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EFFECT OF WATER REGIMES AND IRRIGATION WITH MAGNETIC AND NON-MAGNETIC WATER ON SOIL SALINITY AND GROWTH OF BEAN PLANTS

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ABSTRACT: *This study was carried out during the summer season of 2011 and 2012 at the Experimental Farm of the Faculty of Agriculture, Minufiya University, Shebin El-Kom to investigute the effect of irrigation regimes and irrigation with magnetic or non-magnetic water, along with their interactions on growth and soil salinity.*

1. *Water regimes were applied where the as plants were irrigated by 20, 30, 40, 50 and 60% of the field capacity.*
2. *Irrigation with magnetic water and irrigation with non- magnetic one.*
3. *The interactions effect between water regimes and magnetic or non-magnetic water were also studied.*

Data show clearly that soil salinity, measured as EC (dsm-1) after harvesting, was decreased at different soil depths with irrigation bean plants by magnetized water. So, all values of relative changes of EC as a precent of original soil EC values were negative and were more negatively with magnetized water. Soil salinity measured as EC (dsm-1) was also strongly influenced by soil moisture regimes. Thus, increasing soil moisture up to the maximum level, i.e., 60% of the field capacity caused decrease of soil EC (dsm^1). Little decrease of soil EC (dsm1) was induced with the increase of soil moisture content.

The obtained data reported that a significant increase in plant height, number of leaves and leaf area/plant when bean plants were irrigated by magnetic water compared with non-magnetic one. Application of 60% of soil moisture content gave the highest growth parameters of bean plants. Meanwhile, decreasing soil moisture to 20% of the field capacity achieved the lowest values of plant growth characters, in both seasons.

The highest values of all plant growth parameters were obtained when bean plants were irrigated by magnetic water under the highest level of soil moisture i.e., 60% of the field capacity and the lowest values in this respect were found due to the interactions between non-magnetic water irrigation and the low level of water regimes (20% of the field capacity).

Key words: *Salinity, irrigation, Magnetic, Plant height, Leaf area, dry weight, Soil moisture.*

INTRODUCTION

Common bean *(Phaseolus vulgaris, L.)* is an important legume crop grown for both green pods and dry seeds which considered as a good source of protein. Beans also have high nutritional quality; they are an excellent source of complex carbohydrates and a good source of vitamins and minerals. The technology of Magnetic Water has widely studies and adopted in field of agriculture in many countries (Russia, Australia, USA, China and Japan), but in Egypt, the available review on application of magnetic water in agriculture is very limited. *Selim (2008)* studied the effect of each of magnetic water and magnetic seeds on tomato and pepper seeds , she found that the plant height, root length, leaves number per plant, total leaf area, leaf area index, relative growth rate, net assimilation rate,fresh weights of roots, stems, leaves and whole plant were increased with treating by all magnetic treatments (magnetized seeds, magnetized water and double of magnetized seeds and water) in tomato plants as compared to control plants. *Selim et al (2009)* found that the pepper plant height, total leaf area, relative growth rate, net assimilation rate, dry weight of roots, stems, leaves and whole plant and shoot/root ratio were increased with treating pepper plants with all magnetic treatments (seed, water and both of them). The enhancement was more clearly in the treated pepper plants with magnetized water.

Magnetic field, have been reported to exert a positive effect on the germination of seeds, plant growth and development, ripening of fruits and crop yield. According to the other data, magnetic water treatment decrease soil alkalinity, increase mobile forms of fertilizer, increase earlier vegetation periods. Water regimes affected als growth of several crops. Field capacity at 80% caused an insignificant increase in root length, plant height and number of leaves/plant, meanwhile 60% and 40% FC significantly decreased it. Number of branches/plant was significantly increased at 80% and 60% FC whereas, decreased at 40% FC in comparison to 100% FC (control). For fresh and dry weight of plant organs (g/plant), 80% FC caused a significant increase in stem, leaf and total fresh weights as well as root, stem, leaf and total dry weights *Selim and El-Nady, 2011.*

This study aimd to investigate the effect of both irrigation regimes and magnetic water on growth and soil salinity on beans plants.

