

Effect of Magnetized Water (Biotron) on Seed Germination of *Amaranthaceae* Family

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Abstract

Interactions of magnetized water on three different seeds from the *Amaranthaceae* family namely, *Amaranthus tricolor*, *A. gengeticus*, *A. blitum* germinations were documented. The magnetized water used in the study was collected from Dr. Aquaguard Magna HD RO+UV domestic water purifier incorporated with biotron technology (magnetized water). Further, the effect of magnetized water on seed germination vigor was documented compared to normal tap water. From the findings, it was clear evident that the magnetized treated water had positive impact on all the treated groups in terms of seed germination (%). The seed germination vigor was started little early (14 h) in treated group of *Amaranthus gengeticus* and *A. tricolor* compared to normal tap water treatment (16 h). Similarly, in case of *Amaranthus blitum*, the germination vigor started at 36 h of incubation period in magnetized treated water compared to normal tap water treated group (60 h). In addition, the weight of the magnetically treated water seeds (50 seeds) was gradually increased from 30 to 140 µg which is a clear indication for the rapid penetration of water molecules into seeds.

Keywords: Biotron, magnetized water, *Amaranthaceae*, incubation period, seed germination.

Introduction

Recently, magnetized water had been focused more in research on living systems, in particular to the effect of seeds germination and their plant growth (Shabrangi and Majd, 2009). Actually, the first study was started long back by Savostin (1930) who had reported 100% increase in the rate of elongation of seedlings under the influence of magnetic field. Later, the number of researchers namely, Audus (1960), Pittman (1965) and many more had focused on similar field of research. Evidence to date indicated that the magnetic field was widely used as a pretreatment for seeds in order to increase the seed vigor, seedling growth and yields (Dagoberto *et al.*, 2002; Carbonell *et al.*, 2000; Ijaz *et al.*, 2012, 2015; Iqbal *et al.*, 2012; Magdalena *et al.*, 2015). The reason for increase in seed vigor, seedling growth and yields were due to increased absorption rate, assimilation of nutrients (Kavi, 1983) and ameliorated photosynthetic activities (Lebedev and Litvinenko, 1977). It was also believed that with the use of magnetic field on seed and water, some of the physiological-biochemical changes were occurred due to rearrangement of influenced molecule. Thus, breathing and photosynthesis of the seed intensifies, water assimilation becomes faster which ultimately enhanced the viability of seeds (Putincev and Platonova, 1997). In addition, the exposure of magnetic field also enhances the ions concentration, free radicals and physical changes which favor better seed germination (Haq, 2012).

Better to knowledge, magnetic treatments are assumed to enhance seed vigor by influencing the biochemical process that involve free radicals and by stimulating the activity of proteins and enzymes (Murry, 1965). Moreover, chemical substances used for seed invigoration were found detrimental at later stages of plant development and seedling growth and also considered unfavorable to the environment (Jamil *et al.*, 2012). Therefore, pre-sowing treatment of magnetic field gives safe, inexpensive and most harmless option (Podlesny *et al.*, 2004). Shabrangi and Majd (2009) had reported that the magnetically treated lentil seeds showed better growth and grew taller with improved root seedlings than untreated controls. Few researchers have also studied the comparison of direct and indirect effect of magnetic treatment on seeds. The behavior of seeds passed through magnetic device (direct effect) is different from the normal seeds sown with magnetic water irrigation (indirect effect). Few researchers have reported that both the direct and indirect method had positive effect on seed germination (Alexander and Doijode, 1995; Carbonell, 2000) and also in plants like onion (Dagoberto, 2002), wheat (Harichand *et al.*, 2002), maize (Florez *et al.*, 2007), rice (Alexander and Doijode, 1995), sunflower (Vashisth and Nagarajan 2010) and tomato (Moon and Chung, 2000). Hence in the present study, an attempt was made to investigate the effect of magnetized treated water on seed germination of *Amaranthaceae* family.

