Germination and Growth of Seeds Using Magnetic Water

Methaq Hadi lafta*(1)

ORCID iD: https://orcid.org/0000-0002-9978-6829

(1). Department Biotechnology, Iraqi Ministry of Education, Iraq.

(*Corresponding author: Dr. Methaq Hadi lafta. E-Mail: mithaqiraqi@gmail.com).

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Abstract

The present study discussed the germination vigour efficiency of various seeds tested and their plant growth using magnetized water produced from aqua guard domestic water purifiers, which were compared with the normal tap water. These studies were carried out by few of the universities from India such as Cochin University, Babasaheb Bhimrad Ambedkar University, Sri Venkateswara College from Delhi University and Gauhati University. The seeds of red cow pea (*Vigna unguiculata*), soybean (*Glycine max*), mung bean (*Vigna radiata*), corn (*Zea mays*), mustard (*Brasssica juncea*), tomato (*Lycopersicum esculentum*) and rice (*Oryza sativa*) were used. The parameters like seed germination, osmosis assay, shoot length, root length and leaf sizes were documented. The results showed clear evident that the penetration of magnetized water into various seeds had positive impact on germination vigour and the growth. The germination vigour was documented at different time intervals from 18 h to 72 h. Very interestingly, the avg. % of seed germination from each magnetized treated groups were high compared to seeds treated with normal tap water. In addition, the plant growth parameters like leaf size, shoot length, and root length were increased in treated groups compared to normal groups. The weight of the seeds was gradually increased from treated groups compared to normal groups in all the seeds. In addition, the plant growth parameters like leaf size, shoot length and root length were increased in treated groups compared to normal groups. The weight of the seeds was gradually increased from treated groups compared to normal groups in all the seeds. From the above findings, it was clear evident that the hydration of the seeds soaked in Aquaguard with biotron technology is faster than the normal water soaked seeds and also the exhibited better germination and growth in Aquaguard treated water.

Key words: Water purifiers, Biotron, Magnetized water, Seed germination, Plant growth .

Introduction:

Magnetized water is nothing but the water exposed to the magnetic field or passed through the magnetic device Hozayn and Abdul Qados (2010). During this process magnetic field causes number of changes in water particularly at the atomic and molecular level and also cause changes in electronic

structure (Silva and Dobranszki , 2014; Pang and Dobranszki, 2008). Hence the resulting magnetized water molecules are restructuring into very smaller clusters and made of six symmetrically organized molecules. Because of the tiny and uniform cluster of hexagonal structure of the magnetized water can easily enter into inside the cells through the membranes and these features make the magnetized water more bio-friendly compound for plants and animal cells (Ali *et al*., 2014).

Currently, there are number of reports were discussed on the positive impact of magnetized water on seed germinations and plant growth (Maheshwari and Grewal, 2009; Mahmoud and Usman, 2014). In particular, Sadeghipour and Aghaei (2013) had done the study on improving the growth of cowpea (*Vigna unguiculata* L.Walp.) using magnetized water compared with non-magnetized water and the study was carried out during the summer season. The results showed that the irrigation with magnetized water increased the leaf, stem and root of both fresh and dry weight as well as total biomass compared to treat with non-magnetized water. Followed by previous study, Elshokali and Abdelbagi (2014) had carried out the study on impacts of magnetized water on elements contents like calcium, potassium, iron and zinc concentrations in plant seeds of onion, sun flower and tomato where the results were compared with the normal water. These studies were conducted during the winter and the results were clearly showed that the crops contents of the plants were irrigated with the magnetized water exhibited remarkable increases in elements concentration compared to crops using normal water and also achieved the increase of the yields at the time of harvest .

In an another study, Mahmood and Usman (2014) had explained the consequences of magnetized water application on maize seed emergence in sand culture in order to know any beneficial effects of magnetized water application on seedlings. The outcome of the results indicated that the particular group of magnetized treatment promoted the seed germination as well as faster and heavier growth compared to all the other groups. Interestingly ,

Hilal and Hilal (2000) had done the study on exposing of pepper, cucumber, wheat and tomatoes seeds into magnetized treated water and reported that the notable improvements in seed germination and seedling emergence were observed .