MATERIALS AND METHODS

This study was carried out at the Agricultural Research Farm of the Faculty of Agriculture Menoufia University, Shebin El-Kom, Egypt during two summer seasons, 2011 and 2012 to study the effect of magnetic irrigation water under five levels of water regimes i.e., 20%, 30%, 40%, 50% or 60% of the field capacity (F.C) on soil salinity growth. on bean crop (*Phaseolus vulgaris, L.*) c.v Giza (6). Before planting, soil samples of the experimental soil were taken separately at soil depth of 0-15 , 15-30, sieved through a 2 mm sieve, kept and analyzed for some physical and chemical properties and its content of available N , P and K according to the methods decribed by *Cottenie et al. (1982) ; Page et al . (1982) and Kim (1996).* The obtained data were recorded in Table (1).

Samples of both non-magnetic (Tap water) and magnetic one for the same source were taken before irrigation and analyzed for its chemical constituents (Table 2).

Table (1): Physical and chemical properties of the experimental soil.

Soil properties	Units	Soil depth (cm)			
		0 – 15	15 – 30	30 – 60	60 – 90
Particles size distribution	%				
Coarse sand	%	2.58	2.50	2.35	2.15
Fine sand	%	23.42	23.00	22.10	20.90
Silt	%	34.00	34.50	35.00	36.10
Clay	%	40.00	40.40	40.55	40.95
Textural grade		Clay loam	Clay loam	Clay loam	Clay loam
PH in 1:2.5 (soil:water) susp.		7.60	7.72	7.78	7.80
EC in soil paste	dSm^{-1}	1.40	1.58	1.75	1.82
Organic mater (OM)	%	1.90	1.20	0.90	0.78
Calcium Carbonate (CaCo3)	%	2.10	2.40	2.50	2.55
Cation exchange capacity(CEC)	Cmol kg^{-1}	35.30	32.50	25.40	22.50
Available N	Mg kg^{-1}	55.20	43.17	28.50	20.15
Available P	Mg kg^{-1}	7.25	5.50	4.20	3.50
Available K	Mg kg^{-1}	115.20	105.50	88.10	80.70

Table (2): Chemical composition of the used non-magnetic and magnetic water (magnetic and non- magnetic water) as mean values in the two growing seasons.

Water type	PH	EC dSm^{-1}	Soluble Cations (meq $1^{-)}$				Soluble anions (meq $1^{-)}$			SAR
			Na^+	K^+	Ca^+	Mg^+	Cl^-	HCO_3^-	SO_4^{-2}	
NMW	7.22	0.42	1.75	0.60	1.15	0.70	1.42	1.50	1.28	1.82
MW	7.10	0.43	1.69	0.63	1.20	0.78	1.40	1.48	1.42	1.70

Before starting the experiment, the permanent wilting point (P.W.P) and available water were calculated according to *Iseralson and Hansen (1962)* methods as follows.

$$P.W.P = \frac{Fresh\ weight\ of\ soil - dry\ weight\ of\ soil}{dry\ weight\ of\ soil}$$

$$Q = d \times \frac{(F.C) - (W.P)}{100} \times As \times a$$

Where:

Q = quality of available water.
d = depth of available water.
F.C = field capacity percentage.
W.P= Wilting percentage.
AS = apparent specific weight of the soil.
a = area of irrigation.

The wilting point value was 19%. Also, field capacity was recorded and its value was 39%.

The design of the experiment was split-plot design with three replicates. Before planting the experimental plots were divided into two main groups (15 plots/ main Plot), which treated with one of irrigation water type (magnetic and non-magnetic water) in 12 February (15 days before planting data).

The sub main plots were irrigated with 5 levels of water regimes, i.e., 20%, 30%, 40%, 50% or 60% of field capacity under furrow irrigation system. Seeds of Common beans of Giza 6 c.v were sown on 27th and 26th of February of 2011 and 2012 in the two growing season, respectively. Seeds were sown in hill 10cm apart on the two sides of ridges (4-5 seeds/hill) and thinning later to two plants per hill after 20 days from planting.

