivity (EC) in dS/m, considering temperatures (^{o}C) values in the reading time, are presented as mean values ± SD in Table (1). The data showed that the effect of magnetic treatment slightly increased the EC values (4.78^c ± 0.06, 4.77^c ± 0.06, 4.77^c ± 0.06, 4.78^c ± 0.09, 4.79^c ± 0.08) in comparison to the saline water 'without treatment' (4.72^b ± 0.06). This result agreed with that obtained by (Lee et al., 2013) who explained that the electrical conductivity increased due to the water structure being changed by the magnetic treatment and its temporary change as will be discussed later on.

Table (1): Electrical conductivity EC (dS/m) as affected by magnetic treatment

Treatment	EC (dS/m)	T (°C)
T	0.46^a ± 0.05	30.0
S	4.72^b ± 0.06	30.4
M1	4.78^c ± 0.06	30.4
M2	4.77^c ± 0.06	30.5
M3	4.77^c ± 0.07	30.3
M4	4.78^c ± 0.09	30.4
M5	4.79^c ± 0.08	30.4

Values are presented as means ± SD
Means per factor followed by the same letter are not significantly different at $P \leq 0.05$

1.1.2. Dynamic Viscosity

The effect of different levels of magnetic treatments (M1, M3, M5), saline water (S), and control water 'tap water' (T) on dynamic viscosity with a unit of (cP), considering fixed values of speed, torque percentage, temperature, spindle, and spindle model, are presented as mean values ± SD in Table (2). The data presented that the effect of magnetic treatment increased the dynamic viscosity as the following values (9.33^{bc} ± 0.18, 9.43^{bc} ± 0.42, 9.48^c ± 0.48) in comparison to the saline water 'without treatment' (8.79^{ab} ± 0.36), and the control sample 'tap water' (8.33^a ± 0.20).

This result is appropriate with that obtained by (Toledo et al., 2008) who explained that the dynamic viscosity increased due to the molecular interactions by the magnetic treatment.

Additionally, the interactions between clusters are more significant than those inside. Increased interactions between clusters may be connected to the rise in those characteristics. Considering this, it was proposed that the magnetic field weakens the intra-cluster hydrogen bonds, causing the larger clusters to break up and the formation of smaller groups with stronger inter-cluster hydrogen bonds.

Table (2): Dynamic Viscosity (cP) as affected by magnetic treatment

Treatment	Dynamic Viscosity (cP)	Speed (RPM)	Temperature (^oC)
T	$8.33^{a} \pm 0.20$	60.00	20.03
S	$8.79^{ab} \pm 0.36$	60.00	19.99
M1	$9.33^{bc} \pm 0.18$	60.00	19.98
M3	$9.43^{bc} \pm 0.42$	60.00	19.98
M5	$9.48^{c} \pm 0.48$	60.00	19.98

Values are presented as means ± SD
Means per factor followed by the same letter/s are not significantly different at $P \leq 0.05$

1.1.3. Dissolved Oxygen

The effect of different levels of magnetic (M1, M3, M5), saline water (S), and control water ‘tap water’ (T) on dissolved oxygen (DO) with a unit of (mg/litter), considering temperatures (^oC), are presented as mean values ± SD in Table (3). The data presented that the effect magnetic treatment increased the (DO), as the following values ($4.93^b \pm 0.15$, $5.07^b \pm 0.15$, $5.33^c \pm 0.06$) in comparison to the saline water ‘without treatment’ ($4.70^a \pm 0.10$). This result agreed with that obtained by (Hassan et al., 2018; and Ueno et al., 1995) who explained that the DO increased due to the angle between the two hydrogen and oxygen atoms within the water molecule being lowered from 104° to 103° by the influence of the external magnetic field.

Table (3): Dissolved Oxygen (mg/l) as affected by magnetic treatment

Treatments	DO (mg/l)	DO (%)	Temperature (^oC)
T	$5.13^{bc} \pm 0.06$	63.37	20.2 °C
S	$4.70^{a} \pm 0.10$	58.02	20.4 °C
M1	$4.93^{b} \pm 0.15$	60.91	20.4 °C
M3	$5.07^{b} \pm 0.15$	62.55	20.0 °C
M5	$5.33^{c} \pm 0.06$	65.84	19.7 °C

Values are presented as means ± SD
Means per factor followed by the same letter/s are not significantly different at $P \leq 0.05$

1.1.4. The Potential of Hydrogen (pH)

The effect of different levels of magnetic treatments (M1, M3, M5), saline water (S), and control water ‘tap water’ (T) on pH, considering temperatures (^oC), are presented as mean values ± SD” in Table (4). The data showed that the effect of magnetic treatment decreased the pH, as the following values ($7.85^d \pm 0.01$, $7.75^c \pm 0.03$, $7.61^b \pm 0.04$) in comparison to the saline water ‘without treatment’ ($8.18^e \pm 0.02$). This result agreed with that obtained by (Kotb, 2013; and Maheshwari & Grewal, 2009) who explained that the pH decreased due to polarization and an even distribution of atoms brought on by the development of poles. These findings support the claim made by (Wang et al., 2007) that the opposite occurs with low-salinity water, where pH values increase, due to the absence of salts.

Table (4): pH as affected by magnetic treatment

Treatments	pH	Temperature (^oC)
T	$7.32^a \pm 0.02$	31.2
S	$8.18^e \pm 0.02$	31.3
M1	$7.85^d \pm 0.01$	31.2
M3	$7.75^c \pm 0.03$	31.4
M5	$7.61^b \pm 0.04$	31.2

Values are presented as means ± SD
Means per factor followed by the same letter/s are not significantly different at $P \leq 0.05$

1.1.5. Transmission Electron Microscope (TEM)

Effects of water magnetization on saline water (S) samples and magnetic treatment for saline water (M) with Delta Water device. The distribution of salt crystals (salt particles) was seen using a Transmission Electron Microscope (TEM). Several images from both before and after the treatment process are shown in the Figure (5). In general, it became visible that microstructure changes due to the dispersion of the collected salt particles, and their cracking occurred more clearly under the influence of magnetic treatments based on the study samples that similar to the data obtained by (Cefalas et al., 2010).

