EFFECT OF IRRIGATION WITH MAGNETIC SALINE GROUND WATER ON SOIL AND GRAPE CROP

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ABSTRACT

The aim of this study is to evaluate the effect of magnetic treatments on some soil chemical properties and some characteristics of grapes grown in this soil under saline irrigation conditions. The present investigation was started with samples collection in June 2014, samples were collected from El-khatatba (Mudug Abu El-Azaim, Cairo Alexandria Desert Road, El-Menoufia, Egypt). Soil and plant samples were collected from representing areas irrigated with two different sources of water (treated well-untreated well water). In El-khatatba farm three soil profiles were dug to the depth of 90 cm and soil samples were collected from successive depth (0-30, 30-60 and 60-90 cm). The results indicated that irrigation with magnetized water led to a decrease in pH values in soil samples at different depths comparing to soils irrigated with non-magnetized water. Also data show irrigation with magnetized water led to a decrease in EC and soluble ions contents in soil samples at different depths comparing to soils irrigated with non-magnetized water. The amount of available Fe, Cu, Zn and Mn in different layers of the studied soil profiles were slight increase in soil irrigated with magnetized water compared with soil irrigated with non-magnetized water. Plant results indicated that fresh and dry weights of grape and leaves were higher in plants irrigated with magnetized ground water than those grown without magnetic treatment. Also data showed significant increase in photosynthetic pigment fractions (chlorophyll a&b) in grape leaves irrigated with magnetic water, while low chlorophyll content in leaves not subjected to magnetic treatment. Proline content increased significantly in leaves of grape after magnetic treatment. Total phenols in grape fruits increased significantly after magnetic treatment. Application of magnetic water increased significantly total soluble sugars % and total soluble solids % in grape fruits compared to grapes

irrigated with non-treated water. Irrigation with magnetized water reduced acidity % in grape fruits. Also data indicated that irrigation of grape leaves by magnetic water exhibited an increase in (macro nutrient) nitrogen, potassium and phosphorous contents and (micro nutrient) iron, manganese, copper and zinc contents compared with leaves irrigated with nonmagnetic water.
Key words: Magnetized water – saline water – soil properties – plant properties.

INTRODUCTION

Dissolved salts found in groundwater varied in their amounts and types according to the surrounding environment, water sources, area of aquifer, type and composition of the layers, chemical content, type and degree of metals melting. The prospect of using magnetic technologies in agriculture is not new concept. Recently, magnetizing saline irrigation water through a proper magnetic field has been introduced as an effective mean for soil desalination (Selim, 2008). The experiments of Oleshko et al. (1981) and Takatshinko (1997), highlight the using cheap magnetic energy to improve the properties of soil and water quality. Takatshinko (1997) stated that the possibility of using magnetized water to desalinate the soil is accounted for the enhanced dissolving capacity of the magnetized water, which has been registered repeatedly; moreover, magnetized water could improve plant growth and enhance its productivity, he added that magnetized water removed 50 % to 80 % of soil Cl-, compared to a removal of 30 % by normal irrigation water. Also Zhu et al. (1986) reported that laboratory tests showed that desalination of a saline soil was 29 % greater in the first leaching and 33 % greater in the second leaching with magnetized water compared to untreated water.

Al-Busaidi and Ullman (2014) examined the effect of applying magnetic technologies to improve water productivity of soil irrigated by saline groundwater; they found that soil physiochemical properties were improved in which the magnetized water increased the solubility of minerals and therefore improved the transfer of nutrients to plant.

ELshokali and Abdelbagi (2014) found that crops irrigated with magnetized water exhibited remarkable increases in elements concentration compared to crops using normal water, in addition to the increasing of products at harvest. Under Egyptian condition, application of magnetic technologies is new concept.

Hilal and Hilal (2000) reported that full wheat germination of 100 % was obtained after 6 days for magnetic treatment compared to a rate of 83 % after 9 days for normal practice. Also Moussa (2011) found that utilization of magnetized water (30 mT) can led to improve quantity and quality of common bean crop, suggesting that magnetic water could stimulate defense system, photosynthetic activity, and translocation efficiency of photo assimilates in common bean plants. Al-Khazen et al. (2011) results have shown that irrigation with magnetically treated water (MTW) can be considered as one of the most valuable modern technologies that can assist in saving irrigation water and reducing salt accumulation in plants.

