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Effect of Magnetic Irrigation Saline Water and Pre-Sowing of Grains Treated with Magnetic Field on Saline Soil Fertility and Wheat Productivity and Quality

Khaled A. H. Shaban [a], Marwa A. Ahmed [a*] and Hala A. M. El-Sayed [b]

[a] Soils, Water and Environment Research Institute, Agricultural Research Centre, Giza, Egypt.
[b] Department of Agricultural Science, Higher Institute for Agricultural Co-Operation, Shobra El-Khima, Egypt.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was carried out in a privet farm in Romana village, North Sinia, governorate, Egypt, during winter of two successive years 2020/2021 and 2021/2022 to study the effect of magnetic irrigation water with different salinity levels (1000, 2000, 4000 and 6000 ppm) from four wells and pre-sowing of seeds wheat seeds at (0, 1/4, 1/2 and 3/4 hr) treated with magnetic field on soil fertility and wheat productivity in newly reclaimed soil. In both seasons each experiment was carried out in a split plot design with three replicates. The results suggested that magnetized irrigation saline water and the magnetic pre-sowing grains treatment led to reduce of EC and soil pH and the increasing of availability macro-micronutrients contents in the soil Magnetic treated of

**Corresponding author: Email: marwaahmed901@yahoo.com;*

both seeds and irrigation water salinity led to an increase of yield components and quality for wheat plant as well as the increase of macro-micronutrients concentrations in straw and wheat grains plant Finally, the technique of magnetic field in agricultural fields could be a promising technique for agricultural improvement but extensive research is still required to many studies in the future.

Keywords: Saline irrigation water; magnetic water; pre-sowing grains magnetic field; wheat productivity and quality.

1. INTRODUCTION

"Magnetic water treatment influences molecular and physicochemical properties of water that alter the quality of water" [1]. "Magnetic treatment of water has been reported to change some of the physical and chemical properties of water, mainly hydrogen bonding, polarity, surface tension, conductivity, pH and solubility of salts It was observed that magnetized water helps in dissolving minerals and acids by a higher rate than unmagnetized water and increasing the speed of chemical reactions. The effects of magnetic treatment on irrigation water include increasing the number of crystallization centers and this effect improves the quality of irrigation water" [2]. "Irrigation water molecules were positioned during a magnetic flux, the hydrogen bonds between the molecules either change or disintegrate and reduce the adhesion angle to only 105°, which decreases the union range between the molecules and, thus, absorbs the energy" [3]. "Magnetized water results in large crystals being broken down into small crystals, easily passing through the roots of the pores of plants and soils" [4]. "The use of magnetic treatment of irrigation saline water salinity led to decrease soil pH to without magnetic. The decrease of soil pH as affected by magnetic irrigation water may be a relatively greater soil acidification due to the release of greater organic acids with in the rhizosphere by plants irrigated with magnetically treated water compared with plants irrigated with water un magnetic treatment", [5].

"In general, the magnetic water has different effects the soil 1- the removal of excess soluble salts, 2- bringing down of pH esteems, and 3- the dissolving of slightly soluble components such as phosphates, carbonates and sulphates. Moreover, the attractive strategy of magnetic method for saline water is allegedly a successful technique for soil desalinization" [6].

"Groundwater is available in Sinai in number of aquifers of limited potential. Seasonal rainfall replenishes shallow aquifers in the northern coastal areas of Sinai The thickness of the aquifers varies between 30 and 150 m with a salinity varying from 2000 ppm up to 9000 ppm. In the northern and central parts of Sinai, groundwater is partially replenished from rainstorms falling and collecting in the valleys. The current annual abstraction is estimated as 89 million m^3", [7]. "On the other side, the amount of groundwater abstractions in such areas Delta, Sinai and New Valley are about 5.1 (billion cubic metric /year) BCM/yr. It was found that about 200,000 BCM of fresh water tored in the New Valley's Oasis aquifer only. In Sinai, groundwater is mainly encountered in three different water bearing aquifers", [8]. "The remaining 4% comes from groundwater aquifers and just a small share results from the scarce rainfall received. On the other hand, the planted areas by wheat has expanded in recent years. Since 1980–1989, wheat plantings grew from an average of 559 thousand to 1.36 million hectares during 2010–2017 due to higher domestic wheat procurement prices which incentivized local wheat production relative to competing crops such as clover" [9]. "Agricultural areas was increasing water-use efficiency within the irrigation system from 50% in 2007 to 80% by 2030 and reducing rice planting from 1.67 million to 1.3 million feddans between 2007 and 2030. These data were intended to conserve the water needed for reclaiming 1.25 million feddans of land by 2017, and further to 3.1 million fedd by 2030" [10].

Wheat is one of the most important crops In Egypt 2020, the wheat production amounted to approximately 8.9 million metric tons, which represented and increase of 1.48 percent from the preceding year. During the last decade, the Egyptian wheat production ranged between 7.2 and 8.9 million metric tons in 2010 and 2020, respectively (Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Economics Bulletin, different years according to FAO [11] "wheat area overs 1,418,708 ha of land produced about 9,460,200 tons, Egypt produced approximately 8.9 milion tons of wheat come from total area harvested 1.39 million hectares and was one of the largest wheat importers in the world" [12]. "Egypt had been known by wheat production and consumption since ancient times. Recently, there is a big gap between wheat consumption and production that reached about 55%" [9]. "To decrease this gap , wheat planted area was extended out valley depending on underground water which characterized by different levels of salinity. The irrigation with saline water reduced plant growth in terms of plant height, stem diameter, number of tillars and leaves, leaf area, and dry matter ; however, plants irrigated with magnetic water showed an increase in growth than those irrigated with salin water The attributed to the role of water magnetization is strengthening the properties of water by regulating charges and consequently changes in the properties of water when placing water molecules within a magnetic field resulting in the dissociation of hydrogen bonds between molecules" [13].

In this investigation we attempted to study the possible effects of pre-sowing magnetized seeds and magnetized irrigation saline water on soil characteristics, wheat productivity and grain quality under saline soil conditions

2. MATERIALS AND METHODS

A field experiment was carried out in privet farm in Romana village, North Sinia, governorate, Egypt, during the two successive winters 2020/2021 and 2021-2022 seasons to study the effect of magnetic irrigation water with different salinity levels (1000, 2000, 4000 and 6000 ppm) from four wells and different times of pre-sowing seeds wheat treated with magnetic filed on soil fertility and wheat productivity in newly reclaimed soil.

The main physical and chemical properties of the cultivated soils and also their content of some macro- and micronutrients were determined before sowing according to the methods described by Cottenie et al. [14] and Page et al. [15]. The obtained data were recorded in Table 1.

In both seasons each experiment was carried out in a split plot design with three replicates. The treated irrigation water with or without magnetic in the main plot (A), where the different four levels saline irrigation water was sub plot and the different times exposure to magnetic filed sun main plot. The area of the study about was selected of one fed, each fed = 4200 m^2 has been planted with wheat.

