CODEN (USA): IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.582318

Available online at: http://www.iajps.com Review Article

EFFECTS OF MAGNETIC TREATMENT OF IRRIGATION WATER ON THE QUALITY OF SOIL: A COMPREHENSIVE REVIEW

Ali Yadollahpour[1], Samaneh Rashidi[2,*]

[1]Department of Medical Physics, School of Medicine, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran.

[2]Student Research Committee, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

Abstract:

Background and Objective: *In recent years, positive effects of magnetized water treatment have been shown on growth processes and the development of plant tissues through a change in the soil content. The objective of the current study is to review the effects of magnetized water on the quality of soil.*

Method: *The databases of Scopus (1980-2016), EMBASE (1980-2016), Web of Sciences (1980-2016), and Google Scholar (1980-2016) were searched to find the published studies with the keywords of "magnetic treatment" OR "magnetized water", AND "irrigation water" AND "soil" AND "effect". The obtained titles were reviewed and the relevant studies were selected for comprehensive review of the current literature.*

Results: *Magnetic water technologies used in agriculture can improve the quality and quantity of products. The current evidence shows that magnetic treated irrigation water changes soil and harvest content through increasing the level of specific minerals including N, K, Ca, Mg, Fe, Mn, Na, and Zn and reducing S content.*

Conclusion: *Although using magnetic water is agriculture is in early stage, studies have shown relatively promising outcomes and to reach established technology further controlled studies are needed. Studies to shed more light on the mechanisms of action of the observed effects are important in this regard.*

Keywords: *Magnetized Water, Soil, Irrigation Water, Effect*

Corresponding author:

Samaneh Rashidi ,
Student Research Committee,
Ahvaz Jundishapur University of Medical Sciences,
Ahvaz, Iran.

QR code

.

*Please cite this article in press as Ali Yadollahpour and Samaneh Rashidi , **Effects of Magnetic Treatment of Irrigation Water on the Quality of Soil: A Comprehensive Review**, Indo Am. J. P. Sci, 2017; 4(05).*

INTRODUCTION:

Various researchers have reported the effects of magnetic fields on biological systems resulting in the development of different magnetic based techniques for treatment of various disorders and also health promotion (1-12). Water as the most crucial element of life is known as an interesting compound with several unusual characteristics. Its special properties can be contributed to its 3-dimentional network of hydrogen bond in the molecule. Water is a molecule with cohesive properties which make it a good solvent and reactant (13, 14). Magnetic fields in proper intensity and orientation can interact with living cells on both the activation of ions and polarization of dipoles (1). Findings of the previous studies have shown that electromagnetic field (EMF) affects water absorption, preservation and ionization (15, 16). Magnetized water is water that treated by the magnetic field or passed through a magnetic device. This magnetized water has showed beneficial effectives in irrigation, industry, medical and home use (4, 5, 8, 10, 11). After passing a magnetic field, water achieve a magnetic moment for 24 to 48 hours. The use of magnetic water in irrigation is dependent on several items such as magnetic field intensity and velocity of crossing a magnetron. Results showed that distance of traveling of magnetized water along the irrigation lines is determined the rate of effectiveness of magnetized water on soil salinity and ionic balance in soil solution (17, 18). Results of a study showed that magnetic treatment reduces viscosity and energy level of water, whereas increases its permeability which results in more smoothed flow of water in pipeline or even capillary structures (19). In addition, they reported that magnetic water prevents the uptake of harmful metals like lead and nickel by roots and lead which consequently increases the percentage of nutrient elements such as, phosphorus, potassium and zinc (19). Electromagnetic fields (EMFs) can alter plasma functions through changing the membrane structures (20, 21). Findings of several studies have indicated effectiveness of EMFs on altering the level of some mRNAs in plants and it could accelerate the activation of seed germination, however, the mechanism of these actions is still poorly understood (22-24). The main effects of EMF treatments on biochemical processes are conveyed through influencing on free radicals and stimulating the activities of proteins and enzymes (25). The present study was aimed to review the recent applications of magnetic technologies in water management with the main focus on the effects of magnetized irrigation water on the soil characteristics.