It contains 174 genera and around 2,500 species distributed worldwide and its members are typically herbaceous plants or sub-shrubs, many of which can tolerate poor saline soils. The flowers are often small and borne in dense inflorescences and the simple leaves are usually arranged alternately along the stem. A number of species are important food crops and several are cultivated as ornamentals. In addition, the plants were carrying many medicinal uses like cooling, alexiteric, laxative, stomachic, appetizer and antipyretic; used in burning sensation, hallucination, leprosy, bronchitis, piles, leucorrhoea, constipation, good remedy for the roundworm, emollient and it also used in biliousness, haemorrhagic-diathesis, blisters and many more.

Materials and methods

Materials: The healthy seeds of *Amaranthus tricolor*, *A. gengeticus*, *A. blitum* were obtained from Tamil Nadu Agricultural University (TNAU), Coimbatore, India. Similarly, for magnetized water, the Dr. Aquaguard Magna HD RO+UV product outlet water was used, which was incorporated with Biotron (Magnetron) technology for producing the magnetized water.

Surface sterilization of seeds: Fifty seeds of each control and treated groups with the same size and weight of *Amaranthus tricolor*, *A. gengeticus*, *A. blitum* were surface sterilized with 0.2% HgCl₂ solution for 5 min, thoroughly washed with deionised water to remove any adsorbed HgCl₂ present on the outer coat of the seeds.

Effect of magnetized water on seed germination: The surface sterilized seeds of *Amaranthus tricolor*, *A. gengeticus*, *A. blitum* were exposed with 25 mL of magnetized water (2500 gauge) for 3 h. In control group, seeds were exposed with normal tap water for 3 h. Triplicates were maintained throughout the experiment. Then, the pre-soaked seeds were raised in cotton beds and the germination index of the different treatment groups were calculated using the formula, $G.I = \frac{\text{No. of seeds germinated}}{\text{total no of seeds}} \times 100$. The cotton beds were kept in room at natural light conditions (16 h light: 8 h dark) and the temperature were ranged from 33-38°C. After 96 h of seed germination, the root, stem and leaves were measured in terms of mm.

Osmotic effect: The dry seeds of (50 numbers each) *Amaranthus tricolor*, *A. gengeticus*, *A. blitum* were immersed with magnetized water at different time intervals to understand the rapid absorption of water molecules into the seeds. Similarly, control groups were maintained (Treated with normal tap water). The initial weight and the final weight of the seeds were noted at different time intervals (1, 3 and 6 h).

Statistical analysis: All experiments were performed in triplicates and the data were presented as mean \pm standard deviation (SD) of three independent experiments.

Results and discussion

The present study demonstrated the effect of magnetized water on seed germination of *Amaranthaceae* family. The seeds were exposed with magnetized water collected from Dr. Aquaguard Magna RO+UV domestic water purifier which has incorporated with the biotron (Magnetron) technology (Fig. 1). This method of magnetized water production is very simple, inexpensive and rapid process.

Fig. 1. Dr. Aquaguard Magna RO+UV domestic water purifier incorporated with biotron (magnetron) technology.



A: Magnetron technology for producing magnetized water; B: Dr. Aquaguard Magna RO+UV domestic water purifier incorporated biotron technology.