Similarly, Morejon *et al.*, (2007) had carried out the study on exposing of magnetized water and non-magnetized water to Pinus tropicalis seeds and the results showed that 43% of seed germination observed in control group where as 81% of seed germination observed in magnetically treated water. In addition remarkable improvement on seedlings growth was achieved in magnetically treated group compared to normal group. Recently, in a previous work where a study was carried out on the interactions of magnetized water on three different seeds from the Amaranthaceae family namely *Amaranthus tricolor*, *A.gengeticus* and *A.blitum* where the results clearly showed that the magnetized treated water had positive impact on all the treated groups in terms of seed germination compared to normal treated group (Krishnaraj *et al.*, 2017). Hence based on the previous reports and the present work carried out from few of the universities in India, here the study discusses the comparative efficiency of magnetized water produced from aqua guard domestic water purifiers and normal tap water on various seeds tested .

Materials and Methods:

Seeds selection:

Surface sterilization of seeds:

Ten numbers of healthy seeds with similar size, shape and weight were selected for the study. The seeds were surface cleaned twice with sterilized water thoroughly to remove any physical impurities adhered on the surface of seeds. Triplicates were maintained throughout the study .

Impact of magnetized water on seeds:

The surface sterilized seeds were immersed in freshly collected magnetized water produced from Aquaguard domestic water purifier for 3 h. Similarly, the seeds were exposed to normal tap water for 3 h.

Production of magnetized water:

In order to produce the magnetized water, 5 set of each magnetic rings were connected with a tube and packed in a housing chamber. This housing chamber is called as biotron cartridge and fixed in aqua guard water purifier end point. Each biotron cartridge was produced 5000 gauss of magnetic effect into water .

Seed germination study:

Seed germination study was carried out to check the absorption/penetration efficiency of magnetized water on seeds. Uniform layer of cotton beds were made in to sterilized petri plates, 40 ml of each biotron and normal tap water were added separately. Further the excess amount of water was drained carefully without pressing the cotton layer. Then the pre-soaked seeds were raised in to the cotton bed and the germination of different treatment groups were calculated using the formula:

G.I= No. of seeds germinated / total no. of seeds × 100.

The above work was carried out in natural light condition (16 h light: 8 h dark) and the temperature ranged between 25 – 30 ºC .

Plant growth study:

After 72 h of incubation the leaf size / no. of leaves developed, shoot length and root length were measured in terms of mm.

Osmosis assay:

In order to understand the rapid penetration and rate of absorption of magnetized water molecules into the seeds an osmosis study was carried out. Ten numbers of known quantities of each dry seeds were soaked into freshly produced magnetized water and normal tap water. Further the penetration efficiency of water molecules were documented at different time intervals likely, 1, 3 and 6 h. The initial weight and the final weight were documented .

Results and Discussion:

The present study was carried out from few of the universities in India. The study demonstrated the simple, rapid and inexpensive way of producing magnetized water from aqua guard water purifier.

For these, the seeds were exposed 3 h each into normal tap water and magnetized water. Then the seeds were shifted to cotton bed and raised for germination.

Function of biotron (magnetic) cartridge on water:

Biotron cartridge consist of a 5 set of magnetic rings connected with a tube and each magnetic ring was produced 1000+ gauss of magnetic field. When water molecules passed through the magnetic field a process of de clustering was achieved there by macro cluster form of water molecules converted into

micro cluster form. Due to micro cluster form, the movement and penetration of molecule into cells were achieved faster than the normal water .

The reason behind the fast movement of water molecule in magnetized treated water was due to number of hydrogen bonds was proportional to strength of magnetic fields. Due to increase in number of hydrogen bonds in presence of magnetic fields the size of the water molecules were controlled, resulted in change in behaviour of the water molecules (Changa and Weng, 2006; Krishnaraj *et al.*, 2017) .