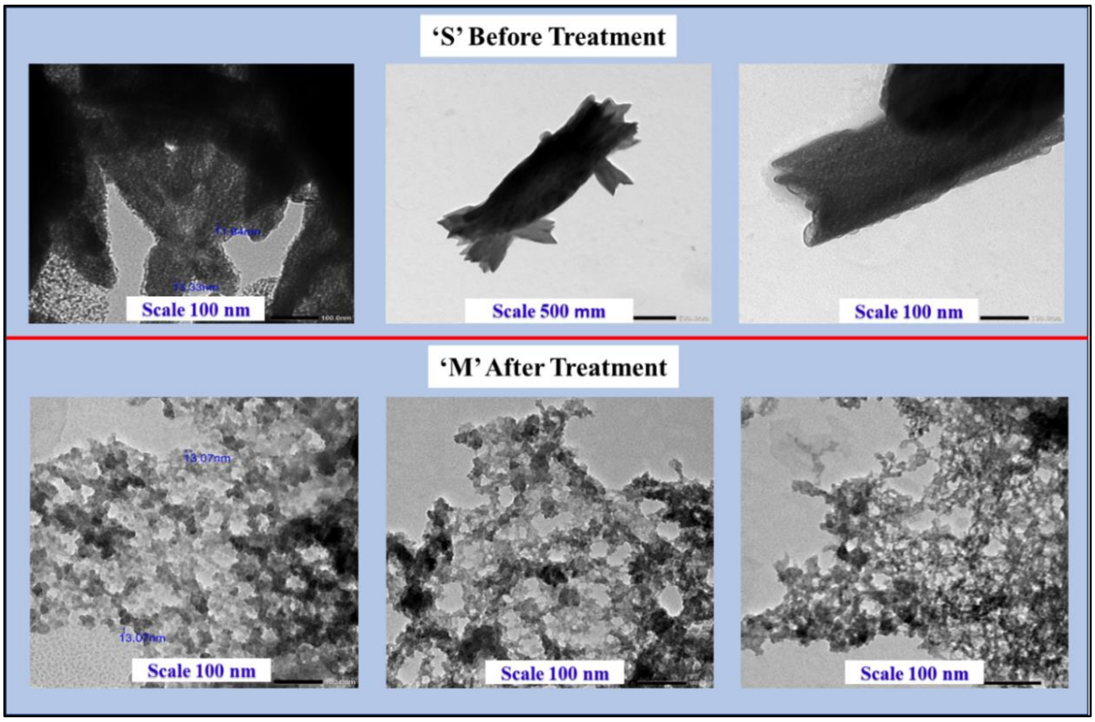


Fig. (5): Saline water before and after treatment using Transmission Electron Microscope (TEM) images after processing using ImageJ software

1.2. Microbiological Analysis

The effect of saline water treated with a magnetic device (M1), saline water (S), and control water 'tap water' (T) on the total bacterial count, fungi count, and E. coli Bacteria count are presented in Table (5) and Figure (6).

The data presented that the effect of magnetic treatment decreased the fungi count as in the sabourat medium one fungus was found, comparing with both saline water (S) and control water 'tap water' (T) found 3 fungi in the sabourat medium for each. Moreover, the fungi hypha growing in before treatments were clear under the microscope as illustrated in Figures (6). Conversely, for total bacterial count, E. coli bacteria did not detect any count in all treatments and it's reasonable due to treatment for the tap water in water plant and high saline water in the farm as shown in Table (5).

These findings support the claim made by (Tiamooz et al., 2020) when using magnetic water or using the direct magnetic field to which the fungi colonies were exposed, the usage of magnetic technology demonstrated positive results in discontinuing the fungal growth of the chosen fungi in the experiment.

Table (5): Effect of magnetic treatment on the total bacterial count, fungi count, and E. coli bacteria

Treatment	Total Bacterial Count	Fungi Count	E.coli Bacteria
T (Control)	ND	3	ND
S (Without Treatment)	ND	3	ND
M1 (With Treatment)	ND	1	ND

ND means not detected

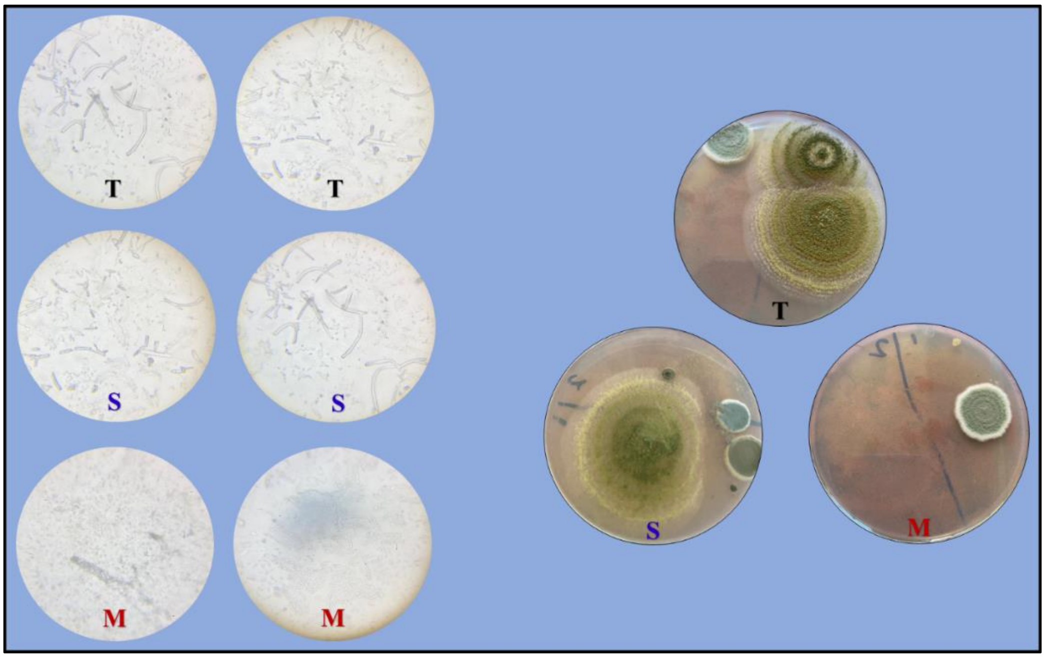


Fig. (6): [left]: Fungi hypha under a microscope, [Right]: Fung count in sabourat medium for saline water treated with a magnetic device (M), saline water (S), and tap water (T)