All experimental area was irrigated with ground water at different salinity levels (1000, 2000, 4000 and 6000 ppm) treated with or without magnetic water. Irrigation water passed through a magnetic device (model Delta water, made in Egypt, technique Garmany), which pinned to the main irrigating water line after the well's injector. The device comprised of two magnets, arranged to the north and south poles. The directions of magnetic field generated at the flow rate diameter 2 inch and were arranged in a way to get the technological magnetic forces is (14.5 thousand gauss) as shown Fig. 1.

The main chemical properties of the irrigation water with different salinity levels with or without magnetized water and also their content of some macro- and micronutrients were determined according to the methods described by Cottenie et al. [14] and Page et al. [15].

All farming processes were carried out before planting. Also, the soils were fertilized by compost as organic fertilizer at rate of 10 ton /fed before 20 days from sowing. Super phosphate calcium (15.5 % P_2O_5) was applied at rate of 200 kg/fed during tillage soil. The compound of fertilizers NPK (19: 19: 19) at rates 100 kg/fed was applied on three periods (31, 45 and 75 days from planting).

Table 1. Mean values of physical and chemical properties of the soil study in Romana North Sinia (two seasones)

Coarse sand (%)	**Fine sand (%)**	**Silt (%)**	**Clay (%)**	**Texture**		**O.M (%)**	**$CaCO_3$ (%)**	
12.45	**74.10**	**5.75**	**7.70**	**Loamy sand**		**0.59**	**5.95**	
pH (1:2:5)	**EC (dS/m)**	**Cations (meq/l)**				**Anions (meq/l)**		
		Ca^{++}	**Mg^{++}**	**Na^+**	**K^+**	**HCO_3^-**	**Cl^-**	**SO_4^{--}**
8.01	5.85	12.40	17.38	27.94	0.78	9.74	21.88	26.88
Available macronutrients (mg/kg)			**Available micronutrients (mg/kg)**					
N	**P**	**K**	**Fe**	**Mn**	**Zn**			
33.65	3.60	185.00	6.40	1.25	0.55			

Fig 1. Magnetic system during irrigation water salinity study

Table 2a. Some chemical properties of irrigation water before and after magnetic water system

Magnetic irrigation water	pH (1:2:5)	EC (mg/kg)	Cations (meq/l)				Anions (meq/l)		
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{--}
Without Magnetic water	7.85	1000	1.88	3.20	5.67	1.75	1.28	6.23	4.99
	8.04	2000	4.75	8.32	16.48	1.65	3.55	12.85	14.80
	8.15	4000	8.50	14.25	38.17	1.58	7.43	33.80	21.27
	8.25	6000	13.20	17.88	42.27	1.65	12.77	38.77	23.46
After flow through magnetic irrigation water									
With magnetic water	7.75	1000	3.45	2.04	4.63	1.88	1.18	5.20	5.62
	7.94	2000	6.34	9.22	14.34	1.90	2.85	11.34	16.61
	7.98	4000	12.85	16.33	30.44	1.88	5.30	31.60	24.40
	8.12	6000	15.32	15.95	40.78	1.85	10.33	35.12	28.45

Table 2b. Some macro-and micronutrients content in Irrigation water before and after magnetic water system

Magnetic water	EC (mg/kg)	NO_3-N	NH_4-N	P	K	Fe	Mn	Zn
		(mg L^{-1})						
Without magnetic irrigation water	1000	16.37	12.84	3.88	7.40	11.65	6.11	0.38
	2000	18.35	17.30	4.77	8.32	11.94	7.63	0.44
	4000	22.18	19.47	5.12	9.63	13.10	8.44	0.47
	6000	20.55	17.97	6.43	9.33	14.22	12.18	0.52
After flow through magnetic irrigation water								
With magnetic irrigation water	1000	12.77	**6**.39	5.34	8.34	12.44	6.63	0.38
	2000	16.66	8.45	6.45	9.42	12.17	8.33	0.45
	4000	22.38	7.55	7.12	9.88	11.96	9.29	0.48
	6000	25.42	9.69	7.80	9.93	11.75	11.44	0.54

Seeds of wheat cultivar Misr 1 were supplement of from Field Crop Research Institute Agriculture Research Center, Giza Egypt. Pre-sowing seeds were treated with magnetic field at times (0, 1/4, 1/2 and 3/4 hr). Sowing of seeds was carried out at 15 November 2020 / 2021 and 2021/ 2022. The area of experimental divided to two divisions' first division irrigated with saline water without magnetic water and second part irrigated saline water treated with magnetic water.

After75 days from planting samples of each experiment plot were prepared for some vegetative growth parameters and some physiological determination.

The end of growth period growth parameters were measured, included, plant height (cm), weight of grans /plant (g), weight of straw/plant , weight of 1000 grains (g), weight of grains yield (ton/fed), weight of straw yield (ton/fed).

Soil Sample: Randomized soil samples were also collected from 0- 30 cm soil depth, from each experimental plot after harvest in the both growth seasons. The soil samples were air -

dried and chemically analyzed i.e., soil pH, organic matter and cation exchange capacity according to the methods described by Page et al.., [15]. The total soluble salts expressed as EC (dSm^{-1}) were determined by using electrical conductivity meter at 25^{oC} in soil paste [15]. Particle size distribution was carried out by the pipette method described by Gee and Bauder [16] using sodium hexameta- phosphate as a dispersing agent. The content of available macronutrient (N, P and K) and micronutrients (Fe, Mn and Zn) in soil was determined according to the methods described by Cottenie et al.., [14].

Plant Analysis: Samples of ten plants were collected from each plot and those harvesting were divided into grains and straw, oven –dried at 70 C^{o}, weighted to obtain their dry matter per plant. The plant samples were ground, 0.5 g of each sample was digested using H_2SO_4, $HClO_4$ mixture according to the methods described by Chapman and Pratt [17]. The plant content of N, P, K, Fe, Mn and Zn were determined in plant digestion using the methods described by Cottenie et al.., [14].

Statistical Analysis: The obtained data were statistically analyzed which was comprised analysis of variance (ANOVA) and least significant difference (LSD) at 0.05 probability level was applied to make comparisons among treatment means according to Gomez and Gomez [18].

3. RESULTS AND DISCUSSION

3.1 Effect of Irrigation Water Salinity Treated with Magnetic Field on Soil Study

Soil pH: The soil pH of all experimental plot units were characterized by slightly to moderately alkaline conditions, where the pH value was ranged between 8.00 -7.79 for soil untreated magnetic water, while the soil pH around to 7.97 to 7.75 for soil treated with magnetic water. The magnetic water of irrigation waters different salinity led to decrease of soil pH compared without magnetic. These results were in agreement with Meysam and Ebrahim [19] indicated the application of irrigation saline water treated with magnetic water led to decrease soil pH compared with the control untreated. El-Sonbaty [20] reported that the soil pH reduced as affected by irrigation magnetic water than soil untreated magnetic water. As well as, the irrigation with different levels of saline water treated with magnetic water resulted in reducing soil pH especially high salinity compared to untreated. These findings were in agreement with Hamza et al.., [21] found that the soils irrigated with higher levels of water salinity treated with magnetic water gave lower soil pH due to increased water salinity levels of the groundwater. Maheshwari and Harsharn [5] showed that soil properties after plant harvest had reduced soil pH, the use of magnetically treated irrigation water.

