ISSN No:-2456-2165

The Impact of Magnetized Water on Some Physiological Characters of Parsley *Petroselinum Crispum* (Mill)

Hozifa H. Mohamed[1], Elnasri, M. Mutwali[2]
[1, 2] Department of Biology, Faculty of Education
Alzaeim Alazhari University, Khartoum, Sudan

Abstract:- A pot experiment was conducted to evaluate the effect of magnetic water on some growth charcters of parsley.The experiment was carried out at Faculty of Education, Alzaeim Alazhari University, Khartoum, during two successive seasons (2016 and 2017). The experiment was set as completely randomized design (CRD), with four different magnetized water treatments. The magnetized water was passed through a magnetic funnel, once, three times, four times and six times compared with the tap water as a control. The results indicated that parsley irrigated with magnetized water exhibit an increase in germination ,plant height number of leaves ,leaf area ,chlorophyll content, and some elements(K,Ca,Ma) as compared with control. The obtained results indicated that magnetized water can be a promising technique for high yield of parsley.

Keywords:- *Chemical Constituents, Chlorophyll Content, Growth, Magnetized Water, Parsley.*

I. INTRODUCTION

The world now is looking for new methods which can promote the crop yield and in the same time have no negative impact on the environment.. One of these methods is the use of electromagnetic field in treating seeds and irrigation water. Many studies reported **the** positive effect of magnetic field on plant germination, plant development **and yield(**Florez etal.,2007;Radhakkrishnan and Kumari,2012).Magnetic field affects the various characteristics of the plant like germination of seeds, root growth, rate of seedling, growth (Reina *et al*, 2007). Parsley is an excellent source of vitamin C, full of antioxidants including apigenin which reduced the risk of cancer and promote heart health.

Parsley is one of the most preferable vegetable and it is used in the daily food of the Sudanese people, but the production cost of parsley is relatively high compared with other vegetables.

The present work was carried out to study the response of some growth characteristics of parsley and an attempt to find a method to increase the production by using the magnetized water in irrigation of parsley in Sudan conditions.

II. MATERIALS AND METHODS

The parsley seeds were local cultivar, obtained from the local market.

A. Magnetic Device:

The device used for water treatment ,was a funnel shaped obtained from the local agent of the Magnetic Technologies Company in Khartoum..

B. Laboratory Experiment:

The seeds of parsley with uniform size without seen defect or insect damage were arranged to five treatments as the following:

- The first treatment (T_1), seeds were irrigated with tap water (the control).
- The second treatment (T_2), seeds were irrigated with magnetized water (once).
- The third treatment (T_3), seeds were irrigated with magnetized water (three times).
- The fourth treatment (T_4), seeds were irrigated with magnetized water (four times).
- The fifth treatment (T_5), seeds were irrigated with magnetized water (six times).

The germination tests were carried out at laboratory conditions. Seeds of parsley were germinated in sterilized Petri-dishes 100mm in diameter, on Whitman filter paper moistened with 10ml of double-distilled water. For each treatment five Petri dishes were used, each with 10 seeds either with distilled water (control) or with magnetized water. Petri dishes were kept in the dark, at 25ºC, for aspan of 7 days. During the experiment germinated seeds were counted daily and then the percentage were calculated at the end of the experiment.

C. Pot Experiment:

Soil material: the soil used in all treatments in this experiment was river silt soil, moderately acid (pH 6.75), highly permeable.

[1] Corresponding author:elnasri shaheen@yahoo.com

D. Seeds Germination:

Plastic pots (27cm in diameter and 18cm in depth) filled with 5Kg of silt soil were arranged in a completely randomized design. There were three replication per each treatment. Seeds were sown in a uniform depth of 20mm and five seeds per pot and later thinned to two seedlings per pot. Measured volume (600 ml/pot) of water with or without magnetic treatment was applied in each pot soon after sowing according to the treatments described earlier and then daily during the entire duration of the experiment. The plant height numbers of leaves, leaf area, were taken during the study. At harvest crude protein, chlorophyll content and some chemical elements (Na, K, Ca, Mg) were analyzed. All data related to plant height, number of leaves leaf area, crude protein, chlorophyll content and the chemical elements were tabulated and statistically analyzed using analysis of variance (ANOVA) according to Gomez and Gomez (1984).

III. RESULTS AND DISCUSSION

A. Laboratory Experiment

The germination of parsley as indicated in Table (1) showed a significant difference between treatments and control. The highest germination percentage (68.33%) was attained by treatment two (seeds irrigated with magnetized water once), and the lowest germination percentage (43.33%) was attained by the control (seeds irrigated with tap water). All other treatments showed germination percentage higher than the control. Many works have been reported that magnetic field exerts a positive effect on germination of seeds.