Interaction of magnetized water on seed germination: The result of the seed germination study clearly revealed that the magnetized water had positive impact on seed germination of *Amaranthaceae* family compared to normal tap water. The seed germination vigor started little early (14 h) in treated group of *Amaranthus gengeticus* and *A. tricolor* compared to normal tap water treatment (16 h). Similarly, in case of *Amaranthus blitum*, the germination vigor was started at 36 h of incubation period in magnetized treated water compared to normal tap water (60 h) (Fig. 2a, b and c). The germination parameter such as seed germinated and the hours taken for germination was recorded. The number of seeds germinated was calculated at different time intervals such as 18, 24, 36, 48, 60, 72 and 96 h (Fig. 3a, b and c). The germination index of the different treatment groups was calculated. The length of the root, stem and leaves were measured in terms of mm and presented in Table 1. Based on the obtained results, it was clear that the length and growth of the plants in magnetized treated water was shown high compared to normal tap water treatment (Fig. 4a, b and c). With reference to the ratio calculation, it is evident that the number of seeds germinated from magnetized water treated group was high compared to normal tap water treatment. Recently, Vashisth and Nagarajan (2010 and 2008) found that the direct effect of magnetic fields increases the speed of germination in sunflower and in chickpea (Vashisth and Nagarajan, 2008). Our results are in consistent with the previously published research reports (Alexander and Doijode, 1995; Carbonell *et al.*, 2000; Moon and Chung, 2000; Harichand *et al.*, 2002; Florez *et al.*, 2007; Vashisth and Nagarajan, 2010; Leelapriya *et al.*, 2003; Bilalis *et al.*, 2013).

Fig. 2. Effect of normal water and magnetized treated water on seed germination of *Amaranthaceae* family.

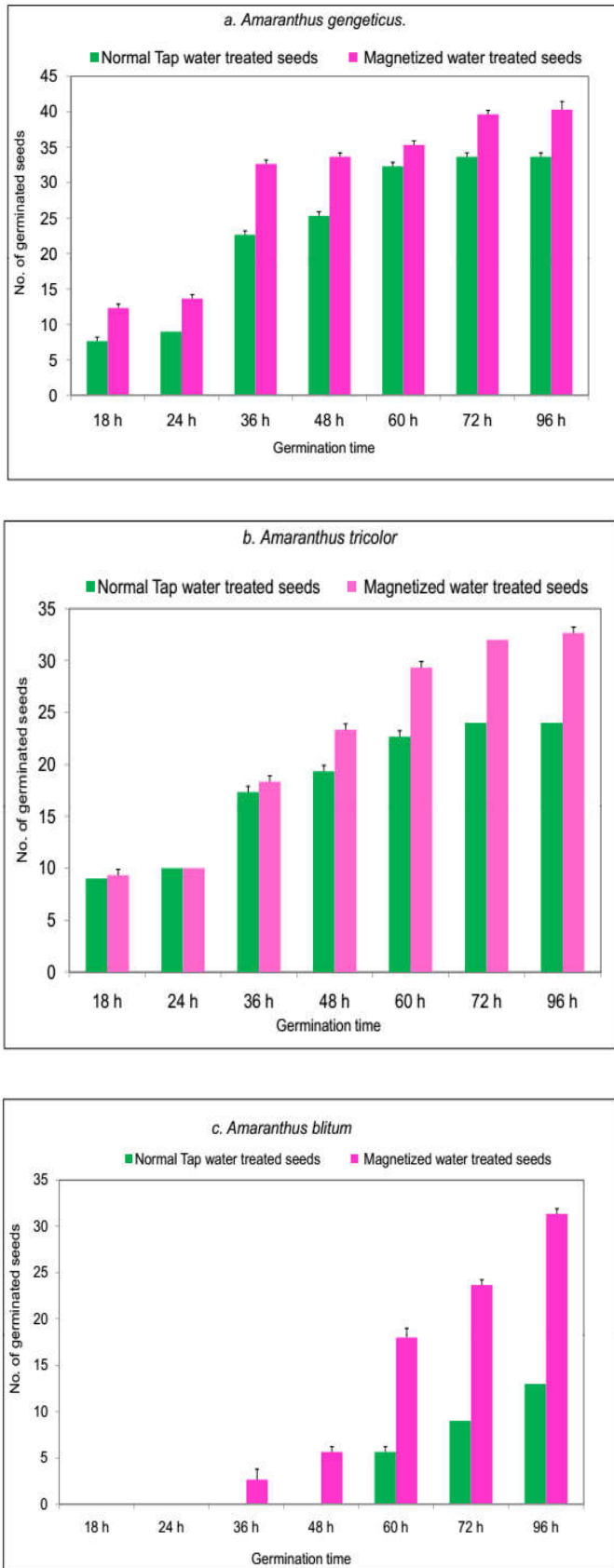
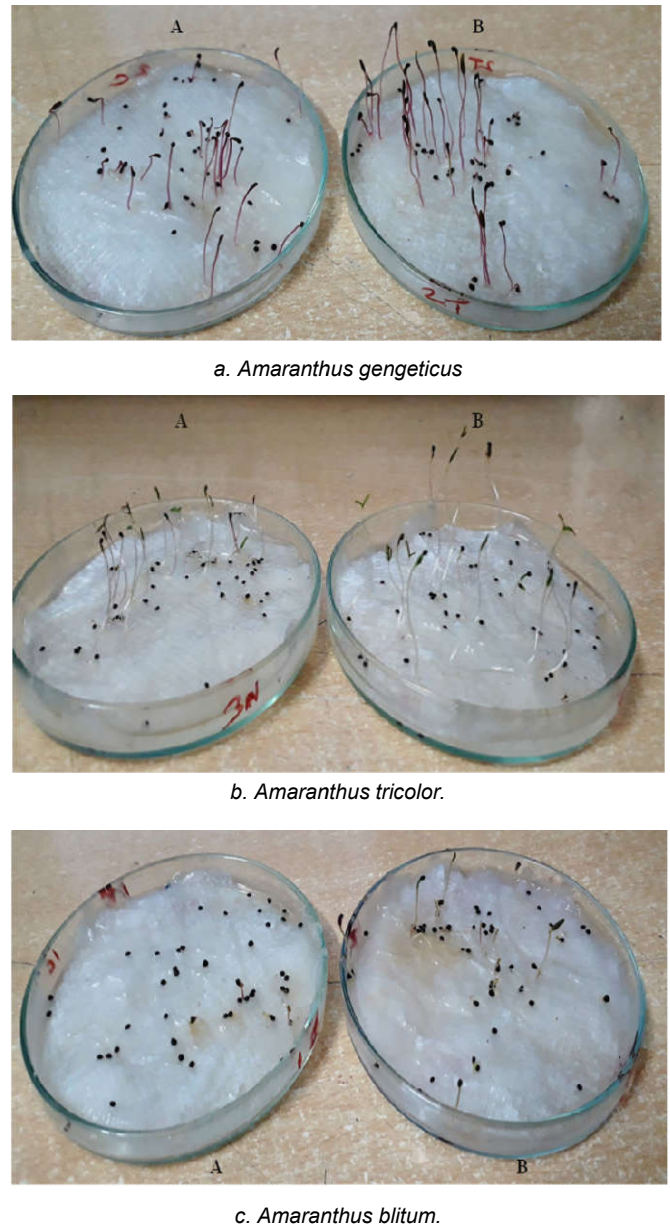