Data recorded:

1- plant growth measurements:

During the vegetative growth period, a random samples of three plants from each experimental unite were taken at 40 and 55 days after planting. The following data were recorded:

1.1. Plant height (cm): from soil surface to the highest top.
1.2. Number of leaves/plant.
1.3. Leaf area per plant (cm^2): was determined by cutting out 20 leaf discs from each plant using a cork borer and dried them in an oven at 75 C^0 (until constant weight). The rest of the leaves were similarly dried. Bassed on the known dry weight of a known surface area of leaves, i.e., leaf discs, and the total weight of leaves, leaves surface area was determined.

Leaf area was measured by the discs method of *Johanson (1967)* using the following formula:

$$leaf\ area\ (l.A) = \frac{Plant\ leaves\ dry\ weight}{Discs\ dry\ weight} \times discs\ area\ (Cm^2)$$

1.4. Leaves, stems and roots fresh and dry weights (gm /plant).
1.5. Total plant fresh and dry weights (gm /plant).

RESULTS AND DISCUSSION

1. Soil salinity

1.1. Effect of magnetic water.

The president data in Table (3) show clearly that soil salinity measured as EC (dsm^{-1}) after harvesting was decreased at different soil depths with irrigated bean plants by magnetic water. So, all values of relative changes of EC as a percent of original soil EC values were negative and were more negatively with magnetic water. Also, the decreases of soil EC with both magnetic and non-magnetic water were

Table (3): Soil EC (dSm^{-1}) and its vertical redistribution and relative change (RC) as a percentage (%) of the original soil value as affected by both magnetic or non magnetic water and irrigation regimes (F.C%) (Mean values of the two growing seasons, i.e. 2011 and 2012).

F.C%	Parameters	Magnetic water					Non- magnetic water				
		0-15 (cm)	15-30 (cm)	30-60 (cm)	60-90 (cm)	Mean	0-15 (cm)	15-30 (cm)	30-60 (cm)	60-90 (cm)	Mean
20%	EC(dsm^{-1})	1.22	1.48	1.68	1.75	1.53	1.40	1.61	1.73	1.81	1.63
	RC(%)	-12.86	-6.33	-4.00	-3.85	-6.76	0.00	-1.89	-1.14	-0.54	-0.89
30%	EC(dsm^{-1})	1.13	1.37	1.65	1.75	1.48	1.31	1.53	1.69	1.79	1.58
	RC(%)	-19.29	-13.29	-5.71	-3.85	-10.54	-6.42	-3.16	-0.03	-1.64	-2.81
40%	EC(dsm^{-1})	0.92	1.18	1.50	1.63	1.31	1.27	1.50	1.66	1.74	1.54
	RC(%)	-27.14	-25.31	-14.28	-10.34	-19.29	-9.28	-5.06	-5.14	-4.39	-5.96
50%	EC(dsm^{-1})	0.95	1.20	1.55	1.72	1.26	1.25	1.49	1.60	1.70	1.51
	RC(%)	-32.14	-24.05	-11.43	-5.49	-18.28	-10.71	-5.69	-8.57	-6.59	-7.89
60%	EC(dsm^{-1})	0.99	1.01	1.40	1.54	1.21	1.21	1.40	1.58	1.66	1.46
	RC(%)	-29.28	-27.85	0.00	-15.38	-18.12	-13.57	-11.39	-9.71	-8.79	-10.86
Mean	EC(dsm^{-1})	1.04	1.24	1.55	1.67	1.35	1.28	1.50	1.65	1.74	1.54
	RC(%)	-24.14	-19.36	-7.08	-7.78	-14.59	-7.99	-5.43	-4.91	-4.39	-5.68

RC(%) = {(EC after harvesting – EC before planting) / EC before planting}× 100 more clear and showed a high negative values of RC in the surface layers (0 -15) and reduced with the increase of soil depth. In this respect, *Takatshinko (1997)* stated that, the possibility of using magnetic water to desalinate the soil as accounted for the enhanced dissolving capacity magnetic water, which has been registered repeatedily, who added that, magnetic water removed 50 to 80% of soil cl^{-1} compared to a removed of 30% by normal irrigation water. *Midan and Tantawy (2013)* found a decrease in soil salinity in the different layers of the soil irrigated by magnetic water compared with these found with non-magnetic water.