Soil Salinity (dSm^{-1}): The soil salinity depends on irrigating with saline water, inappropriate irrigation approaches, and geographical and climatic conditions. The results presented in Table 3 show that the soil irrigated with saline water without magnetic water decreased soil salinity after harvest than EC initial soil. The increase of irrigation water salinity led to increasing soil salinity without magnetic water. On the other hand, the decrease of soil salinity in soil irrigated with saline water treated with magnetization. Theses result were in agreement by Zlotopolsk [22] indicated the salt contents in soil increased with increasing water salinity without magnetic water, while the soil salinity decreased with irrigation saline soil water treated with magnetic water salts moved deeper during the treatment process . The relative deceases of mean soil EC values were 10.03% ; 16.80% , 20.37% and 25.60% respectively, for soil irrigated different levels (1000, 2000, 4000 and 6000 ppm) treated with magnetic water compared without magnetic water. Magnetized water applied to salty soil down the salt crystals and helps in faster leaching of salts. The decrease of soil salinity was from 7.3 to 1.08 dSm^{-1} as affected by magnetized water treatment [23]. The effect of irrigated saline water different levels with or without magnetic water on saline soil was significant decreased of soil salinity. The irrigation water treated with magnetic had positive effect on decreasing salinity of the soil (ECe) after harvesting of plants The obtained results indicated that magnetic water played an important role in salts soluble salts resulting in increasing their removal from the soil [24].

Also, the interaction between magnetic water and saline water on soil salinity resulted significant increase. The treated irrigation water with magnetic water was decrease of soil salinity than irrigated water without magnetic water [25]. Magnetized irrigation water can change the distribution of water and salt in all salinized soils, increase the water holding capacity and salt leaching of soil, and reduce the soil salt contents in the soil profile [26].

Macro-Micronutrients Available Contents in Soil: Data presented in Table (3) show that the effect of irrigation saline water different levels treated with or without magnetic water on available macro – micronutrients contents in soil after wheat harvest were increase with decreasing soil salinity, might be due to available (N, P, K, Fe, Mn and Zn mg/kg) increase in soil as affected with irrigation saline water treated with magnetic water compared without magnetic water. Concerning, that the irrigation water different levels salinity treated with magnetic water was increase of Fe, Mn and Zn contents in soil might be due to the role of magnetic water led to dissolving minerals in soil , dissolve oxygen and increasing rate of activity of chemical reaction. The using irrigation saline water treated with magnetic water to soil increased leaching soluble salts, decreased soil pH caused of increased nutrients content in soil. The irrigation lower saline water level was significant increase N, P, K, Mn and Zn available contents in soil treated with or without magnetic water, while the Fe content was no significant. on the other hand, The used of irrigation saline water treated with magnetic water was significant increasing of N, P, K, Fe, Mn and Zn contents in soil compared with soil untreated. The interaction between irrigation water different salinity levels and magnetic water were significantly increase N and K contents in soil, while the P, Fe, Mn and Zn contents in soil had no significant. From the result obtained the used irrigation high salinity caused decrease of N, P, K, Fe, Mn, and Zn contents in soil might be due to low biological activity, which was not conducive for the accumulation of organic matter and its mineralization Also, the soil irrigated saline water led to decrease the available N, P and K content of soil. This may be due to increasing SAR in irrigation water, The exchangeable sodium percentage (ESP) and pH of soil also increased the high amount of Na may adversely affect the physico-chemical and biochemical properties of soil [27]. Mohamed and Sherif [28] indicated that the used of irrigation saline water treated with magnetic water led to increase the micronutrient contents in soil compared with untreated.

Table 3. Soil pH, EC (dSm^{-1}) and available macro- micronutrients content in soil (over combined with both seasons)

Irrigation water salinity (mg/kg)	Magnetic Pre-sowing seeds time (hr)	pH (1:2.5)	EC (dSm^{-1})	Available macronutrients (mg/kg)			Available micronutrients (mg/kg)		
				N	P	K	Fe	Mn	Zn
No magnetic irrigation water									
1000	0	7.93	3.25	37.25	3.95	192.00	6.89	1.55	0.62
	1/4	7.85	3.02	42.15	4.12	195.00	7.04	1.67	0.66
	1/2	7.82	2.75	44.36	4.32	198.00	7.16	1.73	0.72
	3/4	7.79	2.55	46.28	4.66	201.00	7.43	1.79	0.75
Mean			2.89	*42.51*	*4.26*	*196.50*	*7.13*	*1.69*	*0.69*
2000	0	7.98	4.30	36.55	3.92	189.00	6.74	1.40	0.60
	1/4	7.95	4.10	38.14	4.05	191.00	6.89	1.62	0.63
	1/2	7.93	3.82	41.23	4.14	194.00	7.08	1.65	0.67
	3/4	7.90	3.26	42.18	4.25	197.00	7.32	1.69	0.73
Mean			*3.87*	*39.53*	*4.09*	*192.75*	*7.01*	*1.59*	*0.66*
4000	0	7.99	4.55	36.14	3.85	187.00	6.70	1.35	0.58
	1/4	7.97	4.36	37.85	3.92	189.00	6.85	1.60	0.60
	1/2	7.95	4.22	40.25	3.96	191.00	6.95	1.63	0.64
	3/4	7.93	3.95	42.87	4.13	193.00	7.04	1.67	0.69
Mean			*4.27*	*39.28*	*3.97*	*190.00*	*6.89*	*1.56*	*0.63*
6000	0	8.00	4.85	35.88	3.82	186.00	6.69	1.30	0.57
	1/4	7.98	4.76	36.54	3.88	188.00	6.82	1.52	0.60
	1/2	7.96	4.45	38.12	3.92	190.00	6.88	1.59	0.62
	3/4	7.94	4.20	41.25	4.01	192.00	6.99	1.63	0.65
Mean			*4.57*	*37.95*	*3.91*	*189.00*	*6.85*	*1.51*	*0.61*