The results of this study are supported by the findings of (Morejon *et al*., 2013). The irrigation with magnetically treated water and seed absorption of magnetized water before sowing may be responsible for activation of enzymes and hormones involved in the germination process and mobilization of nutrients. As a result, there is probably an enhancement in the mobilization and transportation of nutrients to embryonic axis and a resultant increase in speed of emergence and germination rate.

Treatment	Germination percentage
T_1	43.33
T_2	68.33
T_3	46.67
T_4	56.67
T_5	53.33
LSD	2.03

Table 1:- Effect of magnetized water on germination percentage of parsley

B. Pot Experiment

Table (2) indicated the plant height of parsley in years 2016 and 2017. The plant height expressed a significant difference (P=0.05) between treatments in both years experiments. These results are in agreement with the results of Nasher (2008) who reported that chick pea plants irrigated with magnetized water were taller than plants irrigated with tap water. Similar results were obtained by Atak *et al*. (2003) and Yaycili and Alikamanoglu (2005) who concluded that magnetic field increased the shoot and root regeneration rate and their fresh weight in soy bean and paulownia organ cultures. In connection to this, Abdul Qados and Hozayn (2010) reported that irrigation flax with magnetized water increased plant height. The increase in plant height in this study may be attributed to the earlier germination of parsley in treatments irrigated with magnetic water.

	Plant height (cm)			
	Treatment	15 DAS	30 DAS	45 DAS
2016	T_1	4.06	7.70	8.80
	T_2	7.44	11.33	13.13
	T_3	8.96	11.76	12.90
	T_4	8.70	11.00	13.26
	T_5	7.96	10.86	12.43
	LSD	3.05	1.30	3.29
2017	T_1	2.47	7.50	9.80
	T_2	8.60	11.56	12.90
	T_3	9.76	11.61	13.86
	T_4	8.43	12.53	13.13
	T_5	8.86	10.36	12.56
	LSD	2.01	1.18	1.99

Table 2:- Effect of magnetized water on plant height of parsley in the years 2016 and 2017.

Table (3) indicated the number of leaves of parsley where significant difference (P=0.05) was observed between treatments as compared to control in both years experiments. Similar results were obtained by Ghasemnezhad *et al*. (2012) who stated that magnetic field can enhance the number of leaves and leaf area in cucumber plant. These results concur with the results of Bashir (2006) who reported that a significant difference was detected in the number of leaves of okra (*Abelmoschus esculentus* L) when irrigated with magnetized water against tap water.

ISSN No:-2456-2165

	Number of leaves			
	Treatment	15 DAS	30 DAS	45 DAS
2016	T_1	3.93	4.73	5.40
	T_2	4.66	5.66	5.96
	T_3	4.93	5.73	5.93
	T_4	4.73	573	5.96
	T_5	4.65	560	5.93
	LSD	0.71	0.57	0.52
2017	T_1	4.66	5.20	5.60
	T_2	4.43	6.66	6.86
	T_3	4.36	6.46	6.73
	T_4	4.73	6.56	8.33
	T_5	4.60	6.36	6.80
	LSD	0.59	0.87	0.92

Table 3:- Effect of magnetized water on number of leaves of parsley in the years 2016 and 2017.

Table (4) demonstrated the leaf area differences between treatments and the control. A significant difference (P=0.05) was observed in 15, 30 and 45 days after sowing (DAS) in the first and second year experiments. These results concur with the results of Naz *et al*. (2012) who found an increment in leaf area of okra with magnetic field compared to control. These increments in leaf area might be due to increased photosynthetic rates due to the greater interception of light and greater amount of assimilates available for vegetative growth (Racuciu *et al*., 2006; Vashisth and Nogarajan, 2010).

	Leaf area (cm)			
	Treatment	15 DAS	30 DAS	45 DAS
2016	T_1	5.62	16.00	17.20
	T_2	10.53	23.64	25.06
	T_3	14.11	23.53	25.93
	T_4	12.19	25.00	2306
	T_5	11.36	23.26	23.30
	LSD	4.52	7.19	6.01
2017	T_1	3.16	12.42	16.64
	T_2	5.55	15.20	21.60
	T_3	14.90	20.94	21.58
	T_4	11.46	19.86	22.11
	T_5	13.16	18.88	20.96
	LSD	3.67	5.23	3.83

Table 4:- Effect of magnetized water on leaf area at parsley in the years 2016 and 2017.

