

## Using Magnetic Water Technique in Fertigation Process

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### ABSTRACT

Recent research indicate that, it is possible to obtain many positive effects on water quality that improve water use in done by using magnetic water technique an devies 15000 Gaus the effectiveness of magnetic flux density were 300-400 meter. This work in using magnetization fertigation process was carried out to investigate soil moisture distributions under three soil layers depth of 10, 20 and 30 cm. The effect of water source electrical conductivity (Ec) and on root mass, leaf area and green leaf mass was investigated. The results indicated that: 1- There were a lot of differences in soil moisture content through soil layers increasing in the upper layers of soil for layer (10-20 cm)., Also the effect of magnetized increases in soil moisture content when the distance to magnatic device less than 200 m. 2- The magnetized process decreasing water sours Ec from 4691.1 to 4467.2 ppm. 3- There were a significant percentage increase (62.7,10.61 and 26.11) and (78.7,16.98 and38.29) in leaf area, leaf green mass and root mass when the magnetic instrument at distances of 200 and 50 m away from the target area.

### INTRODUCTION

Based on salinity hazard: low, medium, high and very high irrigation water is classified into these four categories and the level of management needed for utilization as an irrigation source.

Calcium and magnesium salts dissolved substances found in water that cause the hardness of water. The water quality limits its use because of this water quantity and quality is inseparable. The cost for treatment, management and water scarcity problem will be increasing because of deterioration of water quality.

Marshutz (1996) referred to that beginning in 1863 Michael Faraday was the first researcher who seriously dug into magneto chemistry. The subject of magnetically treating water was labeled "gadgets" and "not sustainable under scientific scrutiny" and had become extremely controversial. Where, Parsons *et al.* (1997) argued that it is important for irrigation use of recycled water, low salinity water, and medium salinity water because of the limited water resources, better use of available water resources.

Magnetized water can be used to reclaim soil and water and to reduce soil moisture stress that is when we use poor-quality irrigation water with high salinity because it is one of the main problems in agriculture. So generally, higher salinity levels can be used on sandy soils where salts can be easily flushed compared to similar values on poorly draining clay soils which may cause problems. Under typical summer stress growing conditions, EC of irrigation water should ideally not exceed 1.25 dS/m soluble salts. Salinity levels above 3.0 dS/m are unsuitable for any length of time as an irrigation source (Camberato, 2001).

Because of the limited water resources, better use of available water resources and use of recycled water with low and medium salinity for irrigation is important. The one of the main problems in agriculture is using poor-quality irrigation water with high salinity. Magnetized water can be used in order to reclaim soil and water and to reduce soil moisture stress, (Kney and Parsons, 2006).

Maria (2007) said that the natural water usually contains dissolved calcium and magnesium salts. There are two types of hardness: permanent hardness and temporary hardness. Permanent or non-carbonate hardness is associated with  $MgCl_2$ ,  $CaCl_2$ ,  $MgSO_4$ . Temporary or carbonate hardness is due to the presence of  $Ca(HCO_3)_2$  and  $Mg(HCO_3)_2$ . Non-carbonate hardness and carbonate hardness together are called total hardness of water.

IWMI (2008) reported that the world in 2025 can divided, according to water scarcity status into categories of (1) no areas and (2) economic areas, these riches in water income relative to use is less than 25% of rivers' water only for human purposes, but economic malnutrition exists. (3) approaching physical areas, more than 60% of only river flows allocated. Finally (4) physical areas, more than 75% of river flows are allocated for agriculture, industries and domestic purposes. Egypt found as a one of countries in category of physical water scarcity.

Water structure and some physical characteristic such as density, salt solution capacity and deposition ratio of solid particles will be changed when the water passes through the magnetic zone (Pang and Deng, 2008).

McMahon (2009) stated that the magnetic water is an environmentally friendly, inexpensive and water treatment that has small installation fees. The effect of magnetization of water is the subject of controversial debate. Where, Lower (2009) found that the magnetic force can break apart water clusters into single molecules or smaller ones. Therefore, the activity of water is improved.

Abou-Ali and Kheir-El-Din (2010) mentioned that due to increasing water scarcity enlargement of the cultivated area is not likely to continue at significantly high rates. The cropping pattern evolved towards more diversification. Contribution of fruits and vegetables to agricultural production, particularly in newly reclaimed lands, increased at the expense of traditional field crops. Cropped area of fruits and vegetables rose from 3.1 and 9.3 % in 1980 to 8.5 and 13.1 % respectively in 2007, while the area of field crops receded from 87.6 to 78.3 %.