2. Preliminary Experiments

This section investigates the optimal approach in terms of the number of treatment times (bypass). Additionally, the magnetic water stability, seedling experiment (seed germination), and plant growth were evaluated.

2.1. Magnetic Water Stability Test

The effect of different levels of magnetic treatments (M1, M5), saline water (S), and control water 'tap water' (T) on magnetic water stability using dynamic viscosity during 0~ 48h, considering temperatures (^oC) values in the reading time, are presented as mean values ± SD in Table (6). The data showed that the effect of magnetic treatment of M1 and M2 increased the dynamic viscosity, as the following values, at zero time ($9.84^c \pm 0.19$, $9.78^c \pm 0.11$), at 24 hours ($8.93^c \pm 0.09$, $9.07^d \pm 0.05$), and at 48 hours ($8.47^b \pm 0.05$, $8.51^b \pm 0.12$). While, the dynamic viscosity of the saline water 'without treatment' was ($8.42^b \pm 0.09$), and for control 'tap water' was ($8.08^a \pm 0.08$).

Contrarily, comparing these values to those obtained at other periods will clearly show that they are declining until they approach the precise value for saline water without treatment, which was attained after 48 hours. This result agreed with that obtained by (Silva et al., 2015) who explained that the memory effect after approximately two days, starts to diminish.

Other researchers found in multiple studies on the impact of magnetization of water that the effect of magnetic treatment is not stable, as it is plain and visible from the prior data that the effect fades after around two days. Additionally, the statistical study found no significant differences between the various levels of magnetic treatment (M1 and M5), which is consistent with the findings of (Silva et al., 2015) and Szcześ et al., 2011).

Table (6): Magnetic water stability using Dynamic Viscosity test (cP)

Dynamic Viscosity (cP)	0 hr	6 hr	24 hr	48 hr
T	$8.08^a \pm 0.08$	$8.08^a \pm 0.07$	$8.08^a \pm 0.08$	$8.08^a \pm 0.06$
S	$8.42^b \pm 0.09$	$8.42^a \pm 0.08$	$8.42^b \pm 0.07$	$8.42^b \pm 0.09$
M1	$9.84^c \pm 0.09$	$9.39^b \pm 0.06$	$8.93^c \pm 0.09$	$8.47^b \pm 0.05$
M5	$9.88^c \pm 0.11$	$9.46^b \pm 0.05$	$9.07^d \pm 0.05$	$8.51^b \pm 0.10$
Temperature (^oC)	20.7	20.1	20.3	20.5

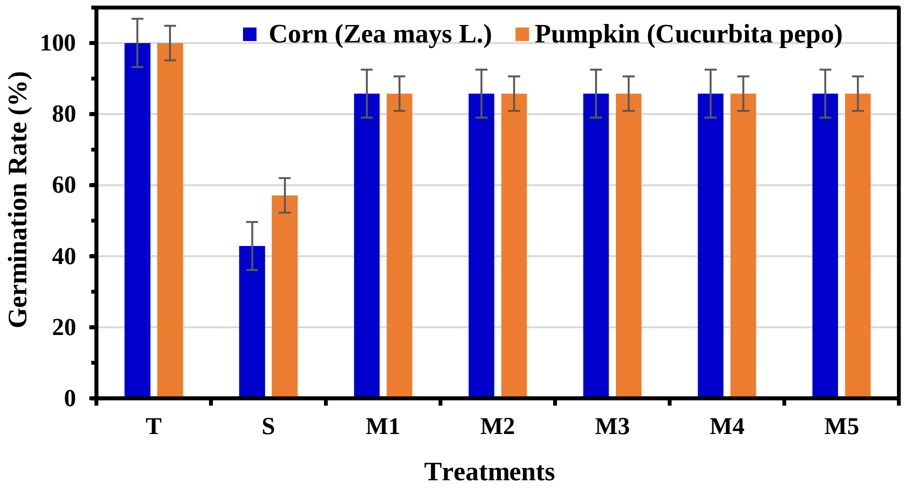
Values are presented as means ± SD
Means per factor followed by the same letter/s are not significantly different at $P \leq 0.05$

2.2. Seedling Experiment (Seed Germination)

The effect of various levels of magnetic treatments (M1, M2, M3, M4, M5), saline water (S), and control water 'tap water' (T) on seedling (seed germination) for Maize (*Zea mays L.*), and Pumpkin (*Cucurbita pepo*) were illustrated in Figures (12) and (13).

The results indicated that both crops require approximately four days after the seedlings begin to emerge. Furthermore, for Maize (*Zea mays L.*) germination was calculated for each treatment and found that for control (tap water) 'T', it reaches 100%, and for saline water 'S' without treatment, it equals 42.86%. However, for saline water after magnetic treatments, germination values were 85.71% as shown in Figure (7).

Similarly, for Pumpkin (*Cucurbita pepo*) germination was calculated for each treatment and found that for control (tap water) 'T', it reaches 100%, and for saline water 'S' without treatment it equals 57.14%. Nevertheless, for saline water after magnetic treatments, germination values were 85.71% as shown in Figure (7). These results completely agreed with the result obtained by (Ercan et al., 2022) which showed that magnetic treatment improves germination.