Ahmed-Ibrahim (2013) results showed that magnetic treatments improved fresh and dry weights of Tomato plant compared to control; he mentioned that utilization of magnetized water technology may be considered a promising technique to improve Tomato yield productivity. Grapevines cultivation area in Egypt has developed progressively in the last few years.

More than a great of this area is concentrated in the new reclaimed soils where grapes have recently become a key component of Egyptian horticultural exports (Ahmed et al, 2013). Therefore, the present study was carried out to examine the effect of magnetically treated saline ground water on some characteristics of grape fruit, leaves and some soil chemical properties.

MATERIALS AND METHODS

Soil sampling and analysis: Soil samples were chosen from sites representing areas irrigated with two different sources of irrigation water located in El-khatatba farm. The first site was irrigated with saline magnetic ground water (treated well) after magnetization through passing in magnetic device (6 inch, output 130 m3 per hour, 0.7 T, made in Germany). The second site was irrigated with un treated well. In each site, three soil profiles were dug to the depth of 90 cm and soil samples were collected from successive depths (0-30, 30-60 and 60-90 cm). Samples were collected in polyethylene bags and sealed by twisting and tying the neck. Soil samples were air dried, crushed and finely ground, through a (1) mm for pH, EC, Soluble ions as well as chemically available forms of some heavy metals determination. Soil general characteristics were determined using the standard methods by Jackson (1958) and Black (1982). Available metals content was extracted with DTPA solution from soil according to Lindsay and Norvell (1978). Thereafter, the concentrations of heavy metals in the clear extracts were measured using Inductively Coupled Plasma-Emission Spectrometry (ICP-OES).

Plant sampling and analysis: Samples of grape (Vitis Vinifera) fruits and leaves were collected in 2014 from El-khatatba farm to study the effect of irrigation with saline magnetic ground water on fresh and dry weights, chlorophyll a and b contents of leaves that determined spectro photometrically according to method described by Maron (1982). Total phenols were determined by using Folin and Ciocalatue method (A.O.A.C. 1970). Total soluble sugars expressed as glucose were determined calorimetrically according to the method of Dubois et al. (1956). Total acidity as gm of anhydrous citric acid determined and estimated per 100 ml fruit juice, according to A.O.A.C. (1990) methods. Fruit juice total soluble solids percentage (TSS %) was determined using Car Zeiss hand refractometer. Nitrogen content was determined by the modified micro-kjeldahl method as described by plummer (1971). Phosphorus content determined colorimetrically according to method described by Jackson (1958). While potassium contents determined by flame-photometer according to Piper (1950). Iron (Fe), Manganese (Mn), Cupper (Cu) and Zink (Zn) were digested according to Tolg (1974) then determined as mg/100g using Inductively Coupled Plasma-Emission Spectrometry (ICP-OES). Proline content was colorimetrically estimated in fresh samples of the middle leaves according to Batels et al. (1973).

Statistical analysis: The mean ± standard deviation calculated for each parameter in soil and plant samples and analysis was conducted using SPSS program Version 20 (Levesque, 2007). A student test (t-test) was done to examine the significance between magnetic and non-magnetic water treatments of all characters for plant samples under study at the significance level of 0.05.

Table(1): The physico-chemical parameters of irrigation water before, after passing on magnetic field and untreated water

Site name / Parameters	El-khatatba		
	Water sample from treated well before passing on magnetic field.	**Water sample from treated well after passing on magnetic field.**	**Water sample from un treated well**
pH	7.64	7.8	7.61
EC dS/m	4.64	4.37	4.39
TDS mg/l	2969	2797	2809
Cl^- mg/l	930.4	909.8	954.7
SO_4^{-2} mg/l	610.12	577	573.4
CO_3^{-2} mg/l	0	0	0
HCO_3^- mg/l	180	180	182
B mg/l	0.585	0.555	0.558
Ca^{+2} mg/l	289.12	264.66	247.3
K^+ mg/l	10	10	8
Mg^{+2} mg/l	91.61	90.88	85.54
Na^+ mg/l	520	500	535
SAR	6.80	6.74	7.45

RESULTS AND DISCUSSION

Effect of magnetic treatment of saline water on some chemical properties of soil samples:

Data in Table 2 show that irrigation with magnetized water led to a decrease in pH values in soil samples at different depths when compared with soil irrigated with non-magnetized water these results were agree those obtained by Maheshwari and Grewal (2009) they reported that decrease in soil pH which irrigated with magnetized water may be a relatively greater soil acidification due to the release of greater organic acids in the rhizosphere by plants irrigated with magnetically treated water compared with plants irrigated with water without magnetic treatment. Organic acids released in rhizosphere may be responsible for desorption of nutrients, and thus making these nutrients more available to plants. Values of electrical conductivity, soluble anions Cl-, SO4-2 and HCO3- and cations Na+, Mg+2, Ca+2 and K+ concentration presented in Table 2 show their distribution through successive soil layers which irrigated with magnetized and non-magnetized water from El-khatatba farm. Data show that irrigation with magnetized water led to a decrease in EC and soluble ions contents in soil samples at different depths comparing to soils irrigated with non-magnetized water. These results were agreeing with those obtained by Mostafazadeh-Fard *et al*. (2012) they reported that soil moisture contents, at different soil depths, were greater for the magnetized irrigation water treatment. Higher soil moisture contents increase soil salt leaching and reduce soil salt concentration. The reason that under magnetized conditions, water molecules were influenced by the hydrogen bonds and Van der Waals forces, were in reactions with the ions, were released, and make the water more cohesive. Therefore, the water molecules easily attach to the soil particles and do not move to the lower soil depths and the water molecules easily penetrate into the microspaces of soil particles and are prevented from moving to the lower soil depths. Data also agree with Hilal *et al.* (2002) who stated that magnetized water increase the leaching of excess soluble salts, lower soil alkalinity, and dissolve slightly soluble salts such carbonates, phosphates and sulfates.

Srivastava *et al.* (1976) studied the effect of solubility of NaCl and Na2CO3 salts in magnetized water and proposed that use of magnetized water for leaching of saline or alkaline soils.

Data in Table 3 show the amount of available Fe, Cu, Zn and Mn in different layers of the studied soil profiles were slight increase in soil irrigated with magnetized water compared with soil irrigated with un magnetized water. Down the movement of minerals, probably due to the effect of acceleration of the crystallizations and precipitation processes of the solute minerals as reported by Noran *et al*. (1996). Also Hachicha *et al.* (2016) reported that electromagnetic treatment of saline water may be influencing desorption of K from soil adsorbed on colloidal complex, and thus increasing its availability to plants, resulting in an improved plant growth and productivity.

Table (2): Electric conductivity dS.m-1 and soluble ions meq.L-1 in soil samples

Area	Depth (cm) pH (1:2.5) Susp.	EC dS.m-1	Ca+2	Mg+2	Na+	K+	Cl-	SO4-2	HCO3-
Soil Irrigated with un magnetized water from El-khatatba farm	0-30 8.10±0.2	2.97 ±0.015	5.05 ± 0.015	2.98 ±0.01	20.14 ±0.03	1.53 ±0.02	18.82 ±0.025	3.97 ± 0.02	6.82 ±0.015
	30-60 8.05±0.1	1.301 ±0.01	2.21 ±0.015	1.31 ±0.015	8.82 ±0.04	0.67 ±0.01	8.25 ±0.015	1.73 ± 0.016	2.99 ±0.026
	60-90 7.95±0.03	0.888± 0.003	1.51± 0.006	0.89± 0.01	6.02± 0.03	0.46±0.01	5.63±0.02	1.17±0.01	2.04±0.01
Soil Irrigated with magnetized water from El-khatatba farm	0-30 7.86±0.1	1.269 ±0.01	2.16 ±0.015	1.27 ±0.01	8.61 ±0.025	0.65 ±0.01	8.04 ±0.025	1.68 ±0.015	2.91 ±0.015
	30-60 7.84±0.01	0.933 ±0.01	1.59 ±0.015	0.94 ±0.002	6.33 ± 0.025	0.48 ±0.006	5.91 ±0.03	1.23 ±0.025	2.14 ±0.02
	60-90 7.76±0.03	0.673 ±0.002	1.14 ±0.02	0.68 ±0.005	4.56 ±0.03	0.35 ± 0.02	4.27 ±0.025	0.88 ±0.01	1.54 ±0.02

Data in Table 3 show the amount of available Fe, Cu, Zn and Mn in different layers of the studied soil profiles were slight increase in soil irrigated with magnetized water compared with soil irrigated with un magnetized water. Down the movement of minerals, probably due to the effect of acceleration of the crystallizations and precipitation processes of the solute minerals as reported by Noran *et al.* (1996). Also Hachicha *et al.* (2016) reported that electromagnetic treatment of saline water may be influencing desorption of K from soil adsorbed on colloidal complex, and thus increasing its availability to plants, resulting in an improved plant growth and productivity.

Table (3): DTPA-extractable heavy metals in the studied soils (mg. kg-1).

