



## Effect of magnetized irrigation water and bio-fertilizer spraying on growth and yields of maize (*Zea mays* L.)

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### Abstract

A field experiment was conducted at the special field in Diyala province during the agricultural season 2012, The soil texture was clay loam to study the effect of magnetic of irrigation water and spraying bio-fertilizers EM1 in the growth and yields maize under drip irrigation system, study included two factors the first one was magnetic water which include two levels (without magnetic and magnetic). The second factor was involved bio fertilizers EM1 with two levels without fertilizer and adding fertilizer with 1 cm<sup>3</sup> and dilute to 500 cm<sup>3</sup>, EM1 was sprayed in early morning at two stage vegetative growth and flowering stage. A factorial experiment was implemented according to randomized complete block design (R.C.B.D) with four replications, use a drip irrigation system type T-tape and installed system drip irrigation on feeds tank to the field and connect a magnetic on the water tank for treatment by using a magnetic device local made with the intensity of 1500 gauss, planted grain maize var. synthesizer 5012 that were obtained from the department of Agricultural Research on March 10<sup>th</sup> 2012 by three grain in each hole and on the lines of the distance between them of 0.75 m and a distance of 0.25 m between hole and other plants were thinned after germination to one plant, has anti-insect stalk borer corn using the pesticide diazinon granular concentrate 10% and two time first after 20 days of germination and the second after 15 days from the first date, feeding the center of the plant after the arrival of the six-leaf stage plant, and conducted the process of weeding manually three times during the season to get rid of the weeding, The results showed significant differences for the levels of magnetic of irrigation water in the properties plant height and leaf area and dry matter and yields grains reached 184.57cm, 63.12 cm<sup>2</sup>, 12.10 tons. ha<sup>-1</sup> and 8.57 tons. ha<sup>-1</sup>, respectively, as well as add enriched bio-EM1 exceed in all the properties previously above reached 179.82 cm, 65.16 cm<sup>2</sup>, 10.60 tons. ha<sup>-1</sup> and 7.47 tons. ha<sup>-1</sup>, respectively, and had an interaction between the magnetic of irrigation water and add bio fertilizers significant effect of all the properties above it gave 192.82 cm, 71.47 cm<sup>2</sup>, 13.60 tons. ha<sup>-1</sup> and 9.67 tons. ha<sup>-1</sup>, respectively.

**Keyword: Magnetic water, Irrigation, Bio-fertilizer EM1, Maize.**

### Introduction

Magnetization technology of water were adopted by several countries such as Russia and the United States, Britain, Japan, Australia, Germany, Turkey, Poland, China and Portugal were carried out numerous studies used in the field of agriculture, and the researchers found results value in various crops (Hozayn and Abdul Qados,2010). It has emerged in recent magnetic technology to adapt and improve the properties of irrigation water and redistribution of water molecules with a random distribution and make it more systematic (Kronenberg, 2005), which depend processes employing magnetic technologies in irrigation, taking into account several factors, including the salinity of water and soil salinity and water flow speed of the devices used for irrigation and installed the user and the strength of the magnet and the duration of contact between the liquid and magnets (Lam,2004). Martin,2007 has pointed out

that the exposure of the magnetic field of water works which reduce the surface tension of water by 8%.

Depending this technology on the passage of water molecules through a magnetic field which leads to the disintegration or change the links or ties hydrogen that bind water molecules with each other, and that this disintegration works to absorb energy and reduce the level of union water molecules and increases the vulnerability of electrolytic decomposition and affects the decomposition of the crystals (Chalabi and Dahl, 2012). When examining the electrical charges in the sample water, found it in a state of chaos and confusion (positive, positive, negative, negative) and this so-called water-dead, in order to revive the role of the water and make it active biologically any healthy organisms (human, animal, plant), and must lift the state of confusion in order to be re-arrangement of the water molecules

as full (positive, negative, positive-negative), and this would give additional power water since gaining its atoms bipolar torque to achieve this magnetization is water (Shamsh, 2009).

In Iraq, some recent studies in the field of agriculture to employ this technology for the purpose of improving of chemicals, fertility and soil physical properties (Al-Juthari, 2006). notes that the rate of production per unit area of the maize crop is still low compared with the rate of global production, which calls for promoting their efficiency productivity to meet the needs of them for different purposes. The use of chemical fertilizers determining factor for the productivity per unit area as the maize yield of crops stressful for the soil as lead chemical fertilizers to the negative effects on the environment and pose a serious threat to human health as well as the direct impact of these chemicals on microorganisms useful in agricultural soils, so began the direction to rationalize the use of such fertilizers and interest in bio-organic farming technology and the use of organic fertilizers and micro-organisms useful in order to provide a healthy diet with the productivity of more high quality among these are the materials used in this area enriched bio fertilizer, and this term is an abbreviation for the word effective microorganism any objects effective, the product normally contains a compatible micro-organisms beneficial and instrumental and active in improving the fertility of agricultural soils, which also lotion is safe from a health point as the neighborhoods in which the non-genetically modified and does not contain any pesticides or harmful chemicals, as well as features that contains more than 60 type of organisms beneficial Which include several groups of micro-organisms from bacteria and fungi useful (Al-Juboory *et al.*, 2011; Higha, 2006).