Effect of magnetized water on seed germination:

In order to confirm the water absorption/penetration efficiency on seeds, the seed germination studies were carried out using various seeds, such as *Vigna unguiculata*, *Glycine max*, *Vigna radiata*, *Zea mays*, *Brasssica juncea*, *Lycopersicum esculentum* and *Oryza sativa*. From the results, it was clear evident that the penetration of magnetized water into tested seeds had positive impact on germination vigour and the growth. The germination vigour was documented at different time intervals from 18 h to 72 h. The avg. % of seed germination from each magnetized treated groups were high compared to seeds treated with normal tap water .

These results are in consistent with the previously published studies (Maheshwari and Grewa, 2009; Hozayn and Abdul Qados, 2010; Grewal and Maheshwari, 2011; Ijaz *et al.*, 2012; Sadeghipour and Aghaei, 2014). The reason behind the increase in seedlings and there by enhanced growth in presence of magnetized treated water was due to activation and production process of enzymes/hormones, enhanced level of the seed-store auxin resulted in initial stimulation, improvement of seed germination, vegetative growth and yield (De Souza *et al*., 1999; De Souza *et al.,* 2005; De Souza *et al*., 2006).

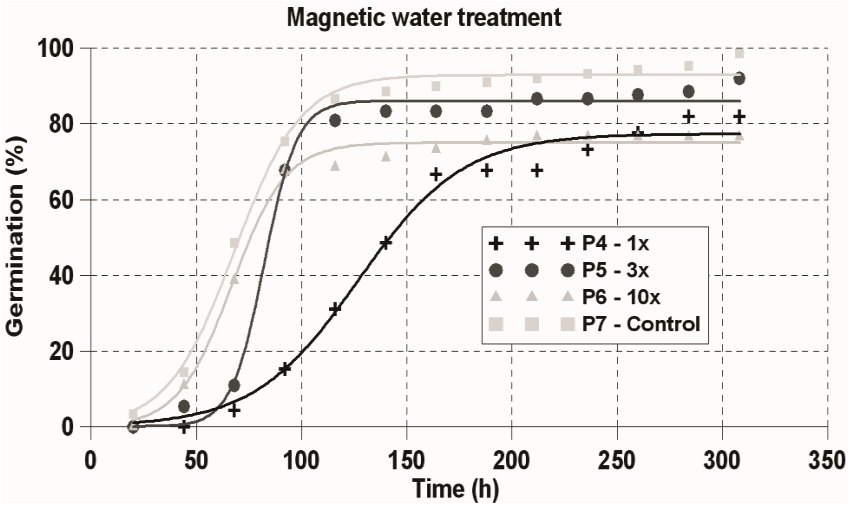
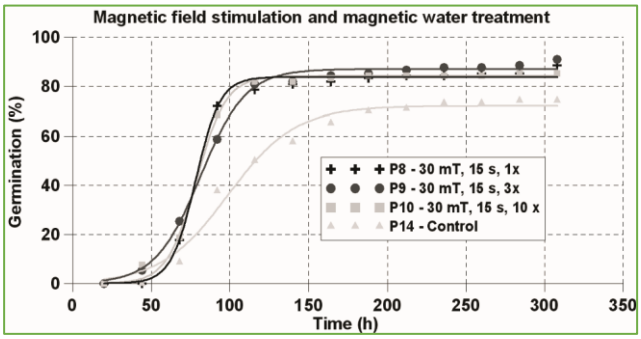


Fig. 1. Germination of sunflower seeds watered with magnetically treated water.



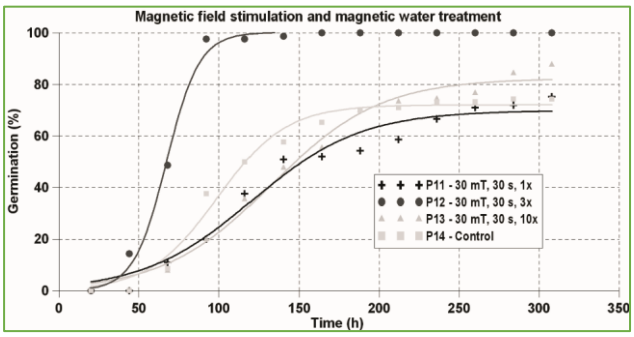


Fig. 2. Germination of sunflower seeds subjected to the activity of a variable magnetic field for: a – 15 s, and b – 30 s, and watered with magnetically treated water.

