

Research Article

Comparative Efficiency of Magnetized (Biotron) Water and Normal Tap Water on Various Seeds for Their Germination and Growth

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Abstract

The present study discussed on the germination vigour efficiency of various seeds tested and their plant growth using magnetized water produced from Aquaguard domestic water purifiers, which are 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 (*Brassica juncea*), tomato (*Lycopersicum esculentum*), and rice (*Oryza sativa*) were used. The parameters like seed germination study, osmosis assay, shoot length, root length and leaf sizes were documented. 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 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, 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.

Keywords: Aquaguard domestic water purifiers; Biotron; Magnetized water; Seed germination; Plant growth.

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Introduction

Magnetized water is nothing but the water exposed to the magnetic field or passed through the magnetic device [1]. 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 [2, 3]. 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 [4].

Currently, there are number of reports were discussed on the positive impact of magnetized water on seed germinations and plant growth [5-13]. 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 [14]. 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 concentration in plant seeds of onion, sun flower and tomato and the results were compared with the normal water [15]. 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 [13]. 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 [16].

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 [17]. In addition remarkable improvement on seedlings growth was achieved in magnetically treated group compared to normal group. Recently, in our previous work we had carried out the study on interactions of magnetized water on three different seeds from the *Amaranthaceae* family namely *Amaranthus tricolor*, *A.gengeticus* and *A.blitum* and the results were 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 [18]. Hence based on the previous reports and the present work carried out from few of the universities in India, here we have discussed on the comparative efficiency of magnetized water produced from Aquaguard domestic water purifiers and normal tap water on various seeds tested.

Materials and Methods

Seeds selection

The selection of healthy seeds and their research work were carried out from few of the Universities in India and the details were presented in **Table 1**.

Table 1: Seeds Selection

| Sl.No | Name of the University | Common name of the Seed | Botanical Name of the seed |
|-------|---|---------------------------|---|
| 1. | Cochin University of Science and Technology | Red cow pea seeds | <i>Vigna unguiculata</i> |
| 2. | Babasaheb Bhimrad Ambedkar University | Soybean Corn | <i>Glycine max</i> <i>Zea mays</i> |
| 3. | Sri Venkateswara College- University of Delhi | Mustard Rice Tomato | <i>Brassica juncea</i> <i>Oryza sativa</i> <i>Lycopersicum esculentum</i> |
| 4. | Gauhati University | Green Gram | <i>Vigna radiata</i> |

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 Aquaguard 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 petriplates, 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 $G.I = \frac{\text{No. of seeds germinated}}{\text{total no. of seeds}} \times 100$. The above work was carried out in natural light condition (16 h light: 8 h dark) and the temperature were ranged between 25 - 30 °C.

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 Aquaguard water purifier (**Figure 1**).