Maize (*Zea mays* L.) ranked third in the terms of importance to food crops, food grains in the world after wheat and rice (Al-Younis, 1993). Cultivated vary according to temperature changes and the abundance of water as it can be grown in different thermal environments and the crop is one of the tropical and subtropical, making them scattered in multiple views of the world. The rate of production per unit area in Iraq is still low compared to the global average as estimates of the food and agriculture organization international that the decline has increased from 37% during the years 1989-1991 for up to 55% in 1998 (FAO, 1998).

### Materials and Methods

Implemented a field experiment in a special field in Diyala province during the agricultural season 2012 in the soil of texture clay loam their physical and chemical shown in (Table 1) to study the effect of magnetization of irrigation water and spraying bio-

fertilizer EM1 in the growth and yields maize under drip irrigation system, study included the first one was magnetized water included two levels (without magnetization, water magnetic), The second factor involved the use of bio fertilizer EM1 and two levels (without adding, 1 cm<sup>3</sup> and dilute to 500 cm<sup>3</sup>), spray bio fertilizer EM1 of the early morning and in two stages, first at the stage of vegetative growth and the second at the stage flowering, distributed transactions on the experimental units randomly in accordance with global experience complete randomized block design with four replications, Plowed the ground before the experiment twice perpendicular and then underwent the process of smoothing and leveling and divided into four lines along each line of 27 m, use a drip irrigation system type T-tape and installed a system of drip irrigation on reservoir feeder for the field and connect the magnetization on the water tank for transactions covered using the device homemade ever magnetic intensity 1500 gauss.

Table (2) illustrates some of the chemical and physical characteristics of magnetized water, Planted grain maize var. synthesizer 5012 that have been obtained from the agricultural research service dated March 10<sup>th</sup> 2012 by three seeds in each hole and lines of distance between them is 0.75 m and a distance of 0.25 m between hole and other eased after germination to plant one, has anti-insect digger stem corn using the pesticide diazinon granular concentrate 10% and two dates, the first one 20 days of germination and the second after 15 days from the first date feeding center of the plant after the plant reach to of six leaves and underwent the process of weeding manually three times during the season to getting rid of the weeds, plants pulling out on July 15<sup>th</sup> 2012 and took the five plants of the middle lines at random and examined the following characteristics:

**Plant height (cm):** as much as measuring the distance from the surface of the soil and even the lower node inflorescence male on the stem to the average of five plants in random (Al-Sahoeke, 1990).

**Leaf area (cm<sup>2</sup>):** Calculated according to equation Al-Sahoeke (1985), which states that the leaf area of the plant is equal to the length of the leaf x leaf width x 0.75 from an average of five plants taken at random.

**The weight of dry matter (ton. ha<sup>-1</sup>):** The amount of the dry weight of the vegetative parts and yields grains after adjusting weight on the basis of 15.5% moisture (Al-Sahoeke, 1990).

**Yields grain (ton.ha<sup>-1</sup>):** Estimated quantity of grain production per transaction and 500 grain weight after separated grain and then dried at a temperature of 65°C for 48 hours.

Statistically analyzed the data in a way analysis of variance calculation averages were compared using the test less significant difference (LSD) at the level of (0.05) using the program (Genestat).

### Results and Discussion

**Plant height (cm):** The results of the statistical analysis presented in (Table 3) and the existence of significant differences in this characteristic since overcome the treatment of the use of magnetized water and gave rise plant amounted to 184.57 cm, while the 157.06 cm at the use of water is magnetized and an increase of 17.51% when using magnetized water compared to water is magnetized, has attributed the cause to the magnetization of water for irrigation works to break the bonds of hydrogen water making it easier to absorb the water from the cells of the roots, as well as becoming a good vector of nutrients and increases the readiness of the nutrients in the soil, and works to dissolve minerals and salts (Kronenberg, 2005). In addition, the surface tension of water magnetized at least what it was water will permeate the cell walls leading to rapid cell division in the growth areas in the plant (Khazraji, 2007).