1.2. Effect of irrigation regimes.

Soil salinity measured as EC(dsm^{-1}) was strongly influenced by soil moisture regimes (Table 3). Thus, increasing soil moisture up to the maximum level, i.e., 60% of the field capacity caused a little decrease of soil EC (dsm^{1}). This decrease was resulted from the little absorbed amounts of soluble ions by the grown plants. So, the high decrease of soil EC resulted from the increase in soil moisture that was found in the surface layer (root zone).

Generally, all values of RC and EC were negative at different soil depth, but their were more negative at the high level of soil moisture contents. Generally, all values of RC and EC were negative at different soil depth, but their were more negative at the high level of soil moisture contents.

These results were attributed to the enhancing effect of these treatments on plant growth and its roots intensity, chemical and biological properties *(Aladjadjiyan,2002 and El-Fakhrani et al.,2012).*

This results may be attributed to the leaching effect of irrigation water , like wise enhancing root growth consequently nutrients absorption and reduction in EC. However, the reduction of EC with magnetic water surpassed that one with non-magnetic water by more than tree fold generally that refer to the beneficial effect of applied magnetic water on reclaiming soil salinity *(Aladjadjiyan, 2002 and Celik et al, 2008).*

2.Vegetative growth characters.

2.1. Effect of magnetic water.

It can be noticed from the data presented in Tables (4,5 and 6) that plant height, number of leaves and leaf area/plant in bean plants were influenced by magnetic or non magnetic water application. The data reported that a significant increases of the plant height, number of leaves and leaf area/plant when bean plants were irrigated by magnetic water compared with non-magnetic one. The enhancement of plant growth under magnetic conditions spears to have been confirmed by many scientists. Similar finding were reported by *Selim,(2008)* who noticed that plant height, leaves number per plant, total leaf area of tomato and pepper plants were increased with using magnetic water. Also, *Midan and Tantawy (2013)* showed that plant height, number of leaves, leaf area of snap bean plants was affected by irrigation with magnetic water compared with non-magnetic one.

The stimulatory effect of the application of magnetic water on the growth parameters i.e plant height, and number of branches may be attributed to the increases in photosynthetic pigments, endogenous promoters (IAA), and the increase in protein biosynthesis *(Hozayn and Abdul Qados, 2010).*

In addition, the data in Table (7,8,9 and 10) show a significant increases of fresh and dry weights of roots and whole plant. The calculation values of total and individual fresh and dry weights show variations of these parameters due to the magnetic or non-magnetic water in the two growing seasons. The increases in plant fresh weight for bean plants which treated with magnetic water irrigation reached to about 11.63% to 39.69% in 2011 and 2012 seasons, respectively. Meanwhile, the increases in whole plant dry weight reached 10.15 to 39.99% at the first and the second seasons, respectively.

The favourable effect of magnetic water may be attributed to its role in increasing absorption and assimilation of nutrients and consequently increasing plant growth.

Magnetic treatments 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. These changes in water properties may be capable of affecting the growth of plants.

Table (4) : Effect of water regimes (F.C%) (a) and magnetic or non- magnetic water (b) on plant height of beans (cm) in 2011 and 2012 seasons.

F.C%(a)	Season 2011			Season 2012		
	Plant height (Cm)			Plant height (Cm)		
	Magnetic water (b)	Non magnetic water (b)	Mean	Magnetic water (b)	Non magnetic water (b)	Mean
20%	47.25	43.00	45.12	49.83	42.83	46.33
30%	51.44	46.25	48.84	56.78	46.63	51.70
40%	52.69	45.63	49.16	56.57	49.53	53.05
50%	55.56	51.06	53.31	57.84	52.64	55.24
60%	58.50	53.56	56.03	59.45	53.07	56.26
Mean	53.08	47.90		56.09	48.94	
L.S.D 0.05	a=2.02	b=0.71	a× b=9.77	a=3.90	b=0.69	a× b=5.34

Table (5): Effect of irrigation regimes a (F.C%) (a) and magnetic or non- magnetic water (b) on number of leaves of beans in 2011 and 2012 seasons.