Magnetized water is obtained by passing water through the permanent magnet installed in or on a feed pipeline (Behrouz *et al.*, 2011).

Pang *et al.* (2012) found that the increase in electrical conductivity of water under influence of a magnetic field is concerned, it is due to the increase of shift speed of charge particles, for example, hydrogen ions ( $H^+$  or protons), or  $H_3O^+$  and  $OH^-$  from one to other molecule in water under action of the magnetic field.

Hassan (2015) said that resources of water uses in Egypt about 127%, it is used for imported food, virtual water and other products about 27%. Egypt will need of 20% more water at 2020 to assist the population increase and their demand "Ministry of Water Resources and Irrigation reported".

**The aims of using magnetization fertigation study were:-**

Investigate soil moisture distributions under three soil layers depth of 10, 20 and 30 cm, evaluate the effect of magnetic water technique on electrical conductivity water source (Ec), and identified the effect of magnetic water on root mass, leaf area and leaf green mass.

**MATERIALS AND METHODS**

**Materials**

A-field (400\*300m) designed for drip irrigation system under the citrus pump discharge of 80 m<sup>3</sup> /h, the main pipe diameters ranged from 125 mm to 75 mm and the sub main ranged from 63 mm to 32 mm. Finally the laterals from the (LDPE) 16 mm. The layout for drip irrigation systems was using out-line dripper each delivering (8 l/h) as shown in Fig (1). Magnetic instruments (Made in USA) Specification shown in table (1).

**Table 1. Magnetic instruments specification**

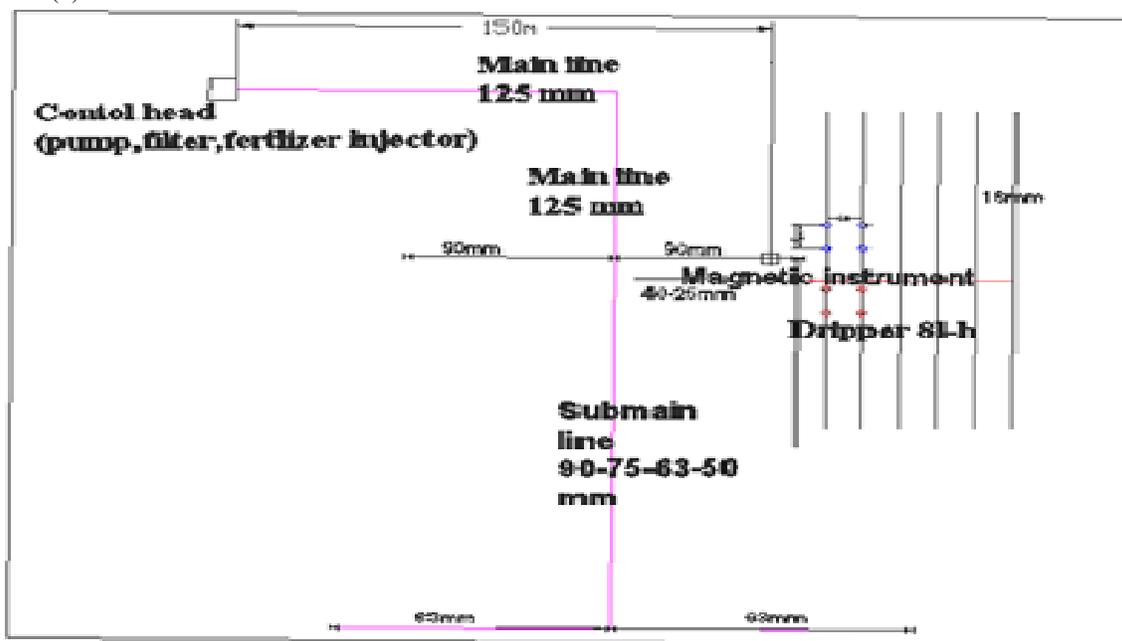
Length	1.0	Meter
Diameters	4	Inch
The magnetic efficiency length	300-400	Meter

The magnetic instrument installs 150 m after control head in the main line which have 90 mm diameter.

Soil and water analysis for the experimental area at Cairo-Alex desert road were identified as shown in tales 2 and 3. Random samples from three soil layers at depth (0-20, 20-40 and 40-60 cm) were collected from the experimental site also water samples were collected from the main water source after pump operation two hour later.