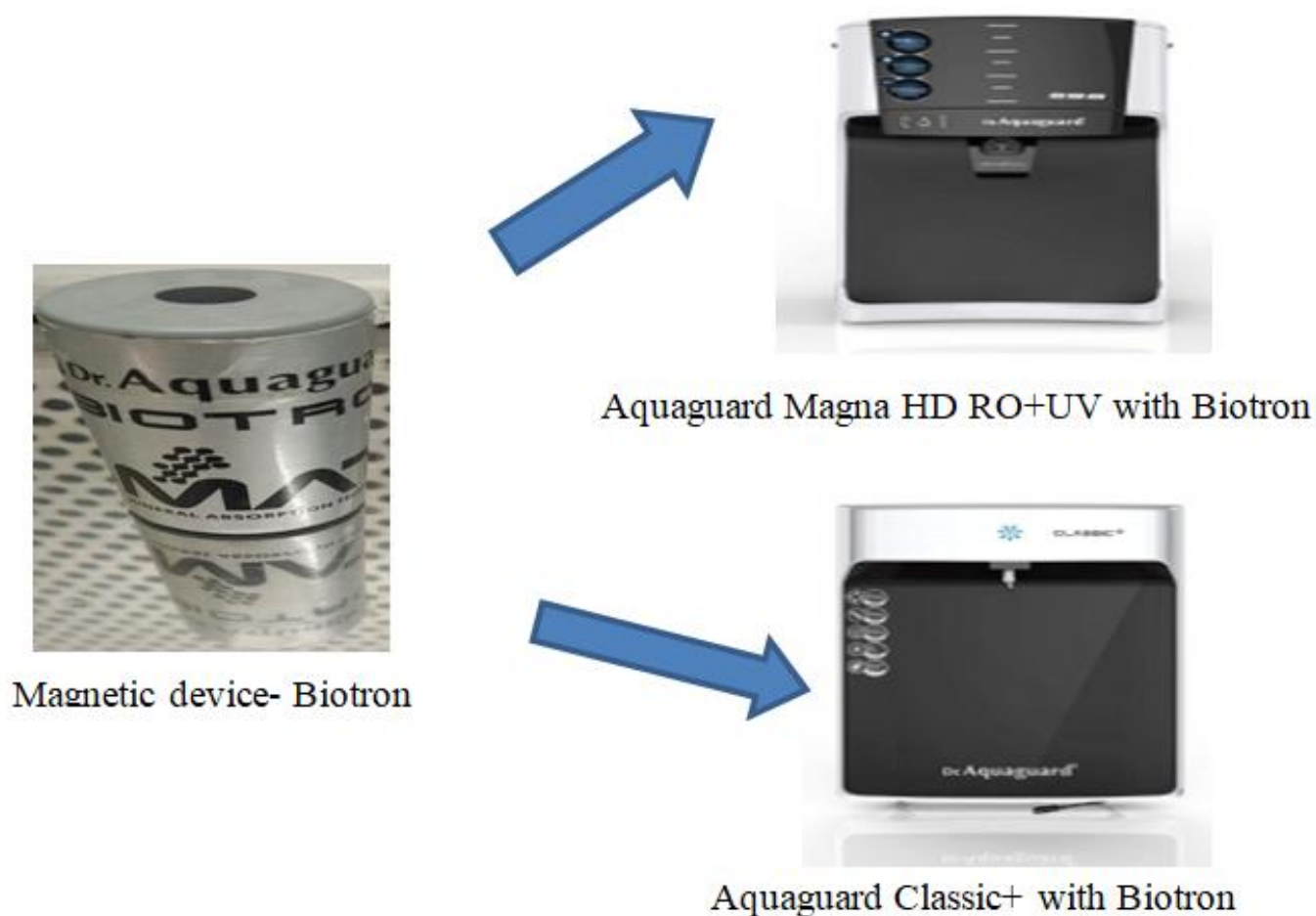


Figure 1 Biotron and Aquaguard picture

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. **Figure 2** demonstrates the overall flow diagram of the work.

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 (**Figure 3**).