Magnetic Water and Desalination

Deposition of salts in the plant roots reduces cellular circulation of plants. In addition, deposit of salt in the soil leads to increased stiffness and decreased permeability of water in the soil. Magnetic treatment of water changes some of the physical and chemical properties of water such as pH and solubility of salts movement (26). The most significant effects of magnetized water are leaching of excess soluble salts and soil alkalinity. Magnetized water increases the leaching of excess soluble salts and decreases soil alkalinity. Another feature of magnetized water is dissolving slightly soluble salts such as carbonates, phosphates and sulfates (27, 28). Mohamed et al. (2013) evaluated the effect of magnetic treated irrigation water on desalination from a sandy soil. Their results showed that total salt removal from the soil was significantly increased with magnetized water (26). Bogatin (1999) in an experimental study investigated the effect of magnetic treatment on desalination and reported that rate of chlorine desalination in treated water was increased by 30-40% (28). In contrast, findings of another study reported that magnetic treated irrigation water increased soil salinity (12).

Effects on Soil Chemical Contents

The findings of previous studies have reported changes in polarity, surface tension, pH, refractive index, and solubility of salts of water due to magnetic field exposure (29-32). Magnetized water imposes direct and indirect influence on the soil. The direct influence is effect on the composition or the mineral structure (33). The usage of magnetic water can change soil pH, EC, available P and extractable K. Different magnetized water sources have significantly increased available soil N, P and K (12, 26, 31, 32, 34). Increasing in soil available P and extractable K under magnetically treated water has played some role improving yield and water productivity of plants (12). In addition, Magnetic treatment of water has shown affect on desorption of P and K from soil adsorbed P on colloidal particles complex and thus improved plant growth and productivity through increasing its availability to plants (26).

In the other words, magnetically treated irrigation water has reportedly reduced soil pH and increased soil EC and available P (35). The Variations in pH and EC in magnetically treated water may be relate to changes in hydrogen bonding and increased mobility of ions. Exposure of water to magnetic fields caused to changes in hydrogen bonding and increased

mobility of Na^+ and Cl^- ions (19). Irrigation the soil with magnetized water were significantly increased available soil P content even in the lower layers of soil (26).

The nutrient extraction from soil had higher iron content, when the soil was irrigated with magnetized water. Hilal et al. (2002) investigated effect of irrigation with magnetically treated water and their results showed increase in Zinc (5 times), P (3 time) and Fe (9 times) in the root and harvest. They also reported the maximum increase in Mn content (18). Results have indicated differences in the concentrations of Na, K, P, N, and Ca+Mg in soils irrigated with magnetically treated water to compare with normal water (27). Magnetic treatment of water because of acceleration of the crystallizations and sedimentation slows down the movement of minerals (12). Results of several studies also showed an increase in P content of citrus and nutrient uptake by magnetically treated irrigation water (12, 18, 36).

Magnetic Treatment and Water Consumption

The salts in soil and water are collected in the surface of the soil and cause to provide problems through salt marsh formation and hardening of the soil (37). Accumulation of salts around the roots lead to reducing plant growth and yield (38, 39). Exposure to EMF increases water solubility and decreases surface tension of water. These effects increase the soil wettability properties. As a result of these features, the capacity of water holding in soil has been increased and also evaporation on the soil surface has been reduced compared to normal irrigation. Less water is used to sweeten the land with saline soil by using this technique. Therefore, the use of magnetically treated irrigation water leads to shorter period of irrigation while maintaining the overall productivity which can result in less water consumption (19, 28, 40).

CONCLUSION:

Magnetic field because of its normalizing effects on metabolisms and impact on cell division has been known as a part of the environment and source of energy (15, 41, 42). The findings have shown that magnetic treatment of water and soil proved to have a favorable effect in soil properties and plant growth (35, 42-44). The magnetic field has a positive effect on the metabolic substances, photochemical activity, respiration ratio and enzyme activity of plants (43-45). It has been found that the usage of magnetic water in the agricultural is beneficial on quantities and qualitative production (11, 46-48). Although using magnetic water is agriculture is in early stage, studies have shown relatively promising outcomes and to reach established technology further controlled studies are needed. Studies to shed more light on the mechanisms of action of the observed effects are important in this regard.

REFERENCES:

1.Moon J-D, Chung H-S. Acceleration of germination of tomato seed by applying AC electric and magnetic fields. Journal of electrostatics. 2000;48(2):103-14.

2.Mostafa J, Ali Y, Zohre R, Samaneh R. Electromagnetic fields and ultrasound waves in wound treatment: a comparative review of therapeutic outcomes. Biosci, Biotech Res Asia. 2015;12:185-95.

3.Reina FG, Pascual LA. Influence of a stationary magnetic field on water relations in lettuce seeds. Part I: Theoretical considerations. Bioelectromagnetics. 2001;22(8):589-95.

