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Application of Magnetic Technologies in Correcting Under Ground Brackish Water for Irrigation in the Arid and Semi-Arid Ecosystem

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Abstract

While water on a global scale is plentiful, 97% is saline and 2.5 % is trapped in glaciers and ice, leaving only 0.75 % available in fresh water aquifers, rivers and lakes. Most of this fresh water (69%) is used for agricultural production, 23% for industrial purposes and 8 % for domestic. Under arid and semi-arid region water are scarce resource and therefore, one of the greatest challenges facing agriculture is how to sustainable management natural resources. Approximately two third of Arab Countries suffer from severe environment of arid and semi-arid zones affected by rare of fresh water and salt saline soil and under ground water. Saline soil can not be reclaimed by any chemicals, conditioners, or fertilizers.
Reclamation of these types of soils only through application enough high quality water to leach the soil thoroughly. The water applied should be low in sodium but must be fairly saline. 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. The experiment of Oleshko and Takatchenko, highlight the using cheap magnetic energy to improve the properties of soil and water quality. Moreover, the result of many experiments stated that magnetized water applied to salty soil breaks down the salt crystals twice as fast as un-magnetized water allowing the salt to be leached from soil. Under Egyptian condition, the application of magnetic technologies is new concept. Therefore, the present work were carried out at South Sinai Governorate ,over three years experiments, in saline sandy soil irrigated with under ground brackish water .The main object of the study is to evaluate the effectiveness of magnetizing under ground brackish water to increase the applicability of water for irrigation, salts accumulation in soil, mobility of nutrient elements in root zone , which are favorable to plant growth and its interact on yield and yield component characters of the tested crops (wheat, Barely and tritical).A magnetic unit for water treatment (magnetron) was installed to flow out magnetized

water through magnetic field compared with untreated water. Obtained results indicated that magnetized water induced changes in mobility of nutrient elements in root zone differed greatly from element to another according to element magnetic susceptibility .Magnetized irrigation water has also induced changes in solubility of some soil components such as $CaCO_3$ and gypsum. Magnetized irrigation water was also effect on seed germination, full seed germination of 100 % for wheat, barley and tritical after 6 days from sowing compared to a rate of 83, 86 and 86 % after 9 days from sowing for untreated one, respectively. Results also manifested that the water traveling distance must be consider. The process is lengthy and there is a cost but the cost of not beating this problem is infinity greater.

Key words: Magnetized water, Water Salinity, Germination, Cereal Crops.

Introduction

Recently the critical problems face the world is depleted water resources and increasing in food demands to cover the human needs and therefore water scarcity is being increasingly accepted as a major limitation for increased agricultural production and food security in the 21 st century .

Water on a global scale is plentiful 97 % is saline and 2.25 % is trapped in glaciers and ice, leaving only 0.75 % available in fresh water aquifers, rivers and lakes. Most of this fresh water (69 %) is used for agricultural production,23 % for industrial purposes and 8 % for domestic purposes (Prathapar,2000). Whenever good quality water is scare, water of marginal quality will have to be considered for used in agriculture.

In arid and semi- arid region sustainable agricultural development is influenced to a great extent by water quality that might be used economically and effectively in developing agriculture programs. Soil desalination at such conditions is also a crucial problem facing agriculture.

Under South Sinai Governorate, agriculture suffered from both salt-affected soil beside saline under ground brackish water contains varying amounts of dissolved salts used for irrigation.

The experiment of Oleshko et al., (1981) and Tkatchenko,(1997), Highlight the using cheap magnetic energy to improve the properties of soil and water quality. Tackashinko ,(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. He added that magnetized water removed 50 % to 80 % of soil CL^-, compared to a removal of 30 % by normal irrigation water. Zhu et al., (1986) has also reported that laboratory tests have 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.