Areas	Depth (Cm)	Fe	Cu	Zn	Mn
Soil Irrigated with un magnetized water from El-khatatba farm	0-30	8 ± 0.2	0.58 ±0.03	0.823 ±0.007	2.12 ±0.1
	30-60	6.89 ±0.05	0.41 ±0.025	0.366 ±0.004	1.56 ±0.03
	60-90	5.23 ±0.1	0.32 ±0.01	0.163 ±0.002	1.45 ±0.05
Soil Irrigated with magnetized water from El-khatatba farm	0-30	9.2 ± 0.2	0.99 ±0.025	1.07±0.02	3.25± 0.03
	30-60	8.5±0.1	0.92 ±0.01	0.84 ±0.015	3.15±0.025
	60-90	6.15± 0.05	0.65 ±0.006	0.233 ±0.006	2.29±0.015

Effect of magnetized water on some characteristics of grapes and nutrients content in leaves:

<u>Leaves fresh and dry weight:</u> Data in Table 4 showed that fresh and dry weights of grape leaves were higher in plants irrigated with magnetized ground water than those grown without magnetic treatment; in this aspect Abou El-Yazied *et al*. (2012) found that tomato plants height and fresh weight were higher in plants grown with magnetic treatments; they observed that vegetative characteristics increased linearly in response to NPK fertilizer levels. Our results are also in line with those of De Souza, *et al*. (2006) and

Moussa (2011) who observed that pretreatment of seeds with magnetic field or irrigation with magnetic water increased leaf, stem and root fresh and dry weight of tomato and common bean respectively. Similar enhancing effect of magnetized irrigation water was reported on snow pea and chick pea (Grewal and Maheshwari, 2011), flax and lentil and wheat (El-Sayed, 2014); who reported that positive effects of magnetized water were observed on growth of root, stem and leaf of cowpea since they appear to induce an improved capacity for nutrients and water uptake; providing greater physical support to the developing shoot (Sadeghipour and Aghaei 2013) Better root growth and development in young seedlings might lead to better root systems throughout the lifetime of a plant (De Souza, *et al.* 2006).

Leaves Chlorophyll- a and b: Results in Table 4 showed significant increase in photosynthetic pigment fractions (chlorophyll a & b) in grape leaves irrigated with magnetic water, while low chlorophyll content in leaves without magnetic treatment might be attributed to the adverse effects of salinity on total chlorophyll due to its negative action on interrupting and reducing water availability and nutrients particularly magnesium (Abdul Qados and Hozayn, 2010), where Magnesium ions are found in the center of chlorophyll molecules, and as chlorophyll is an essential component in the reaction of photosynthesis, which produces energy for growth, magnesium ions are therefore essential (Bohn, *et al*. 2004); similar results recorded by Hozayn and Abdul Qados (2010) in chickpea plants irrigated with magnetized water compared to control treatment; they mentioned that these results may be due to the effect of magnetic field on alteration the key of cellular processes such as gene transcription which play an important role in altering cellular processes. On the same line, El-Sayed (2014) observed that irrigation of broad bean plant with magnetic water exhibited marked significant increase in the chloroplast pigments (chlorophyll a, chlorophyll b and carotenoids), photosynthetic activity, over the irrigated by tap water (control).

Proline contents in leaves: In the present study the results in Table 4 reported that proline content increased significantly in leaves of grape after magnetic treatment. These results cope with those of El Sayed and El Sayed (2014) who reported that magnetic water irrigation increased proline accumulation in sunflower and broad bean plants. Moreover, the protein, amino acids, proline contents increasing in broad bean plants irrigated with magnetic water more than irrigated with tap water may be responsible for the stimulation of growth. These results are in line with Hozayn and Abdul Qados (2010).

Total phenols in fruits: Results in Table 4 showed a primitive effect of magnetic water treatment on total phenols in grape fruits; the improvement observed in grape fruits after magnetic treatment may be attributed to the role of magnetized water in changing the characteristic of cell membrane, effecting the cell reproduction and causing some changes in cell metabolism (Goodman et al., 1995; Atak *et al*., 2003).In this aspect, Balouchi and Sanavy (2009) reported that the magnetic field influences the structures of cell membranes and in this way increases their permeability and ion transport through the ion channels, which then affects various metabolic pathway activities.