4.Yadollahpour A, Rashidi S, Ghotbeddin Z. Electromagnetic fields for the treatments of wastewater: a review of applications and future opportunities. J Pure Appl Microbio. 2014;8(5):3711-9.

5.Yadollahpour A, Rashidi S. Therapeutic applications of electromagnetic fields in musculoskeletal disorders: a review of current techniques and mechanisms of action. Biomedical and Pharmacology Journal. 2014;7(1):23-32.

6.De Souza A, Garcí D, Sueiro L, Gilart F, Porras E, Licea L. Pre-sowing magnetic treatments of tomato seeds increase the growth and yield of plants. Bioelectromagnetics. 2006;27(4):247-57.

7.De Souza A, Sueiro L, González LM, Licea L, Porras EP, Gilart F. Improvement of the growth and yield of lettuce plants by non-uniform magnetic fields. Electromagnetic biology and medicine. 2008;27(2):173-84.

8.Yadollahpour A, Jalilifar M, Rashidi S. Antimicrobial effects of electromagnetic fields: A review of current techniques and mechanisms of action. J Pure Appl Microbio. 2014;8(5):4031-43.

9.Tenuzzo B, Chionna A, Panzarini E, Lanubile R, Tarantino P, Jeso BD, et al. Biological effects of 6 mT static magnetic fields: A comparative study in different cell types. Bioelectromagnetics. 2006;27(7):560-77.

10.Yadollahpour A, Jalilifar M. Electromagnetic Fields in the Treatment of Wound: A Review of Current Techniques and Future Perspective. J pure appl microbio. 2014;8(4):2863-77.

11.Ali Y, Samaneh R, Kavakebian F. Applications of Magnetic Water Technology in Farming and Agriculture Development: A Review of Recent

Advances. Current World Environment. 2014;9(3):695.
12.Maheshwari BL, Grewal HS. Magnetic treatment of irrigation water: Its effects on vegetable crop yield and water productivity. Agricultural water management. 2009;96(8):1229-36.
13.Ibrahim I. Biophysical properties of magnetized distilled water. Egypt J Sol. 2006;29(2):363-9.
14.Eisenberg D, Kauzmann W. The Structure and Properties of Water Oxford Univ. Press, New York. 1969.
15.Taia WK, Kotbi AM, AlZahrani HS. The effect of static magnetic forces on water contents and photosynthetic pigments in sweet basil Ocimum basilicum L.(Lamiaceae). Saudi Journal of Biological Sciences. 2007;14(1):103-7.
16.Paul A-L, Ferl RJ, Meisel MW. High magnetic field induced changes of gene expression in arabidopsis. Biomagnetic research and technology. 2006;4(1):7.
17.Hilal M, Hilal M. Application of magnetic technologies in desert agriculture. I-Seed germination and seedling emergence of some crops in a saline calcareous soil. Egyptian Journal of Soil Science. 2000;40(3):413-22.
18.Hilal M, Shata S, Abdel-Dayem A, Hilal M. Application of magnetic technologies in desert agriculture: III. Effect of magnetized water on yield and uptake of certain elements by citrus in relation to nutrients mobilization in soil. Egyptian Journal of Soil Science. 2002;42(1):43-56.
19.Tai CY, Wu C-K, Chang M-C. Effects of magnetic field on the crystallization of CaCO 3 using permanent magnets. Chemical Engineering Science. 2008;63(23):5606-12.
20.Paradisi S, Donelli G, Santini MT, Straface E, Malorni W. A 50-Hz magnetic field induces structural and biophysical changes in membranes. Bioelectromagnetics. 1993;14(3):247-55.
21.Blank M. Biological effects of environmental electromagnetic fields: molecular mechanisms. Biosystems. 1995;35(2):175-8.
22.Goodman R, Bassett C, Henderson AS. Pulsing electromagnetic fields induce cellular transcription. Science. 1983;220(4603):1283-5.
23.Morar R, Iuga A, Dascalescu L, Neamtu V, Munteanu I, editors. Separation and biostimulation of soybeans using high-intensity electric fields. Proc Int Conf Modern Electrostatics; 1988.
24.Xiyao B, Ancheng M, Jingrun M, Xiaoling L, Li Y, Qingzhao W, editors. Physiological and biochemical experiments in electrostatic treated seeds. Proc Int Conf Modern Electrostatics, October; 1988.
25.Kurinobu S, Okazaki Y, editors. Dielectric constant and conductivity of one seed in germination process. Industry Applications Conference, 1995 Thirtieth IAS Annual Meeting, IAS'95, Conference Record of the 1995 IEEE; 1995: IEEE.
26.Mohamed AI, Ebead BM. Effect of magnetic treated irrigation water on salt removal from a sandy soil and on the availability of certain nutrients. International Journal of Engineering. 2013;2(2):2305-8269.
27.Noran R, Shani U, Lin I. The effect of irrigation with magnetically treated water on the translocation of minerals in the soil. Physical Separation in Science and Engineering. 1996;7(2):109-22.
28.Bogatin J, Bondarenko NP, Gak EZ, Rokhinson EE, Ananyev IP. Magnetic treatment of irrigation water: experimental results and application conditions. Environmental science & technology. 1999;33(8):1280-5.
29.Smikhina L. Changes in refractive index of water on magnetic treatment. Colloid J. 1981;2:401-4.
30.Srebrenik S, Nadiv S, Lin I. Magnetic treatment of water–a theoretical quantum model. Physical Separation in Science and Engineering. 1993;5(2):71-91.
31.Otsuka I, Ozeki S. Does magnetic treatment of water change its properties? The Journal of Physical Chemistry B. 2006;110(4):1509-12.
32.Chang K-T, Weng C-I. An investigation into the structure of aqueous NaCl electrolyte solutions under magnetic fields. Computational Materials Science. 2008;43(4):1048-55.
33.Bresler E. Two-dimensional transport of solutes during nonsteady infiltration from a trickle source. Soil Science Society of America Journal. 1975;39(4):604-13.
34.Amiri M, Dadkhah AA. On reduction in the surface tension of water due to magnetic treatment. Colloids and Surfaces A: Physicochemical and Engineering Aspects. 2006;278(1):252-5.
35.Ibrahim A, Mohsen B. Effect of irrigation with magnetically treated water on faba bean growth and composition. International Journal of Agricultural Policy and Research. 2013;1(2):24-40.
36.Duarte Diaz C, Riquenes J, Sotolongo B, Portuondo M, Quintana E, Perez R. Effects of magnetic treatment of irrigation water on the tomato crop. Hortic Abst. 1997;69:494.
37.Bower C, Wilcox L. Soluble salts. Methods of soil analysis Part 2 Chemical and microbiological properties. 1965(methodsofsoilanb):933-51.
38.Munns R. Comparative physiology of salt and water stress. Plant, cell & environment. 2002;25(2):239-50.