Irrigation water salinity (mg/kg)	Magnetic Pre-sowing seeds time (hr)	pH (1:2.5)	EC (dSm^{-1})	Available macronutrients (mg/kg)			Available micronutrients (mg/kg)		
				N	P	K	Fe	Mn	Zn
Magnetic irrigation water									
1000	0	7.89	3.00	41.48	4.06	199.00	7.05	1.75	0.69
	1/4	7.82	2.84	46.21	4.55	206.00	7.46	1.93	0.78
	1/2	7.80	2.40	49.85	4.92	214.00	7.85	2.04	0.82
	3/4	7.75	2.15	52.21	5.20	223.00	7.93	2.18	0.88
Mean			*2.60*	*47.44*	*4.68*	*210.50*	*7.57*	*1.98*	*0.79*
2000	0	7.92	3.55	39.52	4.02	197.00	6.97	1.70	0.65
	1/4	7.88	3.25	44.18	4.32	203.00	7.22	1.89	0.74
	1/2	7.85	3.12	47.31	4.85	208.00	7.45	1.97	0.79
	3/4	7.80	2.95	49.25	4.91	213.00	7.65	2.09	0.83
Mean			*3.22*	*45.07*	*4.53*	*205.25*	*7.32*	*1.91*	*0.75*
4000	0	7.94	3.85	38.49	3.89	194.00	6.92	1.68	0.62
	1/4	7.90	3.56	41.20	4.15	201.00	6.99	1.84	0.70
	1/2	7. 88	3.12	43.85	4.29	204.00	7.15	1.90	0.75
	3/4	7.85	3.05	45.17	4.38	212.00	7.42	1.98	0.79
Mean			*3.40*	*42.18*	*4.18*	*202.75*	*7.12*	*1.85*	*0.72*
6000	0	7.97	4.05	37.59	3.85	190.00	6.90	1.65	0.60
	1/4	7.94	3.76	40.17	3.97	195.00	6.95	1.78	0.65
	1/2	7.89	3.45	42.89	4.07	198.00	7.09	1.82	0.72
	3/4	7.87	3.20	44.10	4.15	205.00	7.33	1.90	0.75
Mean			*3.40*	*42.18*	*4.18*	*202.75*	*7.12*	*1.85*	*0.72*
LSD. 5 % S			0.212	1.191	0.124	2.351	ns	0.105	1.012
LSD. 5 % T			0.131	1.210	0.120	2.584	ns	0.057	1.013
LSD. 5 % M			0.094	0.912	0.072	1.520	0.090	0.060	0.012
LSD. 5 % S x T			***	*	***	*	ns	ns	*
LSD. 5 % M X S			ns	**	ns	*	ns	ns	ns
LSD. 5 % M X T			ns	***	ns	ns	ns	ns	ns
LSD. 5 % interaction SXTXM			ns	**	ns	ns	ns	ns	ns

*Where: S: water salinity; T : time magnetic grain; M : magnetic irrigation water. * = significant, ** high significant, *** = very high significant, ns = non significant*

Wheat Productivity and Components: Data presented in Table 4 revealed that the effect of irrigation saline water with or without a magnetic field as well as pre-sowing of wheat seeds treated with a magnetic field at different times on wheat components and productivity under saline soil conditions had a positive effect The highest mean values of 89.72 cm , 21.26 (g), 28.15 (g) , 44.04 (g), 2.29 (ton/fed) and 3.68 (ton/ fed) for plant length (cm), weight of grains (g) /plant , weight of straw (g)/plant, weight of 1000 grains (g), weight of grains (ton /fed) and weight of straw (ton/fed) respectively , for grains exposure to different times magnetic field and irrigated with saline water 1000 ppm without magnetic water than other treatments. On the other hand the highest mean values of plant length (cm), weight of grains (g) /plant, weight of straw (g)/plant, weight of 1000 grains (g), weight of grains (ton /fed) and weight of straw (ton/fed) for 103.08 (cm), 26.22 (g/plant), 34.32 (g) /plant, 51.08 (g), 2.81 (ton/fed) and 4.37 (ton/fed)respectively, for grains exposure to different times magnetic field and irrigated with saline water 1000 ppm with magnetic water than other treatments.

3.2 Effect of Irrigation Saline Water on Wheat Growth

Data in Table 4 show that the effect of irrigation saline water different levels on plant growth parameters (plant length (cm), weight of grains (g) /plant , weight of straw (g)/plant , weight of 1000 grains (g) , weight of grains (ton /fed) and weight of straw (ton/fed) respectively) were significantly decreased with increasing irrigation water salinity levels. So, the effect of magnetic saline water irrigation on all parameters of wheat productivity was significantly increased than without magnetic water. The interaction between irrigation saline water different levels and magnetic water had significant effect on plant length (cm), weight of grains (g) /plant , weight of 1000 grains (g) and weight of grains (ton /fed) , While the weight of straw / plant and weight of straw (ton/fed) respectively were no significant. The relative decrease of mean values were 9.48% for plant length; 21.70% for weight of grains g/plant; 25.68% for weight of straw g/plant; 12.10% for weight of 1000 grains; 16.67% for weight of grains yield (ton/fed) and 29.92% weight of straw yield (ton/fed) respectively, for soil treated with irrigation saline water level 1000 ppm compared with magnetic water. Also, the decreased mean values percentage were 9.97% for plant length; 34.09% for weight of grains g/plant; 37.27% for weight of straw g/plant; 22.52% for weight of 1000 grains; 19.82% for weight of grains yield (ton/fed) and 4.48% weight of straw yield (ton/fed) respectively, as affected with irrigation saline water at 2000 ppm compared with irrigation water salinity with magnetic water. As well as, the relative decreases of mean values were 7.64% for plant length; 31.60% for weight of grains g/plant; 32.87% for weight of straw g/plant; 23.04% for weight of 1000 grains; 22.22% for weight of grains yield (ton/fed) and 37.20% weight of straw yield (ton/fed) respectively, as affected with irrigation saline water at 4000 ppm compared with irrigation water salinity with magnetic water. On the other hand, the relative decreases of mean values were 17.85 % for plant length; 33.81% for weight of grains g/plant; 29.02% for weight of straw g/plant; 21.99% for weight of 1000 grains; 10.11% for weight of grains yield (ton/fed) and 31.91% weight of straw yield (ton/fed) respectively, as affected with irrigation saline water at 6000 ppm compared with irrigation water salinity with magnetic water. These results are in agreement with Khalid et al. [13] who found that the irrigation water salinity causes damage to plant cell walls by saline tension and an increase in cell wall thickness as well as enzymes, ruptures the plasma membrane, and thus slows main metabolic processes e.g. photosynthesis, respiration, and protein synthesis. Alikamanoglu and Sen [29] found the response to pre-sowing seeds of wheat plants increased all growth .parameters The effect of interactions among water treatments and seed treatments on vegetative growth was increase from magnetically treated seeds and irrigated by magnetized water during two seasons [30].

Table 4. Wheat productivity (over combined with both seasons)

Irrigation water salinity (mg/kg)	Magnetic Pre-sowing seeds time (hr)	Plant length (cm)	Weight of grains /plant (g)	Weight of straw /plant (g)	Weight of 1000 grains (g)	Weight of grains yield (ton/fed)	Weight of straw yield (ton/fed)
		No magnetic irrigation water					
1000	0	77.23	12.36	18.32	39.23	1.95	2.74
	1/4	85.32	20.20	25.52	43.14	2.25	3.85
	1/2	94.32	24.46	32.85	45.14	2.38	3.98
	3/4	102.00	28.10	35.89	48.66	2.58	4.14
Mean		89.72	21.28	28.15	44.04	2.29	3.68
2000	0	72.35	8.95	13.58	32.65	1.82	2.95
	1/4	81.32	13.35	20.64	35.77	2.17	3.67
	1/2	89.35	18.65	26.21	40.55	2.23	3.84
	3/4	95.41	22.52	32.10	43.41	2.38	3.89
Mean		84.61	15.87	23.13	38.10	2.15	3.59
4000	0	69.85	7.88	12.47	30.89	1.75	1.84
	1/4	78.35	10.32	17.85	35.46	1.95	2.55
	1/2	83.65	14.89	23.28	37.78	2.14	2.71
	3/4	88.52	20.20	28.20	30.66	2.26	2.79
Mean		80.09	13.32	20.45	33.70	2.03	2.47
6000	0	60.85	6.52	10.54	29.55	1.69	1.75
	1/4	67.52	9.58	14.75	22.88	1.74	2.25
	1/2	75.63	11.77	16.34	26.35	1.93	2.38
	3/4	79.85	15.20	23.52	29.14	1.99	2.58
Mean		70.96	10.77	16.29	26.98	1.84	2.24