Table (5) expressed the differences between treatments in crude protein of parsley. A significant increase (P=0.05) in crude protein was observed in treatments irrigated with magnetized water compared with plants irrigation with tap water (control). These results are in agreement with results reported by Amer (2014) who pointed out that the content of protein was high significantly increased with magnetically treated water. In connection to this, Belyavskaya (2001) reported that magnetic water significantly induces cell metabolism and mitosis meristematic cells of pea, lentil and flax. Carimi *et al*. (2002) and Celik *et al*. (2008) concluded that magnetic field stimulates protein synthesis via increase of cytokines and auxins and they can promote the maturation of chloroplast. The increase in protein of parsley may be attributed to the increment in chlorophyll content and the large leaf area,which can promte the synthesis of protein.

Treatment	Chlorophyll (a)	Chlorophyll (b)	Crude protein
T_1	29.081	18.374	15.59
T_2	29.149	22.706	15.70
T_3	29.113	25.237	15.66
T_4	29.145	24.988	16.12
T_5	29.120	20.194	15.71
LSD	3.28	3.63	0.00

Table 5:- Effect of magnetized water on chlorophyll content of crude protein and parsley.

Table (5) showed the chlorophyll content in parsley. A slight increase was detected between the different treatments and the control. Pietruszewski (1999) reported that photosynthetic pigments content in fresh wheat at 55 days after sowing (DAS) have shown a significant increase in response to irrigation with magnetic water. Several studies reported similar results for different plants. Rochalska (2005) found that magnetic field treatment increased chlorophyll content in sugar beet (*Beta vulgaris* L.) leaves. The content of chlorophyll a, b and carotenoids in potato (*Solanum tuberosum* L) increased as stated by Rakosy, Tican *et al*. (2005). Additionally studies by Atak *et al*. (2003) involving magnetic field impact on soybean (*Glycine max* L.) confirmed that magnetic field significantly increased chlorophyll a, chlorophyll b and total chlorophyll contents.

Table (6) indicated some chemical elements of parsley. The accumulation of sodium content was significantly decreased in treatments irrigated with magnetized water as compared with the control. It was notice that irrigation with magnetized water lead to an increase in the elements examined in this experiment except sodium, this because sodium is para-magnetic element which has a small positive susceptibility to magnetic fields, while other elements are diamagnetic which are slightly repelled by magnetic fields (Nave, 2008).

Treatment	Chemical elements			
	Na %	K ppm	Ca %	Mg%
T_1	0.16	9.26	1.70	0.72
T_2	0.15	9.15	1.89	1.20
T_3	0.15	9.33	1.98	0.96
T_4	0.14	9.09	2.20	0.92
T_5	0.14	9.84	1.88	0.84
LSD	0.00	0.00	0.17	0.00

Table 6:- Effect of magnetized water on some chemical elements of parsley

The magnetized water treatments exhibited an increase in potassium content as compared with control. These results are in agreement with that of Grewal and Maheshwari (2011) who observed an increase in potassium content in pea after irrigation with magnetic water. Moreover, Moussa (2011) demonstrated that there is a direct effect of potassium translocation efficiency, because potassium ion is known to be one of the three largest constituents in sieve tube sap.

The calcium content of parsley was affected by magnetized water and an increment was observed in treatments irrigated with magnetic water. Similar results were obtained by Grewal and Maheshwari (2011) who reported that a significant increase in calcium content of pea was observed after irrigated with magnetic water.

Plant processes such as growth, photo-synthesis, mineral nutrition, water transport are quite related to the motion of Ca^{++} ion in cells, changes in intercellular levels of Ca^{++} and other ionic current density across cellular membrane are important changes which are due to magnetic fields (Florez *et al*., 2007).

Concerning magnesium element, an increase was observed in treatments irrigated with magnetized water as compared with control. Similar results were reported by Wojcik (1995) who found that an increase in magnesium, proteins and fiber buck wheat when treated with magnetic field.

It is clear that magnetized treated water plants achieved significantly high nutrients content which represented by potassium, calcium and magnesium.

IV. CONCLUSION

Results of this study revealed a beneficial effect in using magnetized water in irrigation of parsley. An increase in growth parameters was observed when using magnetized water. Also some quality parameters (chlorophyll content and some chemical elements) were observed as parsley irrigated with magnetized water.