Values are presented as means ± SD

Fig. (7): Seeds germination rate for Maize and Pumpkin

2.3. Plant Growth Test

The effect of various levels of magnetic treatments (M1, M2, M3, M4, M5), saline water (S), and control water 'tap water' (T) on growth parameters for Maize (*Zea mays L.*) and Pumpkin (*Cucurbita pepo*) after 20 days, were illustrated in Tables (7) and 8) and Figures (8, 9 and 10).

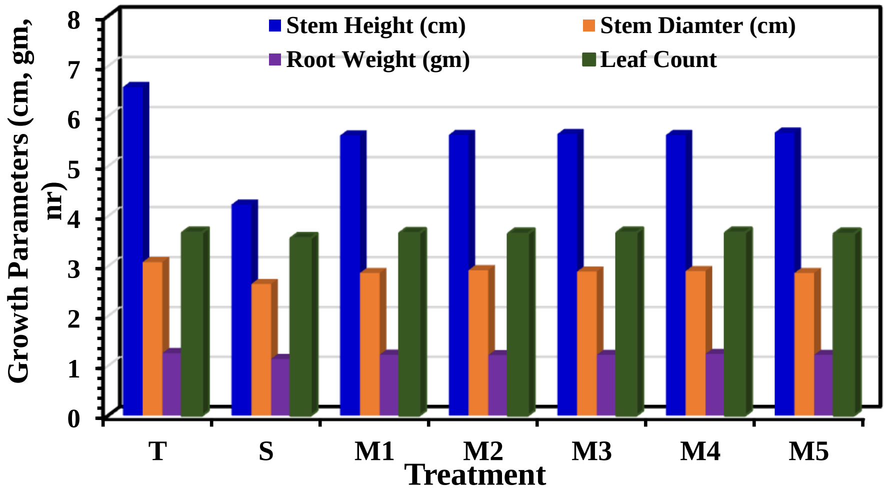
The results indicated the following growth parameters for Maize (*Zea mays L.*); stem height (cm), stem diameter (cm), root spread area (cm^2), root fresh weight (g), and leaf count (range). Firstly, for stem height, the highest value was ($6.58^{a} \pm 0.62$) cm for control water 'T', and the lowest value was ($4.23^{c} \pm 0.56$) cm for saline water 'S'. Secondly, for stem diameter, the highest value was ($3.08^{a} \pm 0.25$) cm for control water 'T', and the lowest value was ($2.64^{a} \pm 0.24$) for saline water 'S'. Thirdly, for the roots spread area, the highest value was ($58.39^{c} \pm 4.94$) cm^2 for four times magnetic treated 'M4', and the lowest value was ($54.56^{a} \pm 5.10$) cm^2 for tap water 'T'. Fourthly, for the root fresh weight, the highest values were ($1.25^{a} \pm 0.08$, $1.25^{a} \pm 0.09$) g for four times magnetic treated 'M3' and tap water 'T' respectively, and the lowest value was ($1.14^{a} \pm 0.10$) g for saline water 'S'. Lastly, for the leaf count was values presented as a range, for tap water 'T' values were (3 – 5), magnetic treated saline water 'M1, M2, M3, M4, M5' (3 - 4), and for saline water 'S' (2 – 4), as shown in Table (7), Figure (8), and Figure (9).

Table (7): Growth parameters for Maize (Zea mays L.)

Treatment	Stem Height (cm)	Stem Diameter (cm)	Root Spread Area (cm^2)	Root Weight (g)	Leaf Count (Range)
T	$6.58^{a} \pm 0.62$	$3.08^{a} \pm 0.25$	$54.56^{a} \pm 5.10$	$1.25^{a} \pm 0.09$	$(3 – 5)^{a} \pm 0.14$
S	$4.23^{c} \pm 0.35$	$2.64^{a} \pm 0.24$	$56.11^{b} \pm 3.20$	$1.14^{a} \pm 0.10$	$(2 – 4)^{a} \pm 0.15$
M1	$5.61^{b} \pm 0.42$	$2.86^{a} \pm 0.18$	$58.29^{c} \pm 4.90$	$1.22^{a} \pm 0.09$	$(3 – 4)^{a} \pm 0.19$
M2	$5.62^{b} \pm 0.49$	$2.92^{a} \pm 0.21$	$58.07^{c} \pm 5.42$	$1.21^{a} \pm 0.05$	$(3 – 4)^{a} \pm 0.12$
M3	$5.64^{b} \pm 0.51$	$2.89^{a} \pm 0.25$	$58.39^{c} \pm 4.94$	$1.22^{a} \pm 0.06$	$(3 – 4)^{a} \pm 0.11$
M4	$5.62^{b} \pm 0.48$	$2.90^{a} \pm 0.23$	$58.34^{c} \pm 5.81$	$1.25^{a} \pm 0.08$	$(3 – 4)^{a} \pm 0.18$
M5	$5.67^{b} \pm 0.52$	$2.86^{a} \pm 0.18$	$58.23^{c} \pm 5.62$	$1.22^{a} \pm 0.04$	$(3 – 4)^{a} \pm 0.19$

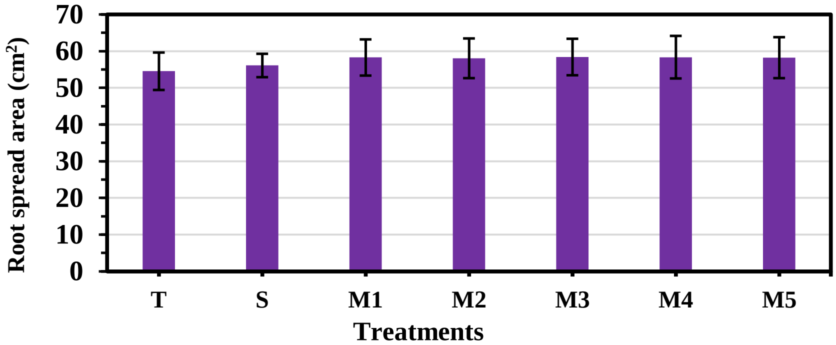
Values are presented as means ± SD, except count values presented as (min-max) ± SD
Means per factor followed by the same letter/s are not significantly different at $P \leq 0.05$