Table 1. Germination of sunflower seeds

Sample	Final number of germinated seeds	Germination capacity (%)	Variation coefficient of germination capacity (%)	Relative germination capacity of seeds
		Series I		
P1	20.3±1.2	67.7	5.9	0.772*
P2	29.3±0.9	97.7	3.1	1.114
P3	26.3 1.1	87.7 Series II	4.2	-
P4	24.6±1.3	82.0	5.3	0.831*
P5	27.6±1.5	92.0	5.4	0.932
P6	23.0±1.9	76.7	8.3	0.777*
P7	29.3 0.7	98.7 Series III	2.3	-
P8	26.6±0.8	88.7	1.9	1.194*
P9	27.3±1.2	91.0	4.4	1.225*
P10	25.6±1.5	85.3	5.8	1.148*
P11	22.6±1.5	75.3	6.6	1.013
P12	30.0±0.0	100.0	0.0	1.346*
P13	26.3±0.9	87.7	3.4	1.180
P14	22.3±0.7	74.3	3.1	-

***Samples of statistical significance were marked. Explanations of the names of samples are describes in the Table 1.**

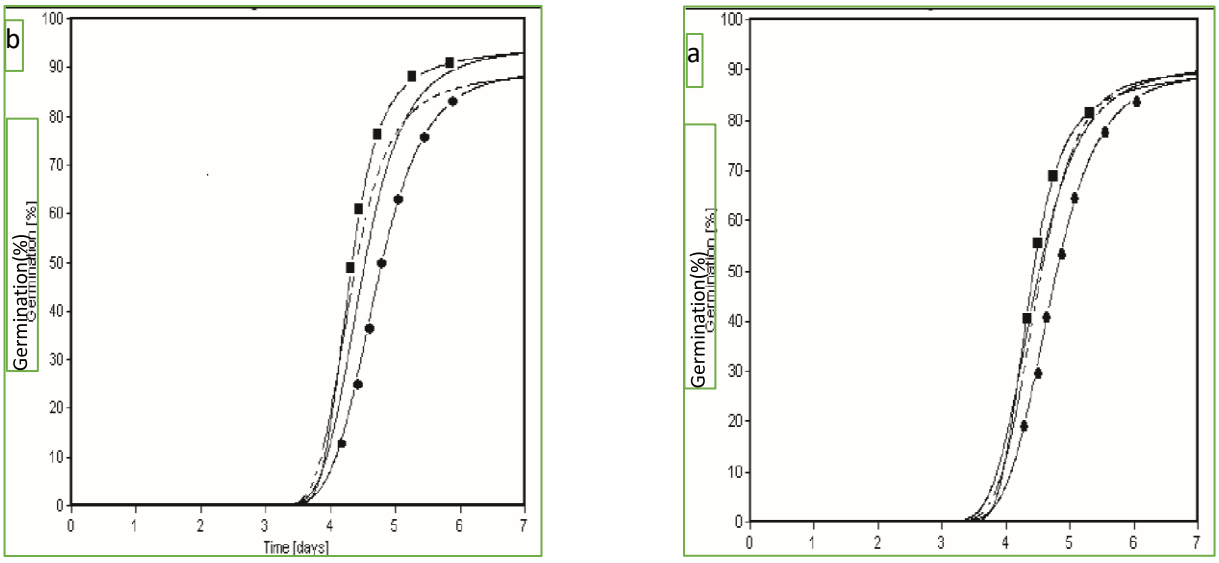


Fig. 3. Germination curves of tomato seeds: a – seeds exposed to 125 mT for 20 min (D3), 24 h (D5), chronic exposure (D6) and control; b – seeds exposed to 250 mT for 20 min (D9), 24 h (D11), chronic exposure (D12) and control