F.C%(a)	Season 2011			Season 2012		
	Number of leaves/plant			Number of leaves/plant		
	Magnetic water (b)	Non magnetic water (b)	Mean	Magnetic water (b)	Non magnetic water (b)	Mean
20%	18.61	15.38	16.99	15.83	13.17	14.50
30%	26.38	16.50	21.44	19.96	14.26	17.11
40%	28.88	24.50	26.69	23.92	16.33	20.12
50%	28.00	25.00	26.50	25.58	16.75	21.16
60%	34.25	30.63	32.44	31.00	20.42	25.71
Mean	27.22	22.40		23.25	16.18	
L.S.D 0.05	a=4.80	b=1.93	a× b=6.03	a=2.17	b=1.23	a× b=5.13

Table (6): Effect of irrigation regimes (F.C%) (a) and magnetic or non-magnetic water (b) on leaf area (Cm^2/plant) of beans (cm) in 2011 and 2012 seasons.

F.C% (a)	Season 2011			Season 2012		
	Leaf area (Cm^2/plant)			Leaf area (Cm^2/plant)		
	Magnetic water (b)	Non magnetic water (b)	Mean	Magnetic water (b)	Non magnetic water (b)	Mean
20%	1487	1335	1411	1471	1179	1325
30%	1524	1382	1453	1499	1351	1425
40%	1607	1428	1517	1580	1434	1507
50%	1782	1476	1629	1672	1514	1593
60%	1535	1893	1714	1832	1588	1710
Mean	1587	1502		1610	1413	
L.S.D 0.05	a= 84	b=46	a× b=111	a= 63	b= 38	a× b= 79

Table (7): Effect of irrigation regimes F.C%(a) and magnetic or non-magnetic water (b) on average root fresh weight of beans (gm/plant) in 2011 and 2012 seasons.

F.C%(a)	Season 2011			Season 2012		
	Average root fresh weight (gm/plant)			Average root fresh weight (gm/plant)		
	Magnetic water (b)	Non magnetic water (b)	Mean	Magnetic water (b)	Non magnetic water (b)	Mean
20%	5.30	4.92	5.11	6.80	5.90	6.35
30%	8.49	6.33	7.41	9.88	7.13	8.50
40%	11.98	8.28	10.13	11.84	8.36	10.10
50%	12.44	9.21	10.82	13.52	10.47	11.99
60%	15.62	11.17	13.39	16.63	12.59	14.61
Mean	10.76	7.98		11.73	8.89	
L.S.D 0.05	a= 0.81	b=1.29	a× b=1.83	a=2.04	b=3.23	a× b=4.98

Table (8): Effect of irrigation regimes F.C% (a) and magnetic or non-magnetic water (b) on average root dry weight of beans (gm/plant) in 2011 and 2012 seasons.

F.C%(a)	Season 2011			Season 2012		
	Average root dry weight (gm/plant)			Average root dry weight (gm/plant)		
	Magnetic water (b)	Non magnetic water (b)	Mean	Magnetic water (b)	Non magnetic water (b)	Mean
20%	1.71	1.45	1.58	0.91	0.96	0.93
30%	1.33	1.19	1.26	0.96	0.98	0.97
40%	1.86	1.63	1.74	0.92	1.10	1.01
50%	1.08	1.56	1.32	1.29	1.14	1.22
60%	1.17	1.71	1.44	0.80	1.43	1.12
Mean	1.43	1.51		0.98	1.12	
L.S.D 0.05	a= 0.29	b=0.46	a× b=0.59	a= 0.20	b=0.31	a× b=0.48

Table (9): Effect of irrigation regimes F.C% (a) and magnetic or non- magnetic water (b) on average of whole plant fresh weight of beans (gm/plant) in 2011 and 2012 seasons.