On the other hand, for Pumpkin (Cucurbita pepo) plant height (cm), data showed that the effect of magnetic treatment increased the plant height, as the following values which measured immediately at 7 days ($2.15^{a} \pm 0.34$, $2.45^{a} \pm 0.25$, $2.04^{a} \pm 0.16$, $1.95^{a} \pm 0.18$, $2.14^{a} \pm 0.11$) cm in general related to the saline water 'without treatment' ($0.51^{b} \pm 0.08$) cm. Also, magnetic treatment values after 35 days ($16.82^{ab} \pm 0.34$, $17.25^{ab} \pm 2.42$, $16.45^{b} \pm 1.32$, $16.12^{b} \pm 0.97$, $17.52^{ab} \pm 1.58$) cm while to the saline water 'without treatment' it was ($12.56^{c} \pm 1.88$) cm, as shown in Table (8) and Figure (10). These results completely agreed with the result obtained by (Surendran et al., (2016), which demonstrated that irrigation water types treated with magnets resulted in an improvement in crop growth.



Values are presented as means ± SD

Fig. (8): Growth parameters for Maize (Zea mays L.)



Values are presented as means ± SD

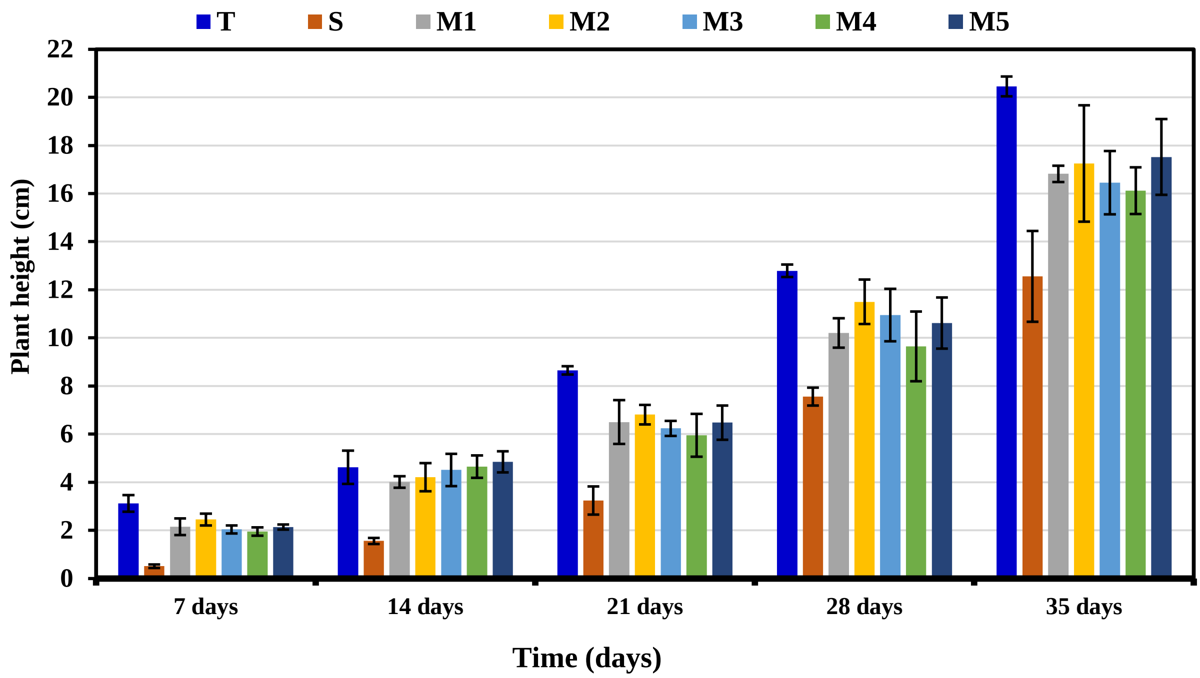
Fig. (9): Root spread area (cm2) for Maize (Zea mays L.)

Table (8): Plant height for Pumpkin (Cucurbita pepo)

Treatment	7 days	14 days	21 days	28 days	35 days
T	$3.12^{a} \pm 0.34$	$4.62^{a} \pm 0.69$	$8.65^{a} \pm 0.17$	$12.79^{a} \pm 0.26$	$20.45^{a} \pm 0.41$
S	$0.51^{b} \pm 0.08$	$1.56^{a} \pm 0.12$	$3.24^{c} \pm 0.58$	$7.56^{f} \pm 0.38$	$12.56^{c} \pm 1.88$
M1	$2.15^{a} \pm 0.34$	$4.01^{a} \pm 0.24$	$6.50^{ab} \pm 0.91$	$10.21^{de} \pm 0.61$	$16.82^{ab} \pm 0.34$
M2	$2.45^{a} \pm 0.25$	$4.21^{a} \pm 0.59$	$6.81^{ab} \pm 0.41$	$11.50^{b} \pm 0.92$	$17.25^{ab} \pm 2.42$
M3	$2.04^{a} \pm 0.16$	$4.51^{a} \pm 0.68$	$6.24^{b} \pm 0.31$	$10.95^{bc} \pm 1.10$	$16.45^{b} \pm 1.32$
M4	$1.95^{a} \pm 0.18$	$4.65^{a} \pm 0.47$	$5.95^{b} \pm 0.89$	$9.65^{e} \pm 1.45$	$16.12^{b} \pm 0.97$
M5	$2.14^{a} \pm 0.11$	$4.85^{a} \pm 0.44$	$6.48^{ab} \pm 0.71$	$10.62^{cd} \pm 1.06$	$17.52^{ab} \pm 1.58$

Values are presented as means ± SD

Means per factor followed by the same letter/s are not significantly different at $P \leq 0.05$



Values are presented as means ± SD

Fig. (10): Plant height for Pumpkin (Cucurbita pepo)

4. SUMMARY AND CONCLUSION

The treatments used in the study are summarized as follows: a treatment used in all measurements as a reference level tap water 'T', saline water from the farm 'S', magnetically treated saline water was carried out on five levels, using a device's Delta Water. In addition, the water was re-passed more than once in the magnetizing device, with water that was passed on the device once was labeled 'M1', twice 'M2', and up to five times 'M5', so the magnetic saline water treatments were (M1, M2, M3 M4, M5).