The results are shown in the same table over the treatment when used bio fertilizer (EM1) was significantly comparing to treatment of the control and the maximum height of the plant 179.82 cm versus 146.90 cm, and the rate of increase in plant height was 22.40%, the reason for this is due to the bio-fertilizer influence on the secretion of a number of growth regulators and vitamins that effect and improve the balance of hormones in the plant and improve its performance in raising the efficiency of plant nutrition, and then increase the concentration of chlorophyll in the leaves and the lack of yellowing caused by iron deficiency and increase the efficiency of photosynthesis and thereby increase the yields, as well as due to the ability of bacterial species contained these fertilizers in nitrogen fixation and improve the nutritional balance of the plant, which to not exposed for washing and loss during the period of crop growth (Al-Jubouri *et al.*, 2007; Gonzalez-Lopez, 1991). The results show the overlap between magnetized water and added bio-fertilizers (EM1) to the existence of a significant increase compared to the treatment of control, the maximum height of the

plant maize when the magnetization of water and the addition of bio-fertilizers (EM1) 192.82 cm versus 146.90 cm at treatment control and an increase of 30.98% and reason for this was to what mentioned previously.

**Leaf area (cm<sup>2</sup>):** The results of the statistical analysis presented in (Table 4) and the existence of significant differences in this characteristic since overcome the treatment of the use of magnetized water and gave the highest area of leaf amounted to 63.12 cm<sup>2</sup>, while the 51.81 cm<sup>2</sup> when using the water is magnetized and an increase of 21.82% when using magnetized water compared to non- magnetic water has been attributed the reason to the effect of the magnetic field in the corner of the correlation between two atoms of hydrogen and oxygen in the water, and the properties of water magnetized of the small size of aggregates water magnetized 6-7 molecule budget by 10 - 12 molecule situation natural which leads to irregular water molecules in one direction than facilitates the entry of water into the membranes of plant and thereby increase growth (Colic *et al.*, 1998), as well as the ability of water magnetized in the cut-resistant walls cellular elongation of cells during the growth process which leads to the increase in leaf area and vegetative growth of the plant (Takashinko, 1997).

The results are shown in Table 4 when add bio fertilizers (EM1) was increased significantly comparing with control and reached the top of the space leafy crop of maize 65.16 cm<sup>2</sup> versus 44.77 cm<sup>2</sup>, and the rate of increase in plant height 45.54%, the reason for this is due to the use of fertilizer, bio contribute to raising the efficiency of nitrogen absorption through the leaves and raise readiness through nitrogen fixation and liberalization of air phosphorus and improve the readiness of the plant, which is reflected in the increase in leaf area (Al-Samarrai, 2002). The results show the overlap between magnetized water and added bio fertilizers (EM1) to the existence of a significant increase comparing to the treatment control, and reached the highest rate of leaf area when the magnetization of water and the addition of bio fertilizers (EM1) 71.47 cm<sup>2</sup> versus 44.77 cm<sup>2</sup> when the treatment control and an increase of 59.63%.

**Table (1): Some physical and chemical characteristics of the soil study.**

Properties		Units	Value
PH		-----	7.4
EC		ds.m <sup>-1</sup>	4.8
CEC		mole.kg <sup>-1</sup> soil	20.4
Available	P	Mg.kg <sup>-1</sup>	4.9
Elements	K	Mg.kg <sup>-1</sup>	155.7
Organic matter		gm.kg <sup>-1</sup>	4.5
Field Capacity		%	23.1
Soil Separate	Sand	gm.kg <sup>-1</sup>	256.10
	Silt	gm.kg <sup>-1</sup>	375.10
	Clay	gm.kg <sup>-1</sup>	368.80
Soil Texture		-----	Clay loam

**Table (2): Physical and chemical properties of magnetized water.**

Properties	Units	Before magnetized	After magnetized
PH	-----	7.50	7.70
EC	ds.m <sup>-1</sup>	0.758	0.759
Viscosity	g.cm.sec <sup>-1</sup>	0.718	0.689
TDS	mg.l <sup>-1</sup>	455	393
Surface tension	dyne.cm <sup>-1</sup>	70.30	68.01

**Table (3): Effect of interaction between magnetic water and spraying bio fertilizer EM1 rise in maize plant at the end of the growing season (cm).**

Water quality	Add bio-fertilizers EM1		Means
	Without added	added	
Non-magnetic	146.90	167.22	157.06
magnetic	176.72	192.42	184.57
Means	161.81	179.82	170.81
	LSD <sub>0.05</sub> W=1.265	LSD <sub>0.05</sub> M=1.265	LSD <sub>0.05</sub> W×M= 1.788

**Table (4): Effect of interaction between magnetic water and spraying bio-fertilizers EM1 in leaf area to maize plant (cm<sup>2</sup>).**