Irrigation water salinity (mg/kg)	Magnetic Pre-sowing seeds time (hr)	Plant length (cm)	Weight of grains /plant (g)	Weight of straw /plant (g)	Weight of 1000 grains (g)	Weight of grains yield (ton/fed)	Weight of straw yield (ton/fed)
Magnetic irrigation water							
1000	0	85.32	15.66	24.65	44.63	2.34	3.91
	1/4	105.00	24.36	30.14	48.95	2.78	4.45
	1/2	109.00	28.35	36.85	53.65	2.97	4.52
	3/4	113.00	36.52	45.62	57.10	3.14	4.59
Mean		103.08	26.22	34.32	51.08	2.81	4.37
2000	0	80.36	13.58	21.65	42.14	2.27	3.10
	1/4	88.36	22.63	27.56	46.34	2.69	4.22
	1/2	95.33	26.28	32.14	50.85	2.88	4.39
	3/4	102.30	34.85	40.23	53.69	2.98	4.44
Mean		91.59	24.34	30.40	48.26	2.71	4.04
4000	0	75.63	11.52	18.55	40.14	2.25	2.93
	1/4	84.36	19.58	30.52	43.45	2.46	3.08
	1/2	92.14	24.69	34.89	48.74	2.69	3.14
	3/4	98.34	30.85	38.95	51.52	2.88	3.23
Mean		87.62	21.66	30.73	45.96	2.57	3.10
6000	0	73.89	9.85	14.85	37.88	1.88	2.57
	1/4	76.85	16.55	22.32	39.35	1.99	2.84
	1/2	89.32	18.36	29.87	44.65	2.17	2.86
	3/4	94.85	24.18	34.65	48.75	2.75	2.88
Mean		83.73	17.24	25.42	42.66	2.20	2.79
LSD. 5 % S		2.531	0.514	0.926	0.825	0.016	0.227
LSD. 5 % T		1.094	0.922	0.738	0.942	0.024	0.189
LSD. 5 % M		1.461	0.650	1.047	0.606	0.018	0.093
LSD. 5 % S x T		***	***	**	***	***	***
LSD. 5 % M X S		*	**	ns	**	***	ns
LSD. 5 % M X T		**	*	*	***	***	ns
LSD. 5 % interaction SXTXM		*	ns	*	***	***	ns

3.3 Effect of Magnetic Filed Different Times of Seeds Wheat Irrigated with Saline Water

Data presented in Table 4 show that the effect of pre-sowing seeds wheat treated with magnetic field different (0, 15, 30 and 45 min) irrigated with saline water treated by magnetic and without on wheat components were significantly effect. Concerning, that the effect of magnetic field to seeds on plant length (cm), weight of straw /plant (g) , weight of grains (g) /plant , weight of 1000 grains (g) , weight of grains (ton /fed) and weight of straw yield (ton/fed) were significant increase with increasing time of treatment from 0 to 3/4 hr respectively. On the other hand, the irrigated saline water and different magnetic time of grains were significant increase with increasing time for plant length (cm), weight of grains (g) /plant, weight of 1000 grains (g) and weight of grains (ton /fed) were significant increase with increasing time, while the weight of straw / plant and weight of straw (ton/fed) respectively were no significant. The magnetic water and magnetic field different time had significant effect on all growth parameters expect weight of straw yield (ton/fed). Also, the interaction between irrigation water salinity; magnetic field different time for grains wheat and magnetic water were significantly increased for all parameters growth of wheat except weight of grains /plant and straw yield (ton/fed) were no significant. These results were in agreement with Hozayn and Abdul Qados [31] who found that the exposure of plants to magnetic water is highly effective in enhancing growth characteristics. This observation suggests that there may be resonance-like phenomena which increase the seed's internal energy. Therefore, increasing the weight yield /fed may be possible. The relative increases of mean values were 23.07% for plant height of treated with magnetic field ate time 1/4 hr irrigated water salinity 1000 ppm with magnetic water compared with seeds treated with 1/4 hr irrigated with irrigation saline water at 1000 ppm without magnetic water; 62.17% for weight of grains /plant, 42.12% for weight of straw /plant , 31.54% for 1000 grains, 31.93% for grains yield and

17.99% straw yield respectively of grains treated with magnetic field at 3/4 hr irrigated saline water at 1000 ppm treated with magnetic water than grains exposure to magnetic field other time irrigated water salinity without magnetic water. The relative increases of mean values were plant length, weight of grains/ plant, weight of straw /plant, weight of 1000 grains and straw yield /feed were 8.66%, 69.51%, 33.53%, 29.55% and 14.99% respectively for grains exposure at 1/4 hr while the weight grains yield (to/fed) for grains treated magnetic field at 1/2 hr of irrigated saline water at level 2000 ppm treated with magnetic water compared irrigation water salinity levels .2000 ppm without magnetic water. Also, the relative increases of mean values were 8.73% for weight of grains /plant, 70.98% for weight of straw /plant and 20.78% for weight of straw yield /fed respectively for grains treated with magnetic field at 1/4 hr while the 11.09 for length plant, 68.04% for 1000 grains and 27.43% weight of grains yield/fed respectively as affected with magnetic field at 3/4 hr and irrigated saline water at 4000 ppm treated with magnetic water than irrigated without magnetic water. On the other hand , the relative increases of mean values were 72.76% for weight of grains; 71.98% for 1000 grains and 26.22% for weight of straw yield (ton/fed) respectively , as affected with grains treated with magnetic field of time 1/4 hr , while the 82.80% for weight of straw /plant of treated with magnetic field at time 1/2 hr, as well as, 18.79% for length plant and 38.19% for weight of grains treated with 3/4 hr of magnetic field and irrigated saline water at rate 6000 ppm treated by magnetic water compared without magnetic water.

The results are in agreement with Anna et al. [32] reported that the effect of magnetic field of seeds a course of changes in the activity of enzymes for increase of yield component and seeds yield. The seeds treated with a magnetic field led to increase the amount of indole-3-acetic acid (IAA) and gibberellic acid (GA_3) in germinating seeds as well as in above-ground parts and in roots of young seedlings of faba bean in comparison to control. Selim et al. [33] found that the application of magnetic treatments in wheat plants resulted in a significant increase in grain number and weight; grain and straw yield, 1000 grains weight, and harvest index compared with the control. Concerning, that the magnetic field of seeds wheat treatment with three different exposure time periods was (0.5, 1, 2 hr) respectively were were a significant increase of the root growth, and wheat yield, and changing in the activity of the antioxidant system in plants may be due to the various biochemical, cellular, and molecular events, including enzyme activity changes, synthesis of proteins and increase in ascorbic acid content [34].