The experiments concerned with studying the effect of magnetization on water properties; the chemical and physical parameters, as well as microbial analysis, for the above-mentioned treatments. Moreover, the benefit of re-magnetization (repeated treatment) on saline water was investigated by analyzing and comparing different measurements statistically.

Moreover, the stability of the magnetic treatment of saline water after treatment was evaluated by the dynamic viscosity (cP). The reason for the previous measurement is to evaluate the time required for pumping water into the irrigation network, as well as the duration of the saline water remaining magnetized and available in the soil for the plant. Measurements proved that "magnetically treated water possesses the effect of magnetic treatment for two days". Through this investigation, it was found that the effect of magnetized saline water (M1, M2, M3, M4, M5) continues for two days (48 hours). By analyzing the results of the effect of treated saline water at different levels (M1, M2, M3, M4, M5), found that the results were very close and without statistically significant differences in most measurements at a significant level of $P \leq 0.05$.

In addition, the germination rates of maize (*Zea mays L.*), and pumpkin (*Cucurbita pepo*) with magnetized were evaluated. The results showed a 48.75% enhancement in germination rates for both crops when utilizing magnetically treated saline water compared to untreated saline water.

Finally, it can be concluded, based on the different measurements and results of water and plant growth, that the difficulties of salinity in the water were successfully solved by using magnetic treatment in the process of treating saline water.

5. REFERENCES

Abdel Kareem, N. S. (2018). Evaluation of Magnetizing Irrigation Water Impacts on the Enhancement of Yield and Water Productivity for Some Crops. *Journal of Agricultural Science and Technology A, 8*(5), 274–286. https://doi.org/10.17265/2161-6256/2018.05.003

Abd-Elrahman, W. (2019). Effect of Repeated Magnetization Process of Water on the Waterand Soil Properties as well as Lettuce Yield. *Annals of Agricultural Science, Moshtohor, 57*(1), 1–10. https://doi.org/10.21608/assjm.2019.41836

Algarra R.V.M., L.L. Zamora, G.M.A. Fos, P.A.A. Lopez (2008): Magnetized water: science or fraud? J. Chem. Educ., 85 , pp. 1416-1418

Ambashta R.D. , M. Sillanpaa (2010). Water purification using magnetic assistance: *a review J. Hazard. Mater,* 180 , pp. 38-49

Apha. (1985). *Standard methods for the examination of water and wastewater*. 16th Edition, American Public Health Association, Washington DC.

Cefalas, A. C., Sarantopoulou, E., Kollia, Z., Riziotis, C., Dražic, G., Kobe, S., Stražišar, J., & Meden, A. (2010). Magnetic field trapping in coherent antisymmetric states of liquid water molecular rotors. *Journal of Computational and Theoretical Nanoscience*, *7*(9), 1800–1805. https://doi.org/10.1166/jctn.2010.1544

Chibowski, E., & Szcześ, A. (2018). Magnetic water treatment–A review of the latest approaches. *Chemosphere, 203*, 54–67. https://doi.org/10.1016/j.chemosphere.2018.03.160

Coey, J. M. D., & Cass, S. (2000). Magnetic water treatment. *Journal of Magnetism and Magnetic Materials*, *209*(1–3), 71–74. https://doi.org/10.1016/S0304-8853(99)00648-4

Da Silva J.A.T. and J. Dobranszki (2016). Magnetic fields: how is plant growth and development impacted? Protoplasma, 253 , pp. 231-248

Duncan, D. B. (1965). A Bayesian Approach to Multiple Comparisons. *Technometrics*, *7*(2), 171–222. https://doi.org/10.1080/00401706.1965.10490249

Ercan, I., Tombuloglu, H., Alqahtani, N., Alotaibi, B., Bamhrez, M., Alshumrani, R., Ozcelik, S., & Kayed, T. S. (2022). Magnetic field effects on the magnetic properties, germination, chlorophyll fluorescence, and nutrient content of barley (Hordeum vulgare

L.). *Plant Physiology and Biochemistry*, *170*(November 2021), 36–48. https://doi.org/10.1016/j.plaphy.2021.11.033

Ezzeldin, H. A., Kamal, A., Reda, A. M., Guindy, K., & El-shamy, I. (2018). Assessment of Factors Affecting the Groundwater Quality in El-Hammam Area , North-West Coast of Egypt. *Middle East Journal of Applied Sciences*, *08*(October), 798–819.

Fayed, M. H., Ghanem, H. G., Sheta, M. H., & Ali, A. A. (2021). Effect of Magnetized Water on Water Use Efficiency of Spinach Under North Sinai Conditions. *Misr Journal of Agricultural Engineering*, *38*(2), 137–154. https://doi.org/10.21608/mjae.2021.66391.1027

Gomez, K. A., & Gomez, A. A. (1984). *Statistical Procedures for Agricultural Research*. John Wiley & Sons, New York. https://books.google.com.eg/books?id=PVN7_XRhpdUC

Harrison, G., & Barlow, A. J. (1981). Dynamic viscosity measurement. In P. D. B. T.-M. in E. P. Edmonds (Ed.), *Methods in Experimental Physics* (Vol. 19, Issue C, pp. 137–178). Academic Press. https://doi.org/10.1016/S0076-695X(08)60334-8

Hassan, S. M., Ridzwan., A. R., Rezuwan, K., & Umoruddin, N. A. (2018). Exposure effect of magnetic field on water properties in recirculation aquaculture systems(RAS). *Iraqi Journal of Agricultural Sciences*, *49*(6), 1015–1031. https://doi.org/10.36103/ijas.v49i6.138

Howari, F. M., Goodell, P. C., & Miyamoto, S. (2002). Spectral Properties of Salt Crusts Formed on Saline Soils. *Journal of Environmental Quality*, *31*(5), 1453–1461. https://doi.org/10.2134/jeq2002.1453

Hozayn M., M. Abdallha, A.E.-M. AA, A. El-Saady, M. Darwish (2016). Applications of magnetic technology in agriculture: a novel tool for improving crop productivity (1): Canola

Afr. J. Agric. Res., 11 , pp. 441-449King, W. (2011). " Winkler Titrations–Measuring Dissolved Oxygen. *Colby at Sea*, *11*.