Fig. 3. Effect of normal water and magnetized treated water on *Amaranthaceae* family at 96 h. (A: normal water; B: Magnetized water)



Recently, Waleed *et al.* (2013) had reported that the magnetic field of 50 mT resulted in increase in the root length, radical length and weight of the radical. This remarkable improvement induced by the magnetic treatment was consistent with the results of other studies on onion (Dagoberto *et al.*, 2002), wheat (Harichand *et al.*, 2002), maize (Florez *et al.*, 2007), rice (Alexander and Doijode, 1995), sunflower (Vashisth and Nagarajan, 2010) and tomato (Moon and Chung, 2000). Recently, a study done by Hozayn *et al.* (2011) has also proved that the magnetized water increased the yield and yield component traits of all crops.

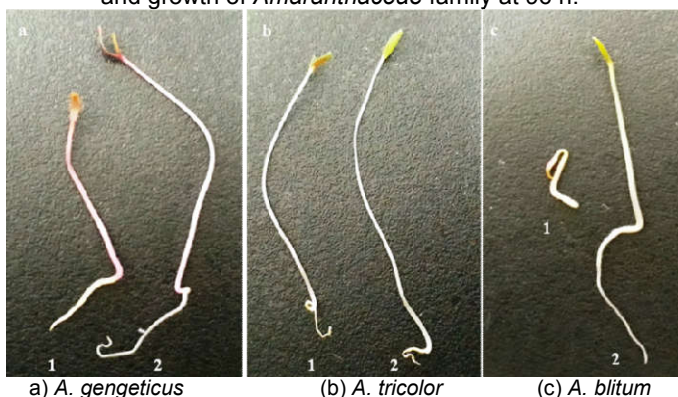
Table 1. Effect of magnetized water on root length, stem and leaves of *Amaranthus* family.

Name of the plant	Plant part	Normal tap water treated (mm)	Magnetized water treated (mm)
<i>Amaranthus gengeticus</i>	Root	17 ± 01	20 ± 02
	Shoot	24 ± 02	33 ± 02
	Leaf	03 ± 01	04 ± 01
<i>Amaranthus tricolor</i>	Root	15 ± 02	17 ± 01
	Shoot	27 ± 02	27 ± 01
	Leaf	04 ± 01	05 ± 02
<i>Amaranthus blitum</i>	Root	03 ± 01	23 ± 01
	Shoot	08 ± 02	29 ± 01
	Leaf	04 ± 01	05 ± 02

Table 2. Osmosis study on different seeds (50 seeds) treated with normal and magnetized water (measured in µg).

Seeds	Treatment	Weight of dry seeds	Weight at 1 h	% Weight increase	Weight at 3 h	% Weight increase	Weight at 6 h	% Weight increase
<i>Amaranthus gengeticus</i>	Normal tap water	60	70	16.6	90	50	110	83.3
	Magnetized water	50	70	40	90	80	130	160
<i>Amaranthus tricolor</i>	Normal tap water	30	40	33.3	40	33.3	50	66.6
	Magnetized water	40	60	50	70	75	80	100
<i>Amaranthus blitum</i>	Normal tap water	50	80	60	110	120	130	160
	Magnetized water	50	100	200	130	160	140	180

Fig. 4. Effect of normal (1) and magnetized water (2) on length and growth of *Amaranthaceae* family at 96 h.



The increase in the yield/plant in monocotyledonous crops reached to 9.10 and 31.33% for flax and wheat and in dicotyledonous crops, it reached to 24.92 and 38.46%, for lentil and chick pea compared with crops irrigated with tap water.

Osmosis study: In order to understand the rapid penetration of water molecules into seeds, the dry seeds of (50 numbers each) *Amaranthus tricolor*, *A. gengeticus*, *A. blitum* were immersed in magnetized water and in normal tap water at different time intervals. The results were shown in Table 2. From the results, it was clear evident that the absorption of water molecules into seeds gradually increased in both the treatment but in case of magnetized treated water, it was much better. The reason behind the rapid penetration of high amount water molecules into magnetized treated water may due to slight increase of hydrogen bonds in presence of magnetic field.

This implies that the size of a water cluster can be controlled by the application of an external magnetic field. Also, the structure of the water is more stable and the ability of the water molecules to form hydrogen bonds is enhanced when a magnetic field is applied. In addition, the behavior of the water molecule changes under the influence of magnetic field (Changa and Weng, 2006). The stimulatory effect of magnetic water may be attributed to their role in increasing the absorption and assimilation of nutrients consequently increasing plant growth (hozayn *et al.*, 2011).

Conclusion

The present study discussed on the interactions of magnetized water on three different seeds from the *Amaranthaceae* family. The effect of magnetized water on seed germination vigor was documented compared to normal tap water. From the results it was clear evident that the magnetized treated water had positive impact on all the treated groups in terms of seed germination (%). The present study clearly concluded that there is a change in the property of water when treated with the magnet. Earlier, it was considered a pseudoscience where magnetic water has effect on the seeds germination and their plant growth. But now studies are focusing more on positive outlook towards the effect of bioavailability of magnetized water on different biological systems.

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