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. Guo Liang et al., (1994),reported that magnetizing seeds is very efficient to increase the number of germinating seeds and to hasten the germination process.
However, very recently, magnetic technologies has still fact in different approaches of our live, available review on the application of magnetize seeds and water in agriculture is very limited.
herefore, the present work was carried out to study the applicability of using magnetizing seeds on seed germination and seedling emergence under laboratory and field conditions and / or saline irrigation water in evaluation yield and yield component characters of some cereal crops

Materials and Methods

The present investigation was carried out to study and evaluate the effect of magnetizing irrigation water and/or seeds on the efficiency of using saline water for irrigation of sandy soil and germination percentage. Work was lay out in two phases as follow:

1- Laboratory experiment :
Carried out to evaluate the effect of magnetic technologies on germination grains percentage as follows

a) 100 Grains of each tested crop (wheat, Barley and tritical) were passed through a magnetic funnel, 3 hours before soaking with water.
b) Magnetic grains were divided into two groups, the first one soaking with magnetic water (a magnetron model U.T.1 of 1 inch diameter was used for magnetizing water) and the other treated with the normal water
c) Grains germinated in plate contain welted cotton.
d) Data obtained compared with the data obtained from the normal treatment (control) , non treated grains and non treated water.

2- Field experiments :
Field experiments were conducted over three successive seasons during (2002/2003 – 2004/2005) to evaluate the effect of magnetizing water on the efficiency of using under ground brackish water for irrigation under South Sinai condition. Before commencement the experimental treatments, sample of soil was taken for chemical and mechanical analyses. Sample of under ground water was also taken for chemical analyses by methods described by Cottenie et al.,(1982) and Burt,(2004) . Data are presented in Table 1 and 2. The experimental design was split-split plot design. Treatments were assigned randomly in four replication according to the methods described by Gomez and Gomez,(1984). (Fig.1 illustrated the distribution of the experimental field). For magnetizing water, magnetron type U.T 6, with 6 inch diameter was used). To avoid the effect of lateral movement of irrigation water, the strips were isolated

by borders of 30 meters in width. Grains were sown in the proper sowing date and all agriculture practices were followed according to the recommendation of extension service. Irrigation system was sprinkler system, took place every 3 days.

After 45 days from sowing, plant sample was taken randomly from each plot of each treatment and dried at 70 C0 to constant weight, handily ground in porcelain mortar to avoid any source of contamination. Samples were wet-ached with a mixture of nitric, perchloric and sulfuric acid (8:1:1).Micronutrients (Fe, Zn, Mn) in the digest were measured in ppm by atomic absorption, spectrophotometer.

At harvest time, a sample of square meter (m^2) was randomly pulled from inner center of each plot for determined grain yield and sub sample of ten plants were taken for determined yield component characters.

The obtained data were statically analyzed by analysis of variance. The data of the three seasons showed nearly the same trend thus, combined analysis was done according to Gomez and Gomez, (1984). Means of the treatment were compared by the least significant difference (L.S.D) at 5% level of significance which developed by Waller and Duncan, (1969).

Table 1: Mechanical and chemical analysis of the experimental soil sites

Soil depth (cm)	pH	Salinity		Particle size distribution %				Texture	$CaCO_3$	O.M
		EC dS/m	%	Sand		Silt	Clay		%	
				Coarse	Fine					
0-30	8.60	15.0	0.96	78.2	15.1	3.3	3.4	Sand	12.3	1.45
30-60	9.1	13.5	0.87	80.9	12.4	4.0	2.7	Sand	7.0	1.11

Table2: Chemical analysis of the under ground water used in irrigation (Means)

Salinity		pH	Cations (meq/L)				Anions (meq/L)				SAR	RSC
T.S.S	EC dS/m		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$		
5168	6.46	8.0	14.67	11.37	37.42	1.1	0.0	11.47	31.05	22.11	10.37	-14.57