Table 2. Germination of tomato seeds

Sample	Exposure times	Final Number of germinated seeds (%)	Time (hour)± standard error						
			T1	T10	T25	T50	T_{75}	T_{90}	MGT
			Exposed to 125 mT stationary magnetic field						
C	non exposed	90.00 ±1.00	86.88 ±1.68	97.92 ±0.72	105.12 ±1.44	115.20 ±2.40	129.36 ±3.36		117.60 ±1.44
P1	1 min	91.00 ±2.52	88.32 ±1.20	96.96 ±0.96	102.96 ±0.72^{c}	111.12 ±0.72^{c}	124.32 ±4.08		114.00 ±1.20^{b}
P2	10 min	89.00 ±1.00^{b}	89.76 ±0.48^{c}	98.16 ±0.72	103.92 ±0.96	111.60 ±1.20^{c}	124.08 ±2.64		113.04 ±1.44^{b}
P3	20 min	90.00 ±4.16	84.96 ±1.20	94.56 ±0.96^{b}	101.40 ±1.68^{b}	109.44 ±2.16^{c}	121.68 ±3.60^{c}		109.92 ±1.68^{a}
P4	1 h	90.00 ±3.46	84.96 ±0.96	94.80 ±0.96^{b}	101.52 ±1.20^{b}	111.12 ±2.16^{c}	126.96 ±5.28		114.00 ±2.16^{c}
P5	24 h	92.00 ±1.00	82.80 ±2.16	92.64 ±0.48^{a}	99.36 ±1.20^{a}	108.48 ±2.16^{b}	122.64 ±2.16^{c}		111.36 ±0.96^{a}
P6	chronic exposure	91.00 ±1.91	88.32 ±0.96	94.80 ±0.72^{b}	99.60 ±0.72^{a}	106.32 ±0.72^{a}	118.32 ±1.20^{a}		110.40 ±1.20^{a}
Exposed to 250 mT stationary magnetic field									
C	non exposed	90.00 ±1.00	86.88 ±1.68	97.92 ±0.72	105.12 ±1.44	115.20 ±2.40	129.36 ±3.36	162.24 ±5.76	117.60 ±1.44
P7	1 min	91.00 ±1.91	83.04 ±1.44^{c}	94.56 ±0.48^{a}	102.72 ±0.96^{c}	114.00 ±2.40	132.48 ±5.52	–	117.60 ±2.40
P8	10 min	92.00 ±3.65	86.40 ±1.44	94.80 ±1.20^{b}	100.56 ±1.20^{b}	108.48 ±1.92^{b}	120.72 ±4.80^{c}	169.44 ±37.20	111.36 ±1.92^{b}
P9	20 min	95.00 ±3.00	85.68 ±1.92	94.56 ±0.48^{a}	100.56 ±1.20^{b}	108.72 ±2.16^{b}	120.44 ±3.84^{c}	143.52 ±34.00	111.84 ±0.96^{a}
P10	1 h	94.00 ±2.00	87.36 ±0.72	95.76 ±0.96^{c}	101.52 ±1.20^{b}	109.44 ±1.68^{b}	121.44 ±1.68^{b}	153.84 ±37.92	113.28 ±0.48^{b}
P11	24 h	90.00 ±2.58	84.72 ±2.40	92.40 ±1.20^{a}	97.92 ±1.20^{a}	105.6 ±1.44^{a}	118.56 ±2.40^{b}	–	108.48 ±2.64^{a}
P12	chronic exposure	95.00 ±1.00^{c}	87.60 ±0.96	93.84 ±0.72^{a}	98.16 ±0.48^{a}	103.92 ±0.72^{a}	112.80 ±1.92^{a}	135.12 ±19.68	107.76 ±1.68^{a}

Samples of statistical significance were marked. Explanations of the names of samples are describes in the Table2

Plant growth study:

Plant growth study was carried out to check the bioavailability of water from seeds to plants. The results of these studies were clearly confirmed that there was a visible change in the growth of plants at 72 h compared to seeds exposed with normal tap water. The seedlings from magnetized treated water were found to have stronger stem, deep penetration capacity of roots as the roots were well developed and healthy leaves.