**Table 2. Soil physical and chemical analysis:**

Soil Layer. cm	Soil texture	Field capacity (%)	Wilting point (%)	Bulk density	pH	Ec (ds/m <sup>1</sup> )
0-20	Sand	10.7	3.1	1.62	7.65	2.16
20-40	Sand	12.1	3.5	1.59	8.17	0.78
40-60	Sand	11.9	3.5	1.58	8.12	1.01



**Fig. 1. Layout of the experiment**

**Table 3. Irrigation water analysis:**

PH	Ec (Ds/m)	TDS (PPM)	SAR	Cations (mg/L)				Anions(mg/L)			
				Ca++	Mg++	Na+	K+	Hco-3	So4-2	co++	CL-
7.0	7.06	4518	8.25	18.8	13.2	33.0	0.25	2.8	15.85	0	46.6

**Fertilizer program**

- Ammonium sulphat and Ammonium nitrate were used week /week for the citrus plant through the period of plant development from April 2018 to September 2018 the amount of every dose is 25 kg /fed through drip irrigation system at the last quarter of irrigation time.

**D- Irrigation time schedule according to wheather parameter**

Time	Month					
	April	May	Jun	July	Aug	Sept
7 Am (Hour)	1	1	1	1	1	1
4 Pm (Min)	--	15	30	45	1	45

**D-Leaf area**

- The measuring of leaf area conducted using Digital plamimeter PLACOM KP-90 N, made in Japan No 51200. Accuracy within +0.2 % (within 2/1000 pulses)

**RESULTS AND DISCUSSION**

**1- Effect of magnetization process in soil moisture content**

Fig. (2) showed that the relationship between soil moisture content (%) and soil layers depth (10,20,30 cm) at the continuously magnetic flux density(15000 Gaus).The Fig. (2-a) showed that experimental blat at the distances 200 m after magnetic instrument, the Fig (2-

b) at distances of 50 m after magnetic instrument and the Fig. (2-c) showed the non-magnetic measurements. All figs indicated that as soil depths (10,20,30 cm) increased the moisture content decreased after magnetic treatments for both distances by 7.60 %, 5.59% and 5.5% respectively for first magnetic treatments (200 m distance from magnetic device). For the second magnetic treatments 50 m distance from magnetic device water content decreased by 7.81%, 5.59 % and 5.06% respectively .But for non magnetic the decreasing was 5.73%, 5.66% and 5.45% respectively. This means that there were a lot of different in soil moisture content through soil layers increasing in the upper part of soil layers between depth 10-20 cm. Also there was an effect of magnetic device distance on soil moisture content it was increase when the distance between the of magnetic device in rang 0-50 m from this device it was 7.81 m compare with the same depth in the other measuring which (7.6, 5.73) for distance 200 m, and non magnetic measurements this will be a helpful to avoid soil salination and increasing water use efficiency by re-managing water addition. These results agree with many others (Ahmed, 2009).And this results may be due to the effect of magnetization process which effect on water preparation and effect on hydrogen bons, which gave the water the possibility of application. Also as will mention in the second part of discussion the magnetic flux density effect on water electrical conductivity be decreasing the value from 4691.2 to 4467.2 ppm.

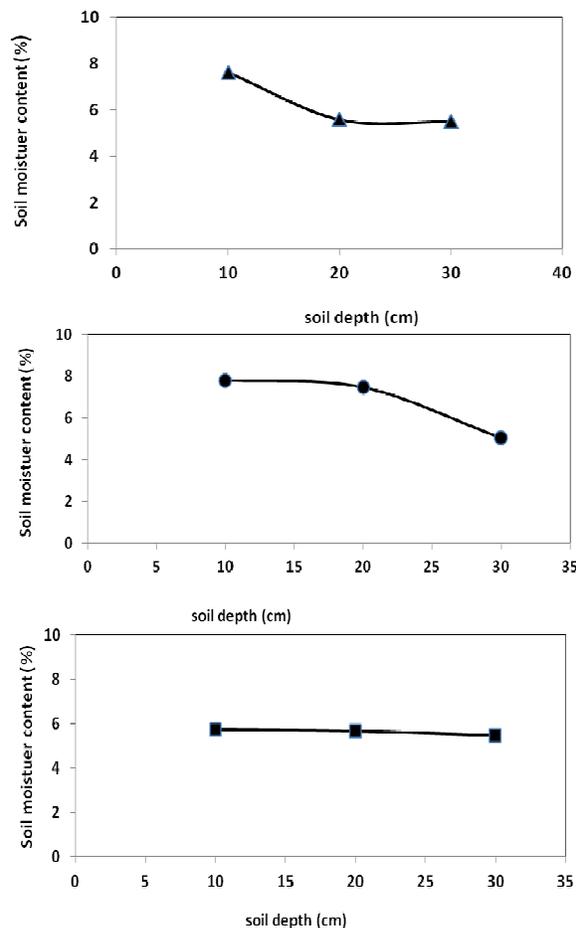
**2-Effect of magnetic process on (Water source, EC)**

Data in table (4) showed that there is a significant effect after using magnetization process in compare with non magnetic treatment in all the following electrical conductivity for water source which was 4691.2 ppm before magnetic process and 4467.2 ppm after magnetic process the decreasing in Ec value after magnetization may be due to the highly effect of magnetic flux density which re-arrange all water hydrogen bons and viscosity this results disagree with (Ahmed, 2006) who mentioned that the magnetization process increasing the Ec values .