RSC: residual sodium carbonate

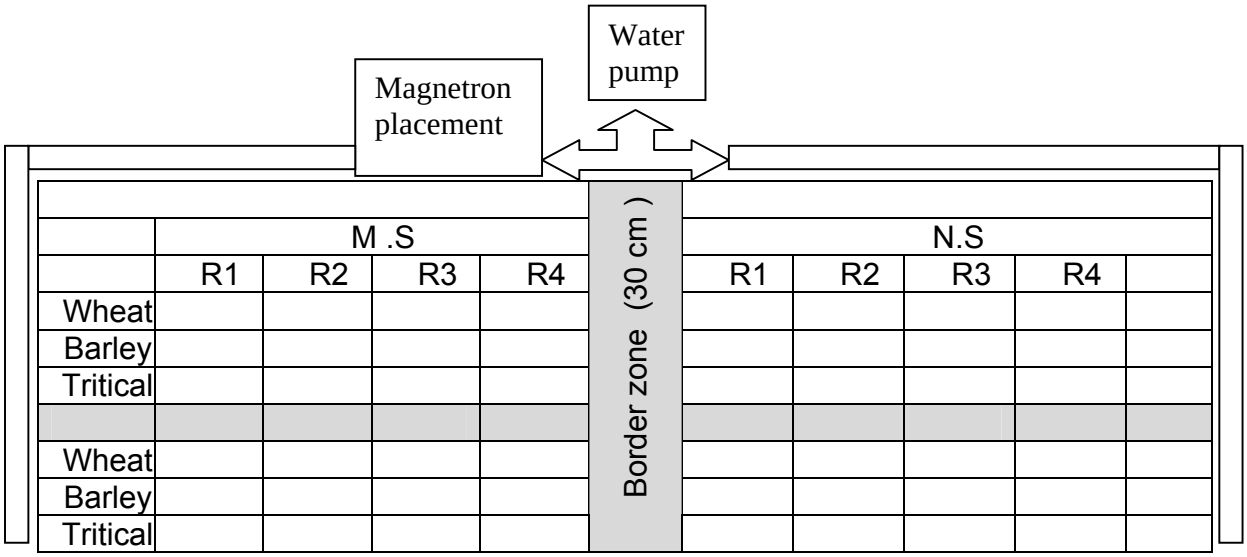

Fig 1: Layout of the experimental treatments in field

Results and Discussion

Effect of magnetic treatments on grain germination:

Many of the germinating seeds might fail to emerge especially under stress conditions. Saline soil or saline water and both are the most important factors effect on seed germination. For this reason seedling test was very important, therefore two seedling test traits were carried out in this work.

As shown in Table 3, data obtained revealed that among the different treatments tested, magnetic technologies caused significant effect on germinating seeds. Full germination rate 100 % was obtained after 9 days from sowing for magnetic water and grains together compared with 83,86 and 86 % after 12 days from sowing for the treatment of normal grains of (wheat, Barely and tritical) soaking with untreated water (control). Data also manifested that any of the magnetic treatments caused an increase in germination rate. Takashinko,(1997),reported that germinating seeds was very difficult and complex stage in seed sowing . Seeds carry various load of energy and therefore, not all of them will eventually sprout. In this regard Hilal and Hilal,(2000) , found that magnetic treatment of seeds and water caused a full germination rate of 100 % after 6 days from sowing compared to only 83% germination after 9 days from sowing for untreated wheat grains. In this regard, the conclusion of many investigators stated that the manner magnetic field affects seeds is the activation of energy influx and stimulation of metabolism. Magnetic field also decreases the effect of germination inhibitors due to increase in pH of the cell juice and can substitute for such expensive material.

Table 3: Germination percentage of some field crops in laboratory experiments as affected by magnetic treatments

Treatment	No. of Grains	Crop	Seedling counts after			Germination Percentage
			6 days	9days	12 days	
Normal grains and normal water	50	wheat	17	25	35	70
		Barley	20	30	40	80
		Tritical	28	36	40	80
Normal grains and Magnetized water	50	wheat	30	39	42	83
		Barley	35	40	44	86
		Tritical	37	40	44	86
Magnetized grains and Magnetized water	50	wheat	39	50	50	100
		Barley	38	50	50	100
		Tritical	40	50	50	100
Magnetized grains and normal water	50	wheat	28	35	44	86
		Barley	30	38	46	92
		Tritical	32	39	48	96

Data in Table 4, compares in field traits the effect of magnetic treatments of seeds and irrigation water on seedling some filed crops (wheat, Barely and tritical) grown in saline sandy soil. Results indicate that magnetization of both seeds and water has come to be the most effective treatment in seed germination as compared with control or to every treatment sole.