3.4 Macro-Micronutrients Concentrations Contents in Grains of Wheat

Data show in Table 5 indicated that the increase of mineral concentrations of N, P, K, Fe, Mn and Zn in grains as affected with or without magnetic water and increase of time magnetic field (3/4 hr) for grains wheat compared with other treatments. The highest mean values of nutrients concentrations in grains irrigated with saline water (1000 ppm) with magnetic water and increase of time magnetic field (3/4 hr) for grains wheat than other treatments. The effect of irrigation water different levels salinity on N, P, K, Fe, Mn and Zn concentration in grains were significant decrease with increasing level salinity. Also, the significant increase of N, P, K, Fe, Mn and Zn concentration in grains were used irrigation water treated with magnetic water compared without magnetic water. The pre-sowing grains treated with magnetic field different times were significant increases with increasing time magnetic field. These results are in agreement with Sary [35] found that the use of magnetized water has a role in the effect on leaching nutrients and their absorption by root and translocation to faba bean seeds, which caused more content of macro nutrients of the seeds exposure magnetized field has a role in the effect on leaching nutrients and their absorption by root and translocation to faba bean seeds, which caused more content of macro nutrients of the seeds. The used of magnetic water has been reported to affect macro-micronutrients uptake, the accumulation of the elements in each plant and in the same plant different parts which led to a noticeable increases content of Fe in grain and P, K and Zn, also the magnetic field increased nutrients content significantly with prolonged exposure treatment may irreversibly affect cell membrane permeability leading to increase element uptake as mentioned by Dhawi [36]. On the other hand, the interaction between of magnetic water and irrigation saline water led to significant increase of P, Fe and Zn concentrations in grains, while the grains treated with different times and irrigation saline water different levels were significant of Fe, Mn and Zn. As well as, the grains treated with magnetic water and magnetic field gave significant increase of Fe and Zn

Table 5. Macro- micronutrients concentrations in grains of wheat (over combined with both seasons

Irrigation water salinity (mg/kg)	Magnetic Pre-sowing seeds time (hr)	Macronutrients concentrations (%)			Micronutrients concentrations (mg/kg)		
		N	P	K	Fe	Mn	Zn
No magnetic irrigation water							
1000	0	2.10	0.45	1.65	74.25	45.20	35.32
	1/4	2.18	0.53	1.77	78.63	49.32	37.62
	1/2	2.43	0.57	1.86	82.14	54.12	39.34
	3/4	2.58	0.59	1.89	86.21	56.32	42.10
Mean		2.32	0.54	1.79	80.31	51.24	38.60
2000	0	1.79	0.37	1.58	70.14	38.25	33.58
	1/4	1.86	0.40	1.70	74.32	42.15	35.43
	1/2	1.95	0.48	1.81	79.35	48.32	36.89
	3/4	1.98	0.54	1.84	83.14	51.22	39.48
Mean		1.90	0.45	1.73	76.74	44.99	36.35
4000	0	1.65	0.35	1.52	58.32	34.62	30.85
	1/4	1.73	0.36	1.59	63.58	39.24	33.65
	1/2	1.83	0.39	1.63	68.21	43.15	35.74
	3/4	1.86	0.44	1.75	74.18	47.52	37.96
Mean		1.77	0.39	1.62	66.07	41.13	34.55
6000	0	1.32	0.28	1.40	55.84	31.25	28.75
	1/4	1.36	0.33	1.45	62.17	34.62	30.32
	1/2	1.45	0.37	1.49	66.20	38.25	28.45
	3/4	1.65	0.40	1.53	69.48	42.18	33.41
Mean		1.45	0.35	1.47	63.42	36.58	30.23
Magnetic irrigation water							
1000	0	2.40	0.62	2.24	78.63	47.65	45.21
	1/4	2.58	0.66	2.65	83.47	53.69	48.52
	1/2	2.63	0.68	2.83	88.22	58.95	52.13
	3/4	2.78	0.71	2.94	93.14	63.01	54.20
Mean		2.60	0.67	2.67	85.87	55.83	50.02
2000	0	2.18	0.57	2.18	75.23	42.15	41.52
	1/4	2.25	0.60	2.23	78.21	50.66	45.47
	1/2	2.47	0.67	2.29	84.35	54.35	49.21
	3/4	2.64	0.69	2.37	89.10	60.18	52.18
Mean		2.39	0.63	2.27	81.72	51.84	47.10
4000	0	1.95	0.52	1.98	69.88	39.85	38.96
	1/4	2.10	0.58	2.05	74.52	46.52	43.24
	1/2	2.36	0.61	2.17	78.92	52.18	48.75
	3/4	2.40	0.63	2.29	83.10	57.30	50.52
Mean		2.20	0.59	2.12	76.61	48.96	45.37
6000	0	1.65	0.38	1.73	62.14	34.52	34.33
	1/4	1.73	0.40	1.95	66.32	39.85	38.45
	1/2	1.79	0.45	2.07	75.42	44.32	43.14
	3/4	1.82	0.51	2.01	80.24	49.37	48.52
Mean		1.75	0.44	1.94	71.03	42.02	41.11
LSD. 5 % S		0.111	0.022	0.100	1.353	1.810	0.830
LSD. 5 % T		1.120	0.023	0.0110	1.474	1.362	0.825
LSD. 5 % M		0.140	0.071	0.336	1.853	0.910	1.790
LSD. 5 % S x T		ns	ns	ns	**	*	***
LSD. 5 % M X S		ns	**	ns	***	ns	***
LSD. 5 % M X T		ns	ns	ns	***	ns	***
LSD. 5 % interaction SXTXM		ns	ns	ns	***	ns	***

concentrations in grains wheat. The interactions between all treatments were significant increase of Fe and Zn concentrations in wheat grains. These results may be due to the changes in the mobility of nutrients in the root zone solution which is different nutrient caused used irrigation water treated with magnetic water and wheat grains treated with magnetic field. Mohamed and Ebead [37] reported that the use of irrigation water treated with magnetic water was increases nutrient mobility in soil and enhance extraction and uptake of N, P, K and Fe by plants. Hozayn et al., [38] indicated that the effect of magnetic field on nutrients contents in plants led to increase of macro – micronutrients (N, P, K, Fe, Mn and Zn), respectively. Hamza et al. [21] found that used of magnetic treatment technology of saline irrigation water by magnetic device optimized water in its ability to dissolve soil salts and ensures to lessen salts in the root zone and an increase transport of nutritious minerals. Sombaty (2021) reported that the irrigation with magnetically water may be responsible for activation of enzymes and hormones gave the increase of the mobilization of nutrients contents in plants.