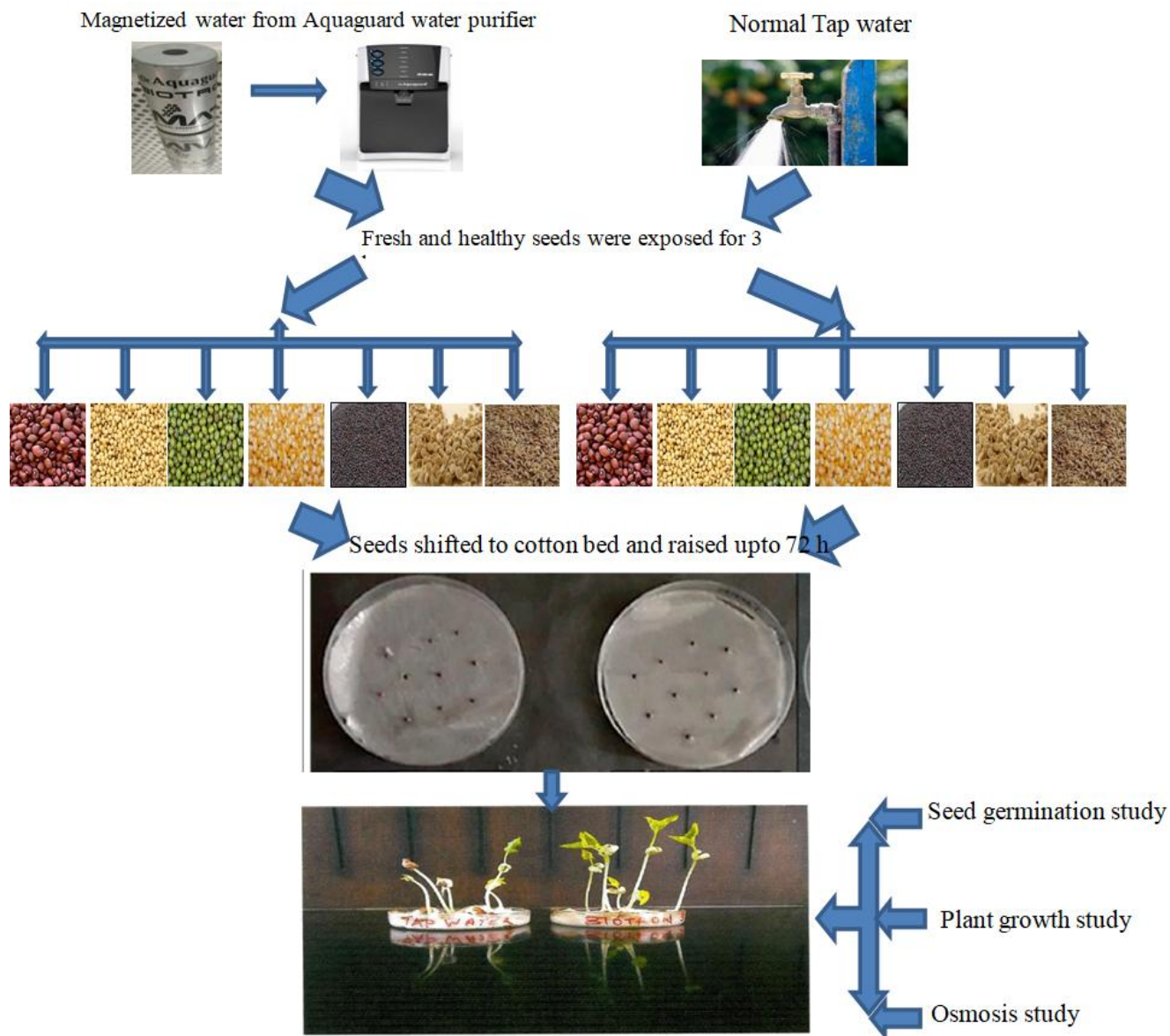
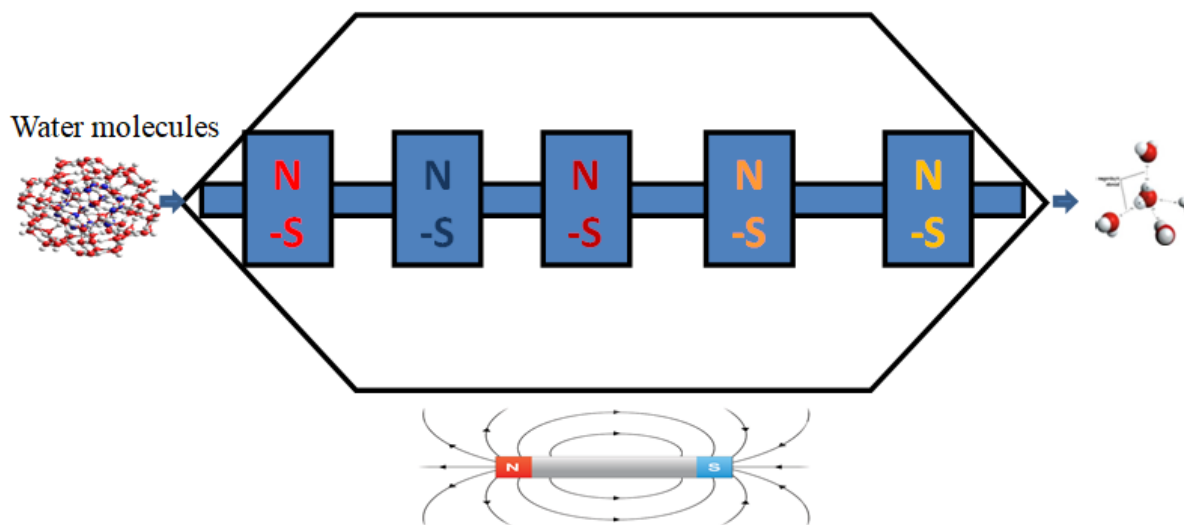


Figure 2 Overall flow diagram of the work



Magnetic Device- Biotron

Figure 3 Schematic flow diagram of biotron cartridge

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 [18, 19].

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*, *Brassica 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 (Figure 4).