Conclusion:

The present study discussed on the comparative efficiency of magnetized water produced from aquaguard domestic water purifier and normal tap water on various seeds. From the results, it was clear evident that the penetration of magnetized water into various seeds had positive impact on germination vigour and the growth. The weight of the seeds was gradually increased from treated groups compared to normal groups in all the seeds. Based on overall findings, it was clearly concluded that the magnetized treated water produced from aquaguard domestic water purifiers is superior and fast penetration in to the cells, there by hydrating of the cells is faster than the normal tap water which tends the faster growth in seed germination.

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References:

Hozayn, M.; and A.M.S. Abdul Qados (2010). Irrigation with magnetized water enhances growth, chemical constituent and yield of chickpea (Cicer arietinum L.). Agricultural and Biology Journal of North America. 1(4): 671-676 .

Silva, J.A.T.; and J. Dobranszki (2014). Impact of magnetic water on plant growth. Environmental and Experimental Biology. 12: 137-142 .

Pang, X.F.; and Deng, B. Investigation of changes in properties of water under the action of a magnetic field. Sci. China Ser. G: Phys. Mech. Astro., 51: 1621-1632 .

Ali, Y.; R. Samaneh; and F. Kavakebian (0214). Applications of magnetic water technology in farming and agriculture development: A review of recent advances. Current World Environment. 9(3): 695-703 .

Maheshwari, B.L.; and H.S. Grewal (2009). Magnetic treatment of irrigation water: Its effects on vegetable crop yield and water productivity. Agricultural Water Management. 96: 1229-1236.

Grewal, H.S.; and B.L. Maheshwari (2011). Magnetic treatment of irrigation water and snow pea and chickpea seeds enhances early growth and nutrient contents of seedlings. Bioelectromagnetics. 32: 58-65 .

Mahmood, S.; and M. Usman (2014). Consequences of magnetized water applications on maize seed emergence in sand culture. J.Ari.Sci.Tech. 16: 47-55 .

Sadeghipour, O.; and P. Aghaei (2013). Improving the growth of cowpea (Vigna unguiculata, L. Walp.) by magnetized water. Journal of Bio. and Env. Sci., 3(1): 37-43 .

Elshokali, A.A.M.; and A.M. Abdelbagi (2014). Impact of magnetized water on elements contents in plants seeds. International Journal of Scientific Research and Innovative Technology. 1(4):12-21 .

Hilal, M.H.; and M.M. Hillal (2000). Application of magnetic technologies in desert agriculture.1-Seed germination and seedling emergence of some crop in a saline calcareous soil. Egypt J. Soil Sci., 40: (3): 413-421 .

Morejon, L.P.; J.C. Castro; L.G. Velazquez; and A.P. Govea (2007). Simulation of *Pinus tropicalis* M. seeds by magnetically treated water. Int. Agrophys. 21: 173–177 .

Krishnaraj, C.; S.I. Yun; and V.K. Abhay Kumar (2017). Effect of magnetized water (Biotron) on seed germination of Amaranthaceae family. Journal of Academia and Industrial Research. 5 (10): 152-156 .

[19] Changa, K.; and C. Weng (2006). The effect of an external magnetic field on the structure of liquid water using molecular dynamics simulation. J. Appl. Phys., 100: 7-11.

Ijaz, B.; S.A. Jatoi; D. Ahmad; M.S. Masood; and S. Siddiqui (2012). Changes in germination behavior of wheat seeds exposed to magnetic field and magnetically structured water. Afr. J. Biotechnol., 11 (15): 3575-3582 .

De Souza, A.; D. Garcia; L. Sueiro; F. Gilart; E. Porras; and L. Licea (2006). Pre-sowing magnetic treatments of tomato seeds increase the growth and yield of plants. Bioelectromagnetics. 27: 247-257 .

De Souza, A.; R. Casate; and E. Porras (1999). Effect of magnetic treatment of tomato seeds (*Lycopersicon esculentum* Mill.) on germination and seedling growth. (in Spanish). Invest Agr Prod Prot Veg., 14(3): 67-74 .

De Souza, A.; D. Garcia; L. Sueiro; L. Licea; and E. Porras (2005). Pre-sowing magnetic treatments of tomato seeds: Effects on the growth and yield of plants cultivated late in the season. Spanish. J.Agric. Res., 3(1): 113-122 .