Kotb, A. (2013). Magnetized Water and Memory Meter. *Energy and Power Engineering*, *05*(06), 422–426. https://doi.org/10.4236/epe.2013.56045

Lee, S. H., Jeon, S. Il, Kim, Y. S., & Lee, S. K. (2013). Changes in the electrical conductivity, infrared absorption, and surface tension of partially-degassed and magnetically-treated water. *Journal of Molecular Liquids*, *187*, 230–237. https://doi.org/10.1016/j.molliq.2013.07.017

Maheshwari, B. L., & Grewal, H. S. (2009). Magnetic treatment of irrigation water: Its effects on vegetable crop yield and water productivity. *Agricultural Water Management*, *96*(8), 1229–1236. https://doi.org/10.1016/j.agwat.2009.03.016

Mahmood, S., & Usman, M. (2014). Consequences of magnetized water application on maize seed emergence in sand culture. *Journal of Agricultural Science and Technology*, *16*(1), 47–55.

Marsh, G. A. (1951). Portable Meter for Determining Dissolved Oxygen. For Use with Oil-Field Brines. *Analytical Chemistry*, *23*(10), 1427–1431. https://doi.org/10.1021/ac60058a019

Mohamed, A.G.M. (2002). Corporation of remote sensing and information systems in water management geographic and land use planning in El-Hammam area, Northern coast of Egypt. *Mediterranean Agronomic Institute of Chania*, *MSc. Thesis* (July).

Morgan, A. M., Royer, T. V., David, M. B., & Gentry, L. E. (2006). Relationships among Nutrients, Chlorophyll- a , and Dissolved Oxygen in Agricultural Streams in Illinois . *Journal of Environmental Quality*, *35*(4), 1110–1117. https://doi.org/10.2134/jeq2005.0433

Mosin, O. and Ignatov, I. (2014). Basic Concepts of Magnetic Water Treatment. *European Journal of Molecular Biotechnology*, 4 (2): 72-85.

Niu, J., Yang, K., Tang, Z., & Wang, Y. (2017). Relationships between soil crust development and soil properties in the desert region of North China. *Sustainability (Switzerland)*, *9*(5). https://doi.org/10.3390/su9050725

Palmas, F., Cosentino, S., Fadda, M. E., Deplano, M., & Mascia, V. (1999). Microbial characteristics of Pecorino processed cheese spreads . *Lait*, *79*(6), 607–613. https://doi.org/10.1051/lait:1999650

Pang, X. F. (2014). The Experimental Evidences of the Magnetism of Water by Magnetic-Field Treatment. *IEEE Transactions on Applied Superconductivity*, *24*(5), 1–6. https://doi.org/10.1109/TASC.2014.2340455

Prabhakar, N., Peurla, M., Koho, S., Deguchi, T., Näreoja, T., Chang, H. C., Rosenholm, J. M., & Hänninen, P. E. (2018). STED-TEM Correlative Microscopy Leveraging Nanodiamonds as Intracellular Dual-Contrast Markers. *Small*, *14*(5), 1701807. https://doi.org/10.1002/smll.201701807

Rhoades, J. D., & Van Schilfgaarde, J. (1976). DIVISION S-2 Soil Chemistry. An electrical conductivity probe for determining soil salinity. *Soil Science Society of America Journal*, *40*, 5.

Said, A., El-Shazly, M., Hassan, A., & Zedan, A. T. (2022). Utilization of Magnetic Water Technology To Improve Water Quality and Growth Performance of Fish. *Misr Journal of Agricultural Engineering*, *0*(0), 0–0. https://doi.org/10.21608/mjae.2022.135864.1072

Schofield, R. K., & Taylor, A. W. (1955). The Measurement of Soil pH. *Soil Science Society of America Journal*, *19*(2), 164–167. https://doi.org/10.2136/sssaj1955.03615995001900020013x

Silva, I. B., Queiroz Neto, J. C., & Petri, D. F. S. (2015). The effect of magnetic field on ion hydration and sulfate scale formation. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, *465*, 175–183. https://doi.org/10.1016/j.colsurfa.2014.10.054

Sophie, V.T.I., (1953). Magnetic treatment device for liquids. U.S. Patent No. 2,652,925

SUHAIL, F. M., & MAHDI, I. A. (2013). Test the efficiency of mycorrhizal fungi (Glomus fasciculatum) and magnetic water to reduce the effect of salinity on plant onion (Allium cepa L.). *Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Agriculture*, *70*(2), 325–333. https://doi.org/10.15835/buasvmcn-agr:9750

Surendran, U., Sandeep, O., & Joseph, E. J. (2016). The impacts of magnetic treatment of irrigation water on plant, water and soil characteristics. *Agricultural Water Management*, *178*, 21–29. https://doi.org/10.1016/j.agwat.2016.08.016

Szcześ, A., Chibowski, E., Hołysz, L., & Rafalski, P. (2011). Effects of static magnetic field on water at kinetic condition. *Chemical Engineering and Processing: Process Intensification*, *50*(1), 124–127. https://doi.org/10.1016/j.cep.2010.12.005