Water quality	Add bio-fertilizers EM1		Means
	Without added	added	
Non-magnetic	44.77	58.85	51.81
magnetic	54.77	71.47	63.12
Means	49.77	65.16	57.46
	LSD <sub>0.05</sub> W=1.213	LSD <sub>0.05</sub> M=1.213	LSD <sub>0.05</sub> W×M= 1.716

**Dry matter weight (tons.ha<sup>-1</sup>):** The results of the statistical analysis presented in Table (5) which monitored significant differences in this characteristic since overcome the treatment of using magnetized water and gave the highest dry weight of the crop of maize amounted to 12.1 tons.ha<sup>-1</sup>, while reached only 6.52 tons.ha<sup>-1</sup> when using water without magnetized water which increased of 85.58% when using magnetized water comparing to water without magnetized, The reason for this is due to the mechanism of magnetization improved physical and chemical properties of water and soil and plant and then increase the process of photosynthesis in plants and the use of carbohydrates and nutrient balance and an increase in transpiration and the general

growth of the plant, which includes growth and expansion of cells and bio-manufacturing of compounds, thereby increasing the productivity of the crop (Al-Juthari, 2006).

The results are shown Table (5) come the treatment added bio fertilizers (EM1) in significant state when comparing with the control and reached the highest rate of dry matter for maize yield 10.60 tons.ha<sup>-1</sup> compared to 5.35 tons.ha<sup>-1</sup>, and the rate of increase in plant height 99.06%, due reason for this is that the fertilizer vital to increase the efficiency of photosynthesis and thereby increase the yields, as well as due to the ability of bacterial species contained in this fertilizer in nitrogen fixation and improve the nutritional balance of the plant, which

not exposed washable and loss during the period of crop growth (AL-Jubouri *et al*, 2007) and Gonzalez-Lopez (1991). as well as was shown that the overlap between magnetized water and bio fertilizers was significant increasing in dry matter yield which reached to 13.60 comparing to 5.35 tons.ha<sup>-1</sup> and a significant increase of 154.2%.

**Grain yield (tons.ha<sup>-1</sup>)** : The results of the statistical analysis presented in Table (6) and the presence of significant differences in this characteristic since overcome the treatment of used magnetized water gave the highest yield of grain crop of maize amounted to 8.57 tons.ha<sup>-1</sup>, while the 4.62 tons.ha<sup>-1</sup> when used water without magnetized and increased of 85.49% when using magnetized water comparing to the water without magnetized, and can be explained by the role of the magnetization of irrigation water to increase the grain yields into the water magnetized characterized by small groups molecules that make up the result to get broken in

some bonds hydrogen, as well as the small size of the molecule water works Pressure to reduce the surface area (Rao, 2002).

The results are shown Table (6) added bio fertilizers (EM1) was significant state comparing with the treatment control and reached its highest rate grain maize yields 7.47 tons.ha<sup>-1</sup> comparing with 3.77 tons.ha<sup>-1</sup>, and increase of the rate in plant height was 98.14%, due reason for this is that the fertilizer vital to increase the efficiency of photosynthesis and thereby increase the yields, as well as due to the ability of bacterial species contained in this fertilizer in nitrogen fixation and improve the nutritional balance of the plant, which not exposed washable and loss during the period of crop growth (AL-Jubouri *et al.*, 2007; Gonzalez-Lopez, 1991), as well as the resulting overlap between magnetized water and bio-fertilizers to the significant increase in dry matter quotient was 9.67 compared to 3.77 tons.ha<sup>-1</sup> and a significant increase of 156.4%.

**Table (5): Effect of the magnetic interaction between water and spraying bio-fertilizers EM1 in the weight of the dry matter of the maize plant (tons. ha<sup>-1</sup>).**

Water quality	Add bio- fertilizers EM1		Means
	Without added	added	
Non-magnetic	5.35	7.70	6.52
magnetic	10.60	13.60	12.1
Means	7.97	10.65	9.31
	LSD <sub>0.05</sub> W=0.2286	LSD <sub>0.05</sub> M=0.2286	LSD <sub>0.05</sub> W×M= 0.3232

**Table (6): Effect of the interaction between magnetic water and spraying bio-fertilizers EM1 on grain yield of maize (tons.ha<sup>-1</sup>).**

Wate quality	Add bio-fertilizers EM1		Means
	Without added	added	
Non-magnetic	3.77	5.47	4.62
magnetic	7.47	9.67	8.57
Means	5.62	7.57	6.59
	LSD <sub>0.05</sub> W=0.3340	LSD <sub>0.05</sub> M=0.3340	LSD <sub>0.05</sub> W×M= 0.4724

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