Total Soluble sugars, total acidity and total soluble solids % in fruits:

Results in Table 4 showed that application of magnetic water increased significantly total soluble sugars % and total soluble solids % in grape fruits compared to those irrigated with non-treated water, in correspondence to these findings, results obtained by El-Sayed and El-Sayed (2014) who found that total available carbohydrates (Monosaccharide, Disaccharides, polysaccharides) contents increased significantly in broad bean irrigated with magnetic water and attributed that to the close relationship between stomatal conductance and photosynthesis, thus lead to an increase in photosynthesis and added that the effects of magnetic exposure on plant growth still require proper explanation; they may be the result of bioenergetics structural excitement causing cell pumping and enzymatic stimulation as reported by De Souza *et al* (2006). Similar findings obtained by Aly *et al.* (2015) who found that magnetic water treatment increased total sugars %, vitamin C % and total soluble solids (TSS) in Valencia orange as compared with nonmagnetic water and added that total sugars, vitamin C % and total soluble solids% increased as a result of the mode of action of magnetized water which caused an increase of nutrients observation from the soil and increases the efficiency of transpiration of these nutrients inside the plants; these results were in harmony with those detected by Abd El-All *et al.* (2013).As for acidity % data revealed that magnetized water reduced acidity % in grape fruits. This result was in the same line with finding by Ismail *et al.* (2010) who found that, the application of 71.5 gm. Magnetite/ tree on grapevine grown in a newly reclaimed area was more effective in achieving the best values of both length and diameter berry, gave low total acidity in juice.

Table (4): Effect of irrigation with magnetized water on some characteristics of grapes and tangerine crops.

	Crop name & Location	
	El-khatatba farm	
Character	**Grapes Irrigated with magnetized water**	**Grapes Irrigated with un magnetized water**
Leaves fresh weight (gm)	15.6 ±0.06	12.91 ±0.01
Leaves dry weight (gm)	4.98 ±0.05	3.62 ±0.03
Leaves chlorophyll-a (mg/100gm fresh weight)	179.9 ±0.3	135.1 ±0.5
Leaves chlorophyll-b (mg/100gm fresh weight)	118.4 ±0.5	80.4 ±0.1
Proline in leaves g/100g	0.179 ±0.005	0.078 ±0.001
Total phenols% in fruits	1.094 ± 0.001	0.771 ±0.004
Total soluble sugars% in fruits	18.76 ± 0.03	17.39 ± 0.02
Acidity% in fruits	0.017 ±0.001	0.0202 ± 0.002
TSS %	20.8 ±0.1	20.1 ± 0.2

Nutrients content in plant leaves: The macronutrients include nitrogen (N), potassium (K) and calcium (Ca). The micronutrients include iron (Fe), zinc (Zn), manganese (Mn) and copper (Cu). Data presented in Table 5 indicated that irrigation of grape leaves by magnetic water exhibited an increase in nitrogen, potassium and phosphorous contents compared with leaves irrigated with nonmagnetic water; similar results recorded by El-Sayed (2014). In the same aspect, Aly et al. (2015) found that magnetic water caused an increase in nitrogen%, phosphorus %, potassium%, calcium % and magnesium % in leaves of Valencia orange, and attributed this increase to the magnetic water treatment that showed higher values for mobile forms of nitrogen, and improved the dissolve of fertilizers in the soil irrigated with magnetized water and increase in the rate of water absorption, moreover they explained the results by the variations induced by magnetic fields in the ionic currents across the cellular membrane which leads to change in the osmotic pressure, our findings were also in accordance with those obtained by Taia et al. (2007); & Maheshwari & Grewal (2009); Abou El-Yazied *et al*. (2012) and Abd El-All et al. (2013). On the other hand, irrigation with magnetically treated water leads to a decrease in leaves sodium content this was explained by Al-Khazen *et al.* (2011) who mentioned that sodium is paramagnetic element which has a small, positive susceptibility to magnetic fields while other elements are diamagnetic which are slightly repelled by a magnetic field. Also data in Table 4 showed that application of magnetic water increased iron, manganese, copper and zinc concentrations in grape leaves compared with nonmagnetic water. Similar results obtained by Aly *et al.* (2015) who mentioned that magnetic treatment of irrigation water is an acknowledged technique for achieving high water use efficiencies due to its effect on some physical and chemical properties of water and soil. These changes result in an increased ability of soil to get rid of salts and consequently better assimilation of nutrients and fertilizers in plants during the vegetative period.