Tiamooz, S. H., Al-Juthery, H. W. A., & Ali, M. A. (2020). The Study Effect of field Magnetic on some of average fungi of the soil. *IOP Conference Series: Earth and Environmental Science*, *553*(1). https://doi.org/10.1088/1755-1315/553/1/012036

Toledo, E. J. L., Ramalho, T. C., & Magriotis, Z. M. (2008). Influence of magnetic field on physical-chemical properties of the liquid water: Insights from experimental and theoretical models. *Journal of Molecular Structure*, *888*(1–3), 409–415. https://doi.org/10.1016/j.molstruc.2008.01.010

Ueno, S., Iwasaka, M., & Furukawa, G. (1995). Dynamic Behavior of Dissolved Oxygen under Magnetic Fields. *IEEE Transactions on Magnetics*, *31*(6), 4259–4261. https://doi.org/10.1109/20.489945

Wang, Q., Li, L., Chen, G., & Yang, Y. (2007). Effects of magnetic field on the sol-gel transition of methylcellulose in water. *Carbohydrate Polymers*, *70*(3), 345–349. https://doi.org/10.1016/j.carbpol.2007.04.006

Wang, Y., Wei, H., & Li, Z. (2018). Effect of magnetic field on the physical properties of water. *Results in Physics*, *8*, 262–267. https://doi.org/10.1016/j.rinp.2017.12.022

Zaidi N.S., J. Sohaili, K. Muda, M. Sillanpää (2014). Magnetic field application and its potential in water and wastewater treatment systems Sep. Purif. Rev., 43 , pp. 206-240

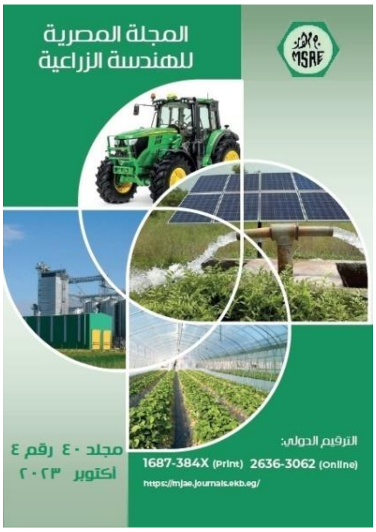
Zein El-Din, A., Youssef Taha, R., & Abdel Hamied, R. (2021). Nanotechnology Sector Applications in Power and Farm Machinery: A Review. *Journal of the Advances in Agricultural Researches*, *26*(2), 38–47. https://doi.org/10.21608/jalexu.2021.170677

Zein Eldin, A. (1999). Finite-Element Model for Predicting Media Filter Performance. *Misr Journal of Agricultural Engineering*, 16(4), 805–828.

تأثير المغنطة علي خصائص مياه الري المالحة

أ.د. عبدالله مسعد زين الدين [١] ، م. محمود عزت عطية [٢] ، أ.د. طارق كمال زين العابدين [١] ، أ.د. أحمد السيد أحمد [١] و د.عبدالعزيز إبراهيم عمارة [٣]

[١] أستاذ - قسم الهندسة الزراعية والنظم الحيوية - كلية الزراعة - جامعة الإسكندرية - مصر.
[٢] معيد - قسم الهندسة الزراعية والنظم الحيوية - كلية الزراعة - جامعة الإسكندرية - مصر.
[٣] أستاذ مساعد - قسم الهندسة الزراعية والنظم الحيوية - كلية الزراعة - جامعة الإسكندرية - مصر.



الكلمات المفتاحية:
الماء المغناطيسي؛ خواص مياه الري المالحة؛ الانبات؛ النمو.

الملخص العربي

في إطار توجه الدولة المصرية للتوسع الأفقي والتغلب على المشاكل والتحديات في المجال الزراعي لذلك يهدف هذا البحث الي دراسة سبل التغلب على هذه الصعوبات وتحقيق التنمية المستدامة للأراضي الصحراوية والشبه صحراوية. من ضمن هذه التحديات ملوحة ماء الري وكذلك ملوحة التربة، وبفعل هذه التركيزات من الأملاح ينتج تجمع لحبيبات التربة. وينتج عنه طبقة صماء سطحية للتربة تمنع نمو البادرات، وتعمل على تغير الخصائص الهيدرولوجية للتربة. وحيث أنه بالبحث وجد أن هناك تضارب في الأراء لاستخدام معالجة المياه مغناطيسياً. لذلك تم استخدام جهاز المغنطة لمعالجة ماء الري المالح للإجابة عن هذه التساؤلات. لذا تم وضع ذلك الاعتبار لدراسة تأثير المغنطة على المياه المالحة، وكذلك دراسة إعادة مغنطة المياه المالحة (Bypass Effect). حيث تم دراسة تأثير معاملات إعادة مغنطة حتى خمس مرات، بالإضافة الى الماء المالح وماء قياسي كمرجع. وتم التوصل الى أن المغنطة توثر على اللزوجة الكينماتيكية، ونسبة الأكسجين المذاب (DO)، وpH، وشوهد تأثير إيجابي للمغنطة تحت الميكروسكوب الالكتروني النافذ (TEM)، وعلى تكون الفطريات، ولكن لا تؤثر بصورة واضحة على الموصلية الكهربائية (EC). ومن التجارب المعملية على مدة بقاء المغنطة وجد أنها تصل الى ٤٨ ساعة. وعلى معدل الإنبات على كل من نبات الذرة (*Zea mays L.*) واليقطين (*Cucurbita pepo*) كانت النتائج للماء المالح المعالج ٨٥%، أما للماء المالح بدون معالجة ٤٢,٨٦% و ٥٧,١٤%، للمحصولين على التوالي، وبالمثل لنتائج معدل النمو، أي أن المغنطة للماء المالح لها تأثير معنوي. وعلى الجانب الأخر ليس هناك تأثير معنوي لمستويات معالجة الماء المالح الممغنط (Bypass). لذلك نوصي باستخدام تقنية معالجة الماء المالح مغناطيسياً مرة واحدة دون تكرار.