**3- Effect of magnetization fertigation process on root mass, leaf area and green leaf mass.**

Also, the data in table (4) showed that there were an increasing in leaf area (cm<sup>2</sup>) green leave mass (gm) and root mass (gm) by using magnetic water fertigation process. The percentage ratio were (78.72, 16.98 and

38.29%) respectively at 50 m distance and 200 m distance after magnetic device were (62.70%,10.61% and 26.17%) respectively. From the previous data, it may be noticed that the point source of water after magnetic treatment affect by distance between water point source and magnetic device by other mean as distance decrease all measuring item increasing in percentage due to non magnetic treatment.



**Fig. 2. The effect of magnetic and non-magnetic process on soil moisture content under three depth from soil layers**

**Table 4. Effect of magnetic process on leave area, water source, root mass, green leaf mass).**

Treatment	Leaf area (cm <sup>2</sup> )	Water source EC (ppm)	Root mass (gm)	Green leaf mass (gm)	The ratio percentage after using magnetization process		
					Leaf area (cm <sup>2</sup> )	Root mass (gm)	Green leaf mass (gm)
Average magnetic area (1) faraway from magnetic instrument center (200m).	18.89	4467.2	29.65	52.1	62.70	26.17	10.61
Average magnetic area (2) direct after magnetic instrument center (50m).	20.75	Average water source (EC) after magnetic	32.5	55.1	78.72	38.29	16.98
		4691.2					
Average Non magnetic area.	11.61	Average water source (EC) non magnetic	23.5	47.1			

## CONCLUSION

The research recommended that to using magnatic instrument for increasing the soil moisture content at the distance to magnatic device less than 200 m, decreasing irrigation water sours Ec by 4691.1 to 4467.2 ppm and a significant percentage increase (62.7, 10.61 and 26.11 and 78.7, 16.98 and 38.29) in leaf area, leaf green mass and root mass when the magnatic instrument 50, 200 m away from the target area, respectively.