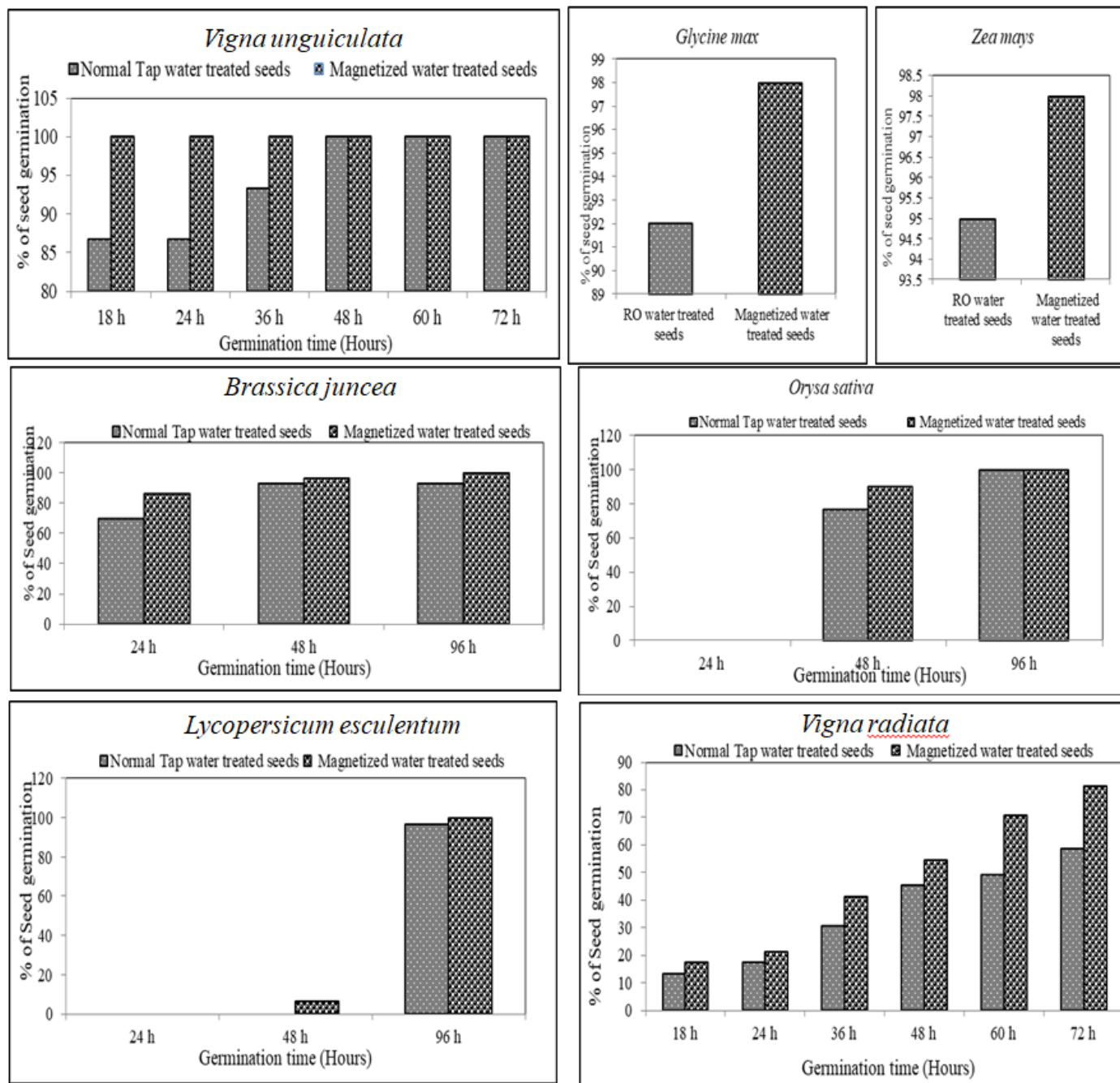


Figure 4 Seed germination study.

These results are in consistent with the previously published research papers [1, 5, 6, 14, 20-25]. 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 on seed germination, vegetative growth and yield [23, 26, 27].

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. Hence the water passed through magnetic cartridge significantly enhanced the plant growth. The leaf size, shoot length and root length of both treated and non-treated groups of tested seeds were present in **Table 2**.