F.C%(a)	Season 2011			Season 2012		
	Average plant fresh weight (gm/plant)			Average plant fresh weight (gm/plant)		
	Magnetic water (b)	Non magnetic water (b)	Mean	Magnetic water (b)	Non magnetic water (b)	Mean
20%	102.15	105.95	104.05	104.55	67.50	86.02
30%	133.35	110.85	122.10	123.80	74.65	99.22
40%	143.10	124.15	133.62	133.75	82.50	108.12
50%	141.65	130.65	136.15	147.60	90.25	118.92
60%	170.00	138.40	154.20	165.55	92.35	128.95
Mean	138.05	122.00		135.05	81.45	
L.S.D 0.05	a=6.84	b= 9.00	a× b=14.00	a=5.13	b=11.98	a× b=17.46

Table (10): Effect of irrigation regimes F.C%(a) and magnetic or non- magnetic water (b) on average of whole plant dry weight of beans (gm/plant) in 2011 and 2012 seasons.

F.C%(a)	Season 2011			Season 2012		
	Average plant dry weight (gm/plant)			Average plant dry weight (gm/plant)		
	Magnetic water (b)	Non magnetic water (b)	Mean	Magnetic water (b)	Non magnetic water (b)	Mean
20%	20.43	21.19	20.81	20.91	13.50	17.20
30%	26.67	22.17	24.42	24.76	14.93	19.84
40%	28.62	24.83	26.72	26.75	16.20	21.47
50%	28.33	26.13	27.23	29.52	18.05	23.78
60%	34.00	29.68	31.84	33.11	18.47	25.79
Mean	27.61	24.80		27.01	16.23	
L.S.D 0.05	a= 3.41	b=1.69	a× b=6.49	a=2.39	b=1.75	a× b=4.35

Magnetic water treatment increased significantly the GA and Kinetin which play an important role on shoot and root formation, axillary bud growth and induction of number of genes involved in chloroplast development *(Abdul Qados and Hozayn 2010, Hozayn et al, 2011 on chick pea and Moussa, 2011 on comman bean).*

Magnetic water also significantly induces cell metabolism and mitosis meristematic cells of pea, lentil and flax *(Belyavskaya, 2001)*. Moreover, the formation of new protein bands in plants treated with magnetic water may be responsible for the stimulation of all growth and promoters in treated plants.

These findings were also confirmed with those obtained with *Selim (2008)* who found that the increasing in fresh and dry weights of whole pepper plant reached about 40.4% to 94.6% at 110 days with treating plants by magnetic water irrigation compared with non-magnetic one. Also, *Grewal and Maheshwari (2011)* recorded that magnetic field stimulated root development and led to an increase in the fresh weight and shoot length. They detected that magnetic field have a highly stimulated effect on cell multiplication, growth and development.

2.2. Effect of irrigation regimes.

It is quite apparent from the data present in Tables (4,5,6,7,8,9 and 10) that the plant height, number of leaves/plant, leaf area, root fresh and dry weights as well as whole plant fresh and dry weights of bean plants were increased with increasing soil moisture. Thus, application of 60% of soil moisture content gave the highest growth of bean plants in the two growing seasons. Meanwhile, the lowest values of soil moisture (20% of the field capacity) decreased all plant growth characters, in both seasons. In this connection, *Fattahallh and Gawish (1997)* found that, the highest record of the plant hight, leaf area and whole plant dry weight in snap beans were achieved at 75% of field capacity compared with 45 and 90%.*Shahien et al (2000)* indicated that application of 80% soil moisture content gave the highest values growth characters of been plants, while, non significant differences could be observed between irrigation at 50 and 90% moisture content. *Sami (2000)* reported that plant height, dry matter of vines, leaves and whole pea plants reached its maximum values at the highest level of water supply,i.e., irrigation after 30% depletion of available soil moisture.

More investigations were carried out by *Ghassemi – Golezani and Mardfar (2008)* on common bean, they found that, dry matter accumulation was reduced due to water deficit.

Increasing plant growth parameters with increasing soil moisture content up to 60% of field capacity may be due to the effect of water on some quantitative and qualitative changes in certain metabolic processes in the plant cell (*Sepaskhah,1977*).Besides, the superioity of irrigation at the highest level of soil moisture content could be attributed also to the adequate water supply, which gave more available soil moisture and this finally gave more vegetative growth. Another explanation could be done as increase number of leaves and total leaf area/plant and consequently dry matter *(Khalil,1977).* Finally, as the noticed from the above mentioned results (Tables 3) that increasing soil moisture content decreased soil salinity in root zone and increased soil available N,P and K , thus resulting in an improved in plant growth.