39.Yang C, Wang P, Li C, Shi D, Wang D. Comparison of effects of salt and alkali stresses on the growth and photosynthesis of wheat. Photosynthetica. 2008;46(1):107-14.
40.Moussa HR. The impact of magnetic water application for improving common bean (Phaseolus vulgaris L.) production. New York Science Journal. 2011;4(6):15-20.
41.Belyavskaya N, Fomicheva V, Govorun R, Danilov V. Structural-functional organisation of the meristem cells of pea, lentil and flax roots in conditions of screening the geomagnetic field. Biophysics. 1992;37(4):657-66.
42.Aladjadjiyan A. The use of physical methods for plant growing stimulation in Bulgaria. Journal of Central European Agriculture. 2007;8(3):369-80.
43.Carbonell MV, Martinez E, Amaya JM. Stimulation of germination in rice (Oryza sativa L.) by a static magnetic field. Electro-and magnetobiology. 2000;19(1):121-8.
44.Phirke P, Patil M, Umbarkar S, Dudhe Y. The application of magnetic treatment to seeds: methods and responses. Seed science and technology. 1996;24(2):365-73.
45.Martinez E, Carbonell MV, Amaya JM. A static magnetic field of 125 mT stimulates the initial growth stages of barley (Hordeum vulgare L.). Electro-and magnetobiology. 2000;19(3):271-7.
46.Qados AA, Hozayn M. Magnetic water technology, a novel tool to increase growth, yield and chemical constituents of lentil (Lens esculenta) under greenhouse condition. American-Eurasian Journal of Agricultural and Environmental Science. 2010;7(4):457-62.
47.Lulu C, Haixia Y, Jingfu L. Effect of magnetic treatment on seed vigor and seed germination of cabbage. Northern Horticulture. 2014;38(2):20-3.
48.Tingyun Z. Increasing paddy rice production by magnetized water treatment. Journal of Shenyang Agricultural College. 1985;16(2):45-54.