3.5 Macro-Micronutrients Concentrations in Straw Wheat Plants

Data presented in Table 6 show that the effect of irrigation saline water at different levels with or without magnetic water and pre-sowing treated with magnetic field different times were positive effect of macro-micronutrients concentrations in straw wheat. The highest mean values of N, P , K , Fe , Mn and Zn concentrations in straw wheat for grains treated with irrigation water salinity at 1000 ppm as affected with magnetic water and pre-sowing grains treated with 3/4 hr time magnetic field than other treatments. The increased of nutrients N, P , K and Fe uptake in plants as affected the irrigation water salinity treated with magnetic water. The magnetic water caused the change in the characteristics of the cell membrane, cell reproduction, the changes in cell metabolism and increased nutrient mobility in soil, and uptake of N, P, K and Fe by plants. These results may be due to the irrigating plants with magnetized water dissolves more nutrients because it lowers the surface tension of water. This lets more minerals be suspended in solution. Also, this improves the pH and causes more minerals and nutrients to pass through the cell walls of the roots Atak et al. [39]. On the other hand, the irrigation water salinity levels was significant decreases of N, P , K , Fe, Mn and Zn concentrations in straw wheat with increasing irrigation water salinity levels. The significant increases of N, P, K , Fe, Mn and Zn concentration in straw for grains treated with magnetic field different time before sowing. Also, the highest values of N, P, K, Fe, Mn and Zn concentrations in straw as affected by magnetic water than without. The concentrations of P, K, Fe, Mn in straw was significantly increasing with increasing magnetic times for grains irrigated with saline water, while the N and Zn concentrations in straw were no significant. The interactions between all treatments were significant increase of P, K. Fe and Mn concentrations straw while the N and Zn were no significant. That effect is due to the magnetic effect on leaching nutrients and their absorption by root and translocation to wheat, which caused more content of micro elements of the straw wheat. These results are in agreement by Grewal and Maheshwari [40] found that the treatment with magnetized water for irrigation water was significant increase in N, P, K, Zn, Fe and Mn contents in snow pea. Abou El-Yazied et al. [30] irrigation saline water with magnetic water increased the amount of microbial content of the soils such as N-fixation bacteria. Such increases may improve the availability of nutrients in the soil and consequently their nutrients uptake by plants. Also, the increases in the availability of soil nutrients might be attributed to soil acidification resulted from the increases in the released root exudates (organic acids) in the root zone. The increase of nutrients contents in plants as affected with irrigation water treated with magnetic water may be due to the caused using magnetic water causes changes in the characteristics of the molecules resulting in reduce surface tension, reduced viscosity, increased dissolvability, increased permeability and improved oxygen content hence became elements more available to plants, so magnetic water has different chemical and physical properties than untreated water [41].

3.6 Wheat Yield Quality

Presented data in Table 7 showed that the effect of per-sowing grains treated with magnetic field times under saline irrigation water different levels with or without magnetic water on protein (%); carbohydrate (%) and chlorophyll (mg/g.f.w) contents in wheat were increase with increasing magnetic time (3/4 hr) irrigated with decreasing saline irrigation water level (1000 ppm).

Table 6. Macro- micronutrients concentrations in straw of wheat (Over combined with both seasons)

Irrigation water salinity (mg/kg)	Magnetic Pre-sowing seeds time (hr)	Macronutrients concentrations (%)			Micronutrients concentrations (mg/kg)		
		N	P	K	Fe	Mn	Zn
		No magnetic irrigation water					
1000	0	1.78	0.25	2.69	85.63	52.14	20.85
	1/4	1.86	0.29	2.74	97.46	66.85	25.63
	1/2	1.97	0.34	2.89	103.10	79.74	29.77
	3/4	2.14	0.36	2.96	106.31	84.12	35.48
Mean		1.94	0.31	2.82	98.13	70.71	27.93
2000	0	1.73	0.23	2.66	83.65	50.14	17.65
	1/4	1.83	0.27	2.71	86.14	63.45	22.65
	1/2	1.92	0.30	2.83	97.65	77.48	25.89
	3/4	1.97	0.34	2.87	102.12	80.88	29.64
Mean		1.86	0.29	2.77	92.39	67.99	23.96
4000	0	1.56	0.20	2.55	80.47	48.75	14.63
	1/4	1.63	0.24	2.63	84.12	61.45	20.17
	1/2	1.72	0.29	2.75	87.36	75.89	23.95
	3/4	1.88	0.31	2.80	94.58	77.65	26.75
Mean		1.70	0.26	2.68	86.63	65.94	21.38
6000	0	1.47	0.19	2.41	75.41	34.63	13.47
	1/4	1.58	0.21	2.44	70.32	57.32	19.68
	1/2	1.69	0.27	2.49	76.42	69.48	23.14
	3/4	1.75	0.29	2.65	82.41	72.41	25.85
Mean		1.62	0.24	2.50	76.14	58.46	20.54
		Magnetic irrigation water					
1000	0	2.15	0.33	2.85	98.65	75.89	24.63
	1/4	2.27	0.46	2.95	113.00	89.34	29.34
	1/2	2.45	0.48	3.04	123.14	98.34	36.52
	3/4	2.62	0.52	3.10	128.64	106.42	42.31
Mean		2.37	0.45	2.99	115.86	92.50	33.20
2000	0	2.10	0.31	2.80	94.85	73.52	22.85
	1/4	2.19	0.36	2.89	99.34	85.46	27.64
	1/2	2.33	0.42	2.96	119.10	93.75	34.89
	3/4	2.45	0.47	3.01	125.63	97.65	38.95
Mean		2.27	0.39	2.92	109.73	87.60	31.08
4000	0	1.98	0.27	2.72	89.65	70.32	20.47
	1/4	2.15	0.32	2.83	93.24	81.36	24.66
	1/2	2.29	0.38	2.88	98.75	87.34	30.17
	3/4	2.36	0.42	2.97	106.14	92.10	37.88
Mean		2.20	0.35	2.85	96.95	82.78	28.30
6000	0	1.75	0.24	2.59	83.41	67.25	17.35
	1/4	1.89	0.28	2.71	88.75	77.85	22.14
	1/2	1.96	0.33	2.78	93.45	82.19	27.63
	3/4	2.10	0.37	2.89	99.75	89.42	30.14
Mean		1.93	0.31	2.74	91.34	79.18	24.32
LSD. 5 % S		0.102	0.013	0.014	0.730	1.100	2.767
LSD. 5 % T		0.099	0.031	0.022	0.558	1.873	2.770
LSD. 5 % M		0.081	0.004	0.008	0.821	0.755	1.957
LSD. 5 % S x T		ns	***	***	***	***	ns
LSD. 5 % M X S		ns	ns	ns	***	ns	ns
LSD. 5 % M X T		ns	***	***	***	***	ns
LSD. 5 % interaction SXTXM		ns	ns	***	***	***	ns

S: irrigation water salinity; T : time magnetic grains; M : magnetic irrigation water

Table 7. Quality of wheat (over combined with both seasons)