REFERENCES

[1]. Abdul Qados, A.M.S. and M. Hozayn, Response of growth, yield and yield components and some chemical constituents of flax for irrigation with magnetized and tap water.(2010). World appl. Sci., J., 8(5):. 630-631.
[2]. Amer,M.M. Elsanat, A.G. and Sahar H. Rashed,(2014). Effects of magnetized low quality irrigation water on some soil properties and soybean yield (*Glycine max* L.) under salt affected soils conditions. J. Soil Sci. and Agric. Eng., Mansoura Univ., 5(10):. 1377-1388.
[3]. Atak, C. Emiroglu, O. Alikamanoglu, S. and Rzakouliev, A. (2003) Stimulation of regeneration by magnetic field in soy bean (*Glycine max* L. Merril). Tissue Cultures. J. Cell Mol. Biol, 2:113-119.
[4]. Bashir,D. J.(2006). Evaluation of magnetic technology for vegetable production under drip irrigation system. M.Sc. Thesis, Faculty of Agriculture, University of Khartoum, 2006.
[5]. Belyavskaya.,N.A.(2001). Ultra structure and calcium balance in meristem cells of pear roots exposed to extremely low magnetic field. Adv. Space Res., 28(4):. 645-650.
[6]. Carimi,F. Zottini,M. Formentin,E. Jerzi, M.and Schiaw,F.L.(2002). Cytokinins new apoptotic inducers in plants. Planta, 216(3): 413-421.
[7]. Celik ,O. Atak,C. and Razakulieva,A. Stimulation of rapid regeneration by magnetic field in Paulownia node culture. Journal of Central European Agric. 9(2), pp. 297-308, 2008.
[8]. Florez ,M. Carbonell ,M.V. and Razakulieva, A.(2008). Exposure of maize seeds to stationary magnetic field. Effects on germination and early growth. Environmental and experimental botany, 9(2): 297-308.
[9]. Ghasemnezhad ,A.. Rezaiiasl A. and Shahabi. S. Study the response of cucumber plant to different magnetic fields.(2012) J. of Advanced Laboratory Research in Biology, 3(1): 42-45.
[10]. Gomez,A.K. and Gomez,A.A.(1984). Statistical procedures for agricultural research. John Wiley and Sons, Inc., Canada .
[11]. Grewal,S.H. and Maheshwari,B.L.(2011). Magnetic treatment of irrigation water and snow pea and chick pea seeds enhances early growth and nutrient contents of seedling. Bio-electromagnetic, (32): 58-65.
[12]. Moussa,H.R.(2011). The impact of magnetic water application for improving common bean (*Phaseolus vulgaris* L.) production. New York Sci., Jor., 4(6): 15-20.
[13]. Nasher,S.H.(2008). The effect of magnetic water on growth of chick pea. Seeds Eng. and Techn. 26(9):
[14]. Nave, C.L .(2008). Magnetic properties of solids. Hyper Phys., (15), :11-23.
[15]. Naz. A. Jamil A. Hag ,Z. Iqbal, M. Ahmed ,M.K. Ashraf, M. I. and Ahmad, R. (2012. Enhancement in the germi nation, growth and yield of okra (*Abelmoschus esculentus*) using pre-sowing magnetic treatments of seeds. Indian J. of Biochemistry and Biophysics, 49:. 211-214,
[16]. Pietruszewski,S.J.(1999). Influence of pre-sowing magnetic bio-stimulation on germination and yield of wheat. Int. Agro-physics, 13 :241-244.
[17]. Racuciu,M. Calvgaru, G. H. and Greanga, D.E .(2006). Static magnetic field influence on some plant growth. Rom. Journey. Phys., 51(1-2): 245-251.
[18]. Radhakrishnan,R. and Ranjitha Kumari, B.(2012).Pulsed magnetic field a contemporary approach offers to enhance plant growth and yield of soybean. Plant Physiol. Biotechn.,51:139-144.

[19]. Rakosy-Tican,L. Aurori ,C.M. and Moraniu,V.(2005). Influence of near null magnetic field in vitro on growth of potato and wild selenium species. Bio-electromagnetic, (26): 548-557.
[20]. Reina,F.G. Pascual ,L.A. and Fundora,J.A. (2007). Influence of stationary magnetic field on water relation in lettuce seeds. Part I. Experimental Results. Bioelectromagnetic, 22:596-602.
[21]. Rochalska, M.(2005). Influence of frequent magnetic field on chlorophyll content in leaves of sugar beet plants. Nukleonika, (50) :25-28..
[22]. Vashisth, A. and Nagarajan, S.(2010). Effect on germination and early growth characteristics in sun flower (*Heliganthus annus*) seeds exposed to static magnetic field. Journal of Plant Physiology, 167:. 149-156,
[23]. Wojcik,S.(1995). Effect of the pre-sowing magnetic bio-stimulation of buck wheat seeds on the yield and chemical composition of buck wheat grain, Current Adv. Buck Wheat Res., 93: 667-674.
[24]. Yaycili,O. and S. Alikamanoglu, S.(2005).The effect of magnetic field on Paulownia tissue cultures plant cell. Tissue and Organ Culture, 83(1): 109-114.