Table(5): Macro and Micro elements in plant leaves

Element	Crop name & Location	
	El-khatatba farm	
	Grapes Irrigated with magnetized water	Grapes Irrigated with un magnetized water
N %	0.513±0.003	0.404 ± 0.002
P %	0.439± 0.005	0.38± 0.003
K %	0.685± 0.002	0.546 ± 0.004
Fe mg/100g	82.35±0.3	76.09±0.2
Mn mg/100g	14.41±0.03	12.58± 0.05
Zn mg/100g	12.69±0.05	10.885± 0.03
Cu mg/100g	6.98±0.02	5.672±0.01

CONCLUSION

It appears that utilization of magnetized water technology may be considered a promising technique to improve grapes characteristics. The results obtained also concluded that the use of magnetic techniques with low quality water is very important for irrigation without any expected problems in the soils and plant.

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أثر استخدام المياه الجوفية المالحة المعالجة بالمجال المغناطيسي على التربة ومحصول العنب

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المستخلص

الهدف من هذة هو دراسة تقييم أثر استخدام أحد الأنظمة الحديثة المستخدمة في معالجة ملوحة المياه الجوفية ودراسة تأثير المياه قبل وبعد المعالجة على التربة والنبات. واجريت هذة الدراسة خلال عام ٢٠١٤ حيث تم أخذ العينات من مزرعة في الخطاطبة (مدق ابو العزم–طريق الاسكندرية الصحراوى، المنوفية، مصر). حيث تم عمل قطاعات أرضية لعمق ٩٠ سم وأخذت عينات من الأراضي المروية بمياه معاجة بالمجال المغناطيسي على اعماق (٠–٣٠، ٣٠–٦٠، ٦٠–٩٠ سم). كما تم أخذ عينات على نفس الأعماق من أراضي مروية بمياه غير معالجة.كذلك تم أخذ عينات نبات وكانت (عنب من مزرعة الخطاطبة) من أراضي مروية بمياه معالجة وأخرى من أراضي مروية بمياه غير معالجة.

وقد تم إجراء التقديرات المختلفة على كل من والتربة والنبات

أولا: عينات التربة: تم تقدير كل من درجة التوصيل الكهربي والأس الهيدروجيني والكاتيونات والأنيونات الذائبة والصورة والميسرة للعناصر الثقيلة.

ثانيا:عينات النبات: تم تقدير كل من الوزن الرطب والوزن الجاف لأوراق النبات ومحتوي الورقة من الكلوروفيل (أوب) ونسبة البرولين في الورقة والسكريات الكلية الذائبة والفينولات الكلية للثمار ونسبة الحموضة في الثمار ومحتوى الأوراق من العناصر الصغرى والكبرى.

ويمكن تلخيص ما تم استنتاجه في النقاط التالية:

أولا: عينات التربة: اظهرت النتائج ان قيم الأس الهيدروجيني في الاراضي المروية بالمياة المعالجة بالمجال المغناطيسي قد انخفضت في جميع الأعماق مقارنة بالأراضي المروية بالماء غير المعالج.

كانت قيم ال (EC) والأيونات الذائبة في الأراضي التي تروى بالمياه المعالجة بالمجال المغناطيسي اقل منها في الأراضي التي تروى بالمياه الغير معالجة وذلك خلال الأعماق المختلفة.

وجد أن نسبة (النحاس، الحديد، المنجنيز و الزنك) الميسرة أعلى في الأراضي التي تروى بالمياه المعالجة بالمجال المغناطيسي مقارنة بالأراضي التي تروى بالمياه الغير معالجة.

ثانيا: عينات النبات: ظهرت النتائج أن الأوزان الجافة ومحتوى ألأوراق من (كلوروفيل أ و ب) ومحتوى البرولين الورقى والفينولات الكلية والسكريات الذائبة الكلية والمواد الصلبة الذائبة الكلية تزيد في العنب المزروع في الأراضي التي تروى بالماء المعالج بالمجال المغناطيسي بالمقارنة مع تلك المروية بالماء غير الممغنط. كذلك اظهرت النتائج زيادة في محتوى المغذيات الصغرى والكبرى في أوراق النبات حيث أشارت النتائج إلى أن ري أوراق العنب بالماء الممغنط أظهر زيادة في محتوياتالنيتروجين والبوتاسيوم والفوسفور مقارنة بالأوراق المروية بالماء الغير ممغنط وكذلك يزيد تركيز كل من الحديد والمنجنيز والنحاس والمنجنيز عند الري بالما المعالج بالمجال المغناطيسي.

الكلمات الدالة: الماء الممغنط – الملوحة – خواص التربة – خواص النبات