Irrigation water salinity ((mg/kg))	Magnetic Pre-sowing seeds time (hr)	Protein (%)	Proline (mg/g.d.w)	Carbohydrate (%)	Total Chlorophyll (mg/g.f.w.)
		No magnetic irrigation water			
1000	0	12.08	38.95	66.32	3.48
	1/4	12.54	26.12	69.34	4.86
	1/2	13.97	22.18	71.95	5.96
	3/4	14.84	17.95	75.83	6.56
Mean		13.36	26.30	70.86	5.22
2000	0	11.33	45.95	62.17	3.24
	1/4	10.70	36.85	65.41	3.99
	1/2	11.21	27.85	67.85	4.25
	3/4	11.39	22.95	73.33	4.88
Mean		11.16	33.40	67.19	4.09
4000	0	9.49	68.94	60.85	3.10
	1/4	9.95	62.14	63.85	3.85
	1/2	10.52	56.34	65.88	4.12
	3/4	10.70	46.95	71.52	4.55
Mean		10.17	58.59	65.53	3.91
6000	0	7.59	75.62	60.44	3.06
	1/4	7.82	68.63	61.87	3.78
	1/2	8.34	60.47	64.32	4.02
	3/4	9.49	55.24	69.52	4.13
Mean		8.31	64.99	64.04	3.75
		Magnetic irrigation water			
1000	0	13.80	33.65	69.52	5.69
	1/4	14.84	24.12	73.65	6.24
	1/2	15.12	16.85	76.52	6.95
	3/4	15.99	14.32	79.52	7.65
Mean		14.94	22.24	74.80	6.63
2000	0	12.54	38.52	66.52	5.33
	1/4	12.94	33.52	69.34	5.88
	1/2	14.20	24.16	72.56	6.32
	3/4	15.18	18.52	76.45	6.75
Mean		13.72	28.68	71.22	6.07
4000	0	11.21	45.63	64.58	5.10
	1/4	12.08	36.85	67.43	5.66
	1/2	13.57	29.85	70.89	5.89
	3/4	13.80	22.95	74.69	6.18
Mean		12.67	33.82	69.40	5.71
6000	0	9.49	65.32	63.89	4.55
	1/4	9.95	58.62	65.89	4.95
	1/2	10.29	41.32	69.88	5.14
	3/4	10.47	35.85	72.55	5.36
Mean		10.05	50.28	68.05	5.00
LSD. 5 % S		ns	1.338	0.943	0.152
LSD. 5 % T		ns	1.048	1.056	0.132
LSD. 5 % M		ns	2.018	0.624	0.155
LSD. 5 % S x T		ns	***	ns	**
LSD. 5 % M X S		ns	***	ns	***
LSD. 5 % M X T		ns	***	ns	**
LSD. 5 % interaction SXTXM		ns	***	ns	ns

Where: S: irrigation water salinity; T : time magnetic grains; M : magnetic irrigation water

The protein content (as %) in wheat grains was increase with decreasing of irrigation water salinity (1000 ppm) treated with magnetic or without magnetic under different pre-sowing of grains treated with different times conditions. The effect of all treatments and interaction between all treatments were no significant for protein (%) content in grains. Pre-magnetic field treatment of seeds led to the increase of plants' growth, protein biosynthesis and root development. The result indicated those different times of exposure of magnetic field had an enhancing effect on the early protein and growth of wheat seeds [42]. Shabrangi and Majd [43] showed that the use of magnetic water led to increasing needs metabolic changes particularly increasing protein biosynthesis. The stimulatory effect of magnetized water on growth parameters may be attributed to the induction of cell metabolism and mitosis.

Proline (mg/g.dw.) accumulation in salt stressed plants is a primary defense response to maintain the osmotic pressure in a cell. Data in presented in Table 7 show that the increase of proline (mg/g.dw.) contents in grains wheat with increasing of saline irrigation water level without magnetic field ,while the decrease of proline content in grains treated with magnetic field Concerning, the effect of magnetic water different salinity and pre-sowing of wheat grains magnetic field different time on proline were significant decreasing proline contents in grains compared without magnetic field. The interaction between irrigation saline water treated with magnetic water and pre-sowing grains exposure magnetic field had significant decreases compared without magnetic. These results are in agree with El-Sonbaty [20] whoindicated that the proline content in maize plants decrease as affected by irrigation with magnetic water compared without magnetic. Sary [35] found that the magnetized saline water decreased levels led to significant decrease of proline content in the plants. Proline content increased significantly in wheat plants irrigated with the non-magnetized saline water compared to magnetized saline one, especially for those grown under saline conditions i.e. Ras Sudr and El-Hosinia Plain soils. Such increases might be a mode of defense to raise the osmotic pressure inside the plant cells to face the water stress [44].

Carbohydrate content in grains wheat was increased with increasing magnetic field time and decrease saline irrigation water. The pre-sowing grains exposure magnetic field different times alone or irrigation water salinity different levels treated with magnetic water were significantly increased in grains contents compared without magnetic water. This may indicate the results of bioenergetics causing cell pumping and enzymatic stimulation. El-Sonbaty [20] found that the carbohydrate contents were higher in the maize irrigated by magnetically treated water than that from non– magnetically treated water. Carbohydrate content in grains wheat increased with magnetic field times and irrigation saline water treated with magnetic water compared to irrigated without magnetic. Babaloo et al. [45] reported that the increasing significantly in carbohydrates because of the close relationship between stomata conductance and photosynthesis, thus lead to an increase in photosynthesis. The effects of magnetic exposure on plant growth still require proper explanation. Moreover, the effects of irrigation water salinity was reduces carbohydrates synthesis at the vegetative growth stage, while it also disrupts or halts the translocation of carbohydrates toward grains at the initiation of grain filling stage, and thus it results in a significant reduction of carbohydrates concentration in wheat grain [46]. Carbohydrate content is an important indicator of wheat grain quality, which is influenced by salinity stress, especially when wheat grains are exposed to magnetic field different time and saline irrigation water at different levels treated with magnetic water. The synthesis and translocation of carbohydrates were more sensitive to suboptimal growing conditions.

Decrease of chlorophyll content in wheat plant as affected by irrigation water different levels salinity without magnetic field , while the increase of chlorophyll contents as affected with magnetic irrigation water and grains wheat different times. On the other hand, the effect of saline irrigation water on chlorophyll content was decreased, while the significant increase of chlorophyll content as affected with pre-sowing grains magnetic field times compared without magnetic. The interaction between irrigation water salinity and magnetic water were significant increase of chlorophyll content in leaves compared without magnetic. The interaction between pre-sowing grains magnetic times and magnetic water were significant increases with increasing time magnetic of chlorophyll content. These results are in agreement by Babaloo et al. [45] reported that magnetic water significantly increased chlorophyll content in wheat plant. This increment may be attributed to increasing nutrient mobility and nutrients uptake improved under magnetic field which leads to a better photo stimulation in wheat plants. Said et al. [47] found that the using of magnetic water was significant increase in chlorophyll concentration in wheat treated 2,500 ppm saline water by 6.03% and magnetically treated 5,000 ppm saline water by 9.92% compared to without magnetic water two seasons. Chlorophyll content in wheat plants leaves decreased under saline stress while increased significantly under irrigation with magnetized water. This may be due to the effect of magnetized water on reducing saline stress [48].

4. CONCLUSION

The study indicated that exposure of wheat seeds to magnetic field durations of exposure significantly increased characteristics of wheat growth under irrigation water salinity treated with magnetic water or without magnetic water. A 3/4 hr exposure durations of a magnetic field showed an increase in macro-micronutrients contents in straw and grains. The improved of quality characteristics suggested that this technique may be had suitably exploited and enhanced wheat growth under different irrigation water salinity different levels. Recommendation the used magnetic treatment of irrigating saline water and pre-sowing of grains treated magnetic field could be a promising technique for the soil and agricultural improvements, besides this technique is considered a friendly environmental one. Also, it might increase the fertilizers use efficiency. In addition, it significantly improved the parameters growth and yield parameters beside the macronutrients content of wheat plants. Magnetized irrigation saline water or pre-sowing grains magnetic field could be a promising technique for agricultural improvements but more studies is required on different crops.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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