Table 2: Plant growth study

| Growth parameters after 72 h- Cochin University | | | | |
|---|------------------|-------------------|------------------|----------------|
| Seed Name | Type of water | Shoot length (mm) | Root length (mm) | Leaf size (mm) |
| 1. <i>Vigna unguiculata</i> | Normal water | 20 | 23 | 25 L x 10 W |
| | Magnetized water | 26 | 29 | 35 L x 20 W |
| Growth parameters after 7 days- Babasaheb Bhimrad Ambedkar University | | | | |
| Name of seeds | Type of water | Total length (cm) | Leaves count | |
| 2. <i>Glycine max</i> | RO water | 15.4 | 2 | |
| | Magnetized water | 16.5 | 2 | |
| 3. <i>Zea mays</i> | RO water | 24.0 | 2 | |
| | Magnetized water | 24.6 | 2 | |
| Root and Shoot biomass after 120 h- Sri Venkateswara college – University of Delhi | | | | |
| Name of seeds | Type of water | Dry weight | | |
| | | Root | Shoot | |
| 4. <i>Brassica juncea</i> | Normal water | 0.007 | 0.018 | |
| | Magnetized water | 0.015 | 0.027 | |
| 5. <i>Oryza sativa</i> | Normal water | 0.011 | 0.007 | |
| | Magnetized water | 0.009 | 0.020 | |
| 6. <i>Lycopersicum esculentum</i> | Normal water | 0.0024 | 0.00389 | |
| | Magnetized water | 0.00566 | 0.01103 | |
| Avg % of growth parameters after 72 h- Gauhati University | | | | |
| Seed Name | Type of water | Shoot length (mm) | Root length (mm) | Leaf size (mm) |
| 7. <i>Vigna radiata</i> | Normal water | 11 | 02 | No leaf |
| | Magnetized water | 19 | 06 | 02 |

Researchers have reported that the magnetic treatment produced the bio stimulation on the initial growth stages and increase the germination rate of several seeds such as rice [28, 29] wheat [30] and barley [31]. Very recently, Sayed and Sayed (2014) had done the study on impact of magnetic water irrigation for improve the growth, chemical composition and yield production of Broad bean (*Vicia faba* L.) plant and reported that the magnetic treated broad bean significantly increased the growth parameters (plant height, fresh and dry weight of leaves, stem, and root, leaf area) as compared to the tap water (control) [32]. In addition Aladjadjiyan (2012) showed that the exposure of *Zea mays* seeds had a favourable effect on the development of shoots in the early stages [7]. In addition, Nasher (2008) had reported that the chick pea plants irrigated with magnetized water were taller than plants irrigated with tap water [22].

Osmosis study

Osmosis study was carried out to confirm the efficiency of water molecules penetrating into the tested seeds (**Table 3**).

Table 3 Rate of water absorption VS time (Hours) – 10 seeds each measured in gm

| Sl. No. | Name of the Seed | Type of water | Wt of dry seeds | Wt after 1 h | % Wt increase | Wt after 3 h | % Wt increase | Wt. after 6 h | % Wt increase |
|---------|--------------------------|------------------|-----------------|--------------|---------------|--------------|---------------|---------------|---------------|
| 1. | <i>Vigna unguiculata</i> | Tap water | 1.439 | 1.848 | 28.42 | 2.262 | 57.19 | 2.662 | 84.9 |
| | | Magnetized water | 1.521 | 2.149 | 41.28 | 2.737 | 79.94 | 3.317 | 118.08 |
| 2. | <i>Glycine max</i> | RO water | 0.20 | 0.21 | 5 | 0.24 | 20 | 0.24 | 20 |
| | | Magnetized water | 0.19 | 0.21 | 10.52 | 0.23 | 21.05 | 0.26 | 36.84 |
| 3. | <i>Zea mays</i> | RO water | 0.38 | 0.39 | 2.63 | 0.41 | 7.89 | 0.42 | 10.52 |
| | | Magnetized water | 0.38 | 0.39 | 2.63 | 0.41 | 7.89 | 0.42 | 10.52 |
| 4. | <i>Vigna radiate</i> | Tap water | 0.972 | 1.469 | 51.13 | 1.524 | 56.79 | 1.648 | 69.54 |
| | | Magnetized water | 0.987 | 1.671 | 69.30 | 1.766 | 78.92 | 1.971 | 99.69 |

From the results, it was clear evident that the absorption/penetration efficiency of water molecules were gradually increased in both the treatment but in case of magnetized treated water, it was much better. These results are in agreement with the study conducted by Taia *et al.*, (2007) had observed the significant increase in rate of water absorption could cause by the variations induced by magnetic fields in the ionic currents across the cellular membrane resulted in change in osmotic pressure [33]. Similarly, Stange *et al.*, (2002) reported that the electromagnetic fields cause changes in rate of ion transportation across the plasma membrane and also affect the structure of the cell membrane lipid protein dynamics resulted in alteration in the permeability of the plasma membrane of plant roots [34]. In addition, Vashisth and Nagarajan (2010) had demonstrated that the leachate conductivity of magnetic-exposed seeds was lower than unexposed seeds, due to better membrane integrity in magnetically-exposed seeds [35]. The modification of binding properties of seed water and increased seed membrane integrity in magnetically -exposed seeds might have enhanced the germination traits and early seedling growth of maize [36].

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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