Regarding the effect of magnetic treatments of grains or water and both on micronutrients (Fe, Zn and Mn) concentration in digested solution of all plant organs ,data in Table (5), evident that ,in general all magnetic treatments were better than control in maximizing the concentration of Fe compared to control treatment about (79.0 %,50.0 % and 48.61 %) for wheat, barley and tritical ,respectively. The same data also showed that slight increase was detected in Zn and Mn concentration. The increment in Zn was about 28.57, 22.22 and 5.00 % for wheat, barley and tritical, respectively. Whereas, the increment in Mn was 22.80, 20.00 and 14.93 % for wheat, barley and tritical, respectively. Such effect of magnetic field may be due to weakness bonds between certain ions and thought to be a major factor affecting on their activity in soil and plant. Obtained data agree those reported by Hilal et al., (2002).

Table 4: Germination percentage of some field crops in field experiments as affected by magnetic treatments

Crop	Magnetic treatment		Seedling counts percentage after		
	Water	grains	6days	9 days	12 days
Wheat	-	-	65	70	86
		+	68	76	88
	+	-	68	79	90
		+	66	84	95
Barely	-	-	69	80	86
		+	74	82	94
	+	-	73	82	92
		+	75	84	95
Tritical	-	-	76	84	86
		+	79	84	92
	+	-	78	86	95
		+	80	89	96

Table 5: Effects of magnetic treatments on micronutrients: concentration after 45 days from sowing for some field crops (Means of three seasons)

crop	Magnetic Treatment		Micronutrient concentration (ppm)		
	Water	grains	Fe	Zn	Mn
Wheat	----	---	162	70	57
		+	260	83	62
	+	--	178	88	65
		+	290	90	70
Barely	--	-	140	72	60
		+	197	80	68
	+	-	174	79	67
		+	210	88	72
Tritical	-	-	144	73	58
		+	154	78	64
	+	-	170	80	67
		+	214	84	77

With respect to yield and yield component parameters, data given in Table (6) reveal that yield was increased due to magnetic treatments compared to untreated treatment (control). Maximum increase in grain yield was obtained by magnetized grain and water.

Table 6: Yield and yield component parameters as affected by magnetic treatments (Means of three seasons)

crop	Magnetic treatment		Yield component parameters			Yield (ton/fed)	
	Water	grains	No. of spike m^2	Spike length ,cm	No. of grains / spike	Grain	Biologica
Wheat	-	-	119	6	25	1.248	.2.483
		+	150	7	30	1.360	2.843
	+	-	160	7	35	1.387	3.045
		+	190	8	39	1.432	3.245
Barely	-	-	124	7	27	1.334	2.543
		+	155	8	32	1.465	2.897
	+	-	174	8	38	1.532	2.996
		+	200	8	40	1.688	3.231
Tritical	-	-	152	9	29	1.499	3.473
		+	168	9	31	1.594	3.564
	+	-	185	9	34	1.599	3.762
		+	220	9	36	1.653	3.896

Fed. = faddan equal 4200 m^2

According to the effect of the magnetized water on the biological and grain yield, data in the Table (6) illustrate that magnetized water more effective in increasing both biological and grain yield by about 11.8 and 9.5 %, respectively. While in case of magnetized grain, there was no significant differences (the increase were 7.0 and 6.4 for biological and grain yield after magnetized grains, respectively). According to the grain and biological yield of investigated crops, it takes the following descending order: Tritical > barley > wheat**.**

Conclusion

It can be concluded that magnetic technologies can provide better soil water plant relation and is thus worth further consideration. The process is lengthy and there is a cost but the cost of not beating this problem is infinity greater.

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تطبيقات تقنيات المغناطيسية فى معالجة مياه الآبار المالحة لأستخدامها فى الرى تحت الظروف البيئية للمناطق الجافة وشبة الجافة