The adverse effect of drought stress on growth parameters may be attributed to the decrease in net photosynthetic rates (photoinhibition) in plants due to stomatal closure, which decressed or prevent water loss but reduces CO_2 availability for chloroplast *(Flexas et al., 2004). Erice et al.(2007)* indicated that total dry weight of plants significantly reduced to the well water ones. Moreover, the growth reduction that followed drought stress may be explain as a result of massive and irreversible expansion of small daughter cells produced by meristemic divisions and growth inhibition of cell expansions as well as reduced rates of new cell production. Futher-more, water stress causes losses in tissue water content, which reduce turgor pressure in the cell, there by inhibiting enlargement and division of cells causing a reduction in plant growth *(Shao et al 2007*).

2.3. The interactions effect.

In respect of the interactions between both magnetic or non-magnetic water irrigation and irrigation regimes, data in Tables (4,5,6,7,8,9 and 10) indicate that plant growth characters,i.e., plant height, number of leaves, leaf area, root fresh and dry weight and total plant fresh and dry weight were significantly affected by the interaction between magnetic or non-magnetic water and irrigation regimes. The highest values of all plant growth parameters were obtained when bean plants were irrigated by magnetic water under the highest level of soil moisture content (irrigation at 60% of field capacity). On the other hand, the lowest values in the previous characters were found due to the interaction between non-magnetic irrigation water and the low level of water regimes (20% of the field capacity).

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"تأثير الأنظمة المائية و الرى بالماء الممغنط والغير الممغنط على ملوحة التربة وصفات النمو الخضرى لنبات الفاصوليا"

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الملخص العربى

أجريت تجربتان حقليتان خلال الموسم الصيفى لعامى ٢٠١١، ٢٠١٢ بمزرعة التجارب بكلية الزراعة جامعة المنوفية بشبين الكوم لدراسة تأثير كلاً من معدلات ومصادر الماء المستخدم فى الرى حيث تم استخدام الرى بالماء العادى (ماء الصنبور) والماء الممغنط بمعدلات ٦٠،٥٠،٤٠،٣٠،٢٠ % من السعة الحقلية والتفاعل بينهما على صفات النمو الخضرى والتركيب الكيماوى وصفات الجودة والمحصول ومكوناته لنبات الفاصوليا.

تم تصميم التجربة بنظام القطع المنشقة حيث وضعت نوع أو مصدر الماء فى القطع الرئيسية بينما وضعت معدلات الرى فى القطع المنشقة.

<u>وتتلخص النتائج المتحصل عليها فى الاتى:</u>

١.ملوحة التربة.

ملوحة التربة والتى قيست بعد انتهاء التجربة وعلى جميع الاعماق انخفضت باستخدام الرى بالماء الممغنط، حيث أدى زيادة معدل الرى الى ٦٠% من السعة الحقلية الى انخفاض ملوحة التربة بالمقارنة بباقى معدلات الرى المستخدمة.

٢.صفات النمو الخضرى.

أوضحت النتائج زيادة معنوية فى طول النباتات وعدد الأوراق والمساحة الورقية للنبات عند رى نباتات الفاصوليا بالماء الممغنط بالمقارنة بالرى بالماء العادى، كما وجدت زيادة معنوية لصفات الوزن الطازج والجاف للجذور والوزن الطازج والجاف للنبات نتيجة الرى بالماء الممغنط فى كلا موسمى التجربة.

طول النبات وعدد الأوراق والمساحة الورقية للنبات والوزن الطازج والجاف للجذور والنبات الكامل زادت زيادة معنوية بزيادة معدلات الرى، واعطى الرى عند ٦٠% من السعة الحقلية اعلى القيم بالنسبة لجميع الصفات المدروسة.

فيما يتعلق بالتداخل بين مصدر الرى ومعدلات الرى اوضحت النتائج ان الرى بالماء الممغنط عند ٦٠% من السعة الحقلية ادى الى زيادة فى صفات النمو السابقة حيث اعطت اعلى القيم لهذه الصفات، بينما كانت اقل القيم للصفات السابقة عند الرى بالماء الغير ممغنط عند ٢٠% من السعة الحقلية.