## REFERENCES

- Abou-Ali, H. and H. Kheir-El-Din (2010). Economic efficiency of crop Production in Egypt, Faculty of Economics and Political Science, Cairo University. [http://www.eces.org.eg/MediaFiles/Uploaded\\_Files/7B05B96790-F8D8-4F19-ADBF-E29D147C4D627D\\_FinalWP155.pdf](http://www.eces.org.eg/MediaFiles/Uploaded_Files/7B05B96790-F8D8-4F19-ADBF-E29D147C4D627D_FinalWP155.pdf)
- Ahmed, S. M. (2009). Effect of Magnetic Water on Engineering Properties of Concrete, Al- Rafidain Eng., 17(1):71-82. <<http://www.uom-arej.org/OldSite/files/no1/E/F-1-6-2009.pdf>>
- Behrouz, M. F.; M. Khoshravesh; S. F. Mousavi and A. R. Kiani (2011). Effects of Magnetized Water and Irrigation Water Salinity on Soil Moisture Distribution in Trickle Irrigation, J. Irrig. Drain. Eng., 137:398-402.
- Camberato J. (2001). Irrigation Water Quality, Clemson University. <[http://www.scnla.com/Irrigation\\_Water\\_Qualiy.pdf](http://www.scnla.com/Irrigation_Water_Qualiy.pdf)>
- Hassan, K. K. (2015). Magnetic Treatment of Brackish Water for Sustainable Agriculture, M.Sc. in Environmental Eng. School of Sci. and Eng., American University, Cairo, Egypt.
- IWMI (International Water Management Institute) (2008). Annual Report 2007-2008. [http://www.iwmi.cgiar.org/About\\_IWMI/Strategic\\_Documents/Annual\\_Reports/2007\\_2008/IWMI\\_AR\\_2007\\_2008.pdf](http://www.iwmi.cgiar.org/About_IWMI/Strategic_Documents/Annual_Reports/2007_2008/IWMI_AR_2007_2008.pdf)
- Kney, A. D., and S. A. Parsons (2006). A spectrophotometer-based study of magnetic water treatment: Assessment of ionic vs. surface mechanisms, Water Res., 40(3):517-524.
- Lower, S. (2009). Water Cluster Quackery, CHEM1, viewed 20, April 2009. <<http://www.chem1.com/CQ/clusqk.html>>
- Maria, O. (2007). Reducing Formation of Scale With Magnetic Descaler, Republic of Estonia. <[http://www.inepo.com/english/uplFiles\\_resim/Estonia\\_MariaOrb.pdf](http://www.inepo.com/english/uplFiles_resim/Estonia_MariaOrb.pdf)>
- Marshutz, S. R. (1996). The Art Of Scale Reduction, Journal: Plumbing, Heating and Cooling, 76(2) 00487066.
- McMahon, C. (2009). Investigation of the quality of water treated by magnetic fields, University of Southern Queensland, Faculty of Engineering and Surveying, Courses ENG4111 and 4112 Research Project: 9- 38.
- Mohamed, I. A. (2013). Effects of Magnetized Low Quality Water on Some Soil Properties and Plant Growth, Soil and Water Department, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt, Int. J. Res. Chem. Environ., 3(2):140-147.
- Mohamed, I. A. and B. M. Ebead (2013). Effect of Magnetic Treated Irrigation Water on Salt Removal from A Sandy Soil and on The Availability of Certain Nutrients, Soil and Water Department, Fac. of Agri., Suez Canal University, EGYPT, Int. J. Eng. and Applied Sci., 2 (2) : 36-44.
- Pang, X. F. and B. Deng (2008). Investigation of Changes in Properties of Water Under The Action of a Magnetic Field, Sci China Ser G-Phys Mech Astron, 51 (11) : 1621-1632.
- Pang, X. F.; B. Deng and B. Tang (2012). Influences of Magnetic Field on Macroscopic Properties of Water, Modern Physics Letters B, 26 (11) : (13 pages).
- Parsons, S. A.; B. L. Wang; S. J. Judd and T. Stephenson (1997). Magnetic Treatment of Calcium Carbonate Scale-Effect of pH, Water Research, 31(2):339-342.
- Tai, Y.; M. C. Chang; R. J. Shieh and T. G. Chen (2008). Magnetic Effects on Crystal Growth Rate of Calcite in A Constant-Composition Environment, Journal of Crystal Growth, 15 (310) :3690- 3697.
- WPT (Water Properties Tutorial) (2007). Chemistry Land. <http://www.chemistryland.com/CHM107/Water/WaterTutorial.htm>

## إستخدام تقنية الماء الممغنط على إدارة الري التسميدي

وائل محمود سلطان ، أحمد عبد العاطي حسين و نرمين سيد حسين  
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أظهرت الأبحاث الحديثة أنه من الممكن الحصول على نتائج إيجابية لزيادة خصائص المياه التي تحسن من إستخدامها عن طريق أستخدام جهاز الممغنطة بطاقة قدرها ١٥٠٠٠ جالس أيضا كثافة الفيض المغنطيسي من ٣٠٠-٤٠٠ متر. استخدمت تقنية الممغنطة والري التسميدي لدراسة تأثيرها على توزيع الرطوبة في طبقات التربة وعلى ملوحة مصدر المياه (Ec) وكذلك تأثيرها على وزن الجذر، مساحة الورقة والوزن الأخضر للورقة. وأظهرت النتائج الآتي: ١- يوجد الكثير من الاختلافات في المحتوى الرطوبي للتربة خلال طبقاتها ووجد زيادة في المحتوى الرطوبي في الجزء العلوي من طبقات التربة (١٠-٢٠ سم) عند إستخدام جهاز الممغنطة وكذلك وجد ان إستخدام جهاز الممغنطة أدى الى زيادة في المحتوى الرطوبي للتربة عندما يكون الجهاز على مسافة أقل من ٢٠٠ متر. ٢- أن عملية الممغنطة قللت من تأثير ملوحة المياه من ٤٦٧.٢ الى ٤٦٧.٢. ٣- يوجد زيادة كبيرة بنسبة (٦٢.٧ %، ١٠.٦١ % و ٢٦.١٧ %) في مساحة الورقة، وزن الورقة الأخضر وايضا وزن الجذر و بنسبة ١٦.٩٨، ٧٨.٧ و ٣٨.٣٩ عندما يكون جهاز الممغنطة على بعد ٢٠٠ و ٥٠ متر بالترتيب من المساحة المستهدفة بالماء الممغنط.