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الملخص العربى

تصل نسبة المياه المالحة على سطح كوكب الارض حوالى 97 % من أجمالى حجم المياه والنسبة المتبقية والتى تبلغ حوالى 2.5 % عبارة عن مصادر مياه متجمدة او جبال جليدية وتمثل المياه العذبة الصالحة للاستخدام فقط حوالى 0.75 % وهى عبارة عن مياه الانهار والبحيرات والمياه الجوفية المختزنة فى طبقات الصخور تحت سطح الارض ويستخدم منها ما يقرب من 69 % فى الزراعة و23 % يستخدم فى الاغراض الصناعية والباقى 8 % يستخدم فى الاغراض المنزلية.وتحت ظروف المناطق الجافة وشبة الجافة حيث تندر المياه الصالحة للاستخدام ويقل معها او ينعدم سقوط الامطار تصبح المياه التحدى الوحيد والاكبر امام حسن ادارة الموارد الطبيعية لهذه المناطق .ويعيش ما يقرب من ثلثى البلدان العربية ضمن حزام المنطقه الجافه وشبه الجافه التى يغلب عليها طابع المناخ الجاف الذى يتميز بقسوتة وقلة مصادر المياه وملوحتها ان وجدت الى جانب ملوحة التربة.والارضى المالحة لم تنجح معها المواد الكيماوية فى ازالة الاملاح منها لاستصلاحها ويتطلب استصلاح مثل هذة النوعية من الاراضى اجراء عمليات الغسيل بكمية كافية من المياه العذبة عالية الجودة خالية من الاملاح وعلى الاخص املاح الصوديوم او احتوائها على كمية منخفضة جداً منها . وكان لظهور نطبيقات تقنيات المغنطيسية فى مجالات عديدة الفضل فى تشجيع بعض المشتغلين بعلوم المياه الى محاولة استخدام هذه هذه التكنولوجيا فى علاج الاضرار الناجمة عن ملوحة المياه ومحاولة استخدامها فى الرى للتوسع فى زراعة مساحات من الاراضى وكان للنتائج التى حصل عليه يورى تشينكو السبق فى فتح المجال امامك استخدام هذه التقنيات كمصدر من الطاقة الرخيصة فى تحسين خواص التربة الملحية ورفع جودة المياه المالحة . وتؤكد نتائج العديد من الدراسات ان استخدام المياه الممغنطة فى علاج الاراضى المتأثرة بالاملاح كان لة الفضل فى التخلص من بلورات بعض الاملاح من الارض ونحت بمعدل يزيد مرتين ضعف المياه غير الممغنطة مما ساعدعلى سرعة غسيل التربة من الاملاح .وتحت الظروف المصرية أجريت حديثاً عدد من التجارب على استخدامات تقنيات المغنطيسية فى مجالات عديدة منها الزراعة . لذلك أقيمت الدراسة الحالية فى تجربة معملية وحقلية لمدة 3 سنوات فى ارض رملية متأثرة بالاملاح واستخدم فى الرى مياه الآبار المتوسطة

الملوحةبمنطقة الطور محافظة جنوب سيناء بهدف دراسة تقيم معاملة مياه الآبار المالحة بالمغنطيسية (عن طريق امرار المياه المالحة خلال حقل مغنطيسى (مجنترون)) ومتابعة التأثير على ملوحة التربة وتأثر نمو النباتات المنزرعة تحت ظروف هذه المنطقة ومدى انعكاس ذلك على كمية المحصول ومكوناتة واختير فى هذه الدراسة زراعة بعض محاصيل الحبوب الشتوية (القمح ، الشعير،التريتكال)مع تثبيت جميع العمليات الزراعية الاخرى التى تجرى تحت ظروف منطقة الزراعة والعامل الوحيد المتغير هو معاملة المياه المستخدمة فى الرى حيث قسمت الى فسمين الاول استخدام مياة الابار المالحة مباشرتاً والقسم الثانى استخدام مياه الابار بعد تمريرها على جهاز المجنترون لاكسابها المغنطيسية. أظهرت النتائج المتحصل عليها ان الرى بالمياه الممغنطة أحدث تأثير ايجابى على نسبة الانبات حيث تكامل الانبات للمحاصيل الثلاثة المنزرعة 100 % بعد 6 ايام من الزراعة مقارنة بالمعاملات التى رويت بالمياه مباشرة دون معالجة والتى أظزهرت نسب انبات 83 ،86،86 لكل من القمح والشعير والتريتكال على التوالى .كما تأثر المحصول الناتج وكذلك مكونات المحصول .كما أظهرت الدراسة ان المسافة التى تقطعها المياه الممغنطة لها تأثير على قوة وفعالية المياه والذى تضائل بزيادة المسافة .وعلى الرغم من ان الطريق فى هذا المحال مازال طويلاً ومكلفاً الا ان تركة وعدم الاستفادة منة يكلفنا أكثر .