Effects Of Electromagnetic Fields On Seed Germination In Urtica Dioica L

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Abstract: The study of electromagnetic fields on plants growth and other living beings are one of the most important subjects which attract many researchers, attention therein. Various plants react against electromagnetic fields with different levels of intensities. In this research, the effects of electromagnetic fields on germination of seeds property of Urtica dioicaL. were studied. Seeds of this plant were put under electromagnetic field by 0.8 and 1.6mT for duration of 5,10,20 minutes. In addition this test was performed at first on dry seeds and after 48 hours on wet seeds. Under these conditions, the velocity of germination and percentage of treated seeds were increased against control. Except on item in which germination percentage was decreased against control about wet seeds which put under electromagnetic field by 0.8 for 5 20 minutes duration. Among treated samples, electromagnetic field by 0.8mT in 5 minutes duration and 1.6mT in 10 minutes duration in dry seeds and also for 5 minutes duration in wet seeds showed the fastest germination among treated.

Key words: electromagnetic field, germination, Urtica dioica

INTRODUCTION
Weak magnetic fields and low frequency electromagnetic fields were ubiquitous environmental factors on the earth at every time. More and more scientific reports are focused on the stimulation of living organisms, including plants, with various types of magnetic field[15]. Exposure of seeds to magnetic field for a short time was found to help in accelerated sprouting and growth of the seedlings [16]. The magnetic field is not as widely applicable to the pre-sowing seed treatment as the electric field is. The magnetic field used in the experiments is mainly the constant magnetic field produced by magnets or electromagnets. Labile magnetic field is used uncommonly but with still growing interest[11],[12],[10],[21]. Magnetic field may play an important role in cation uptake capacity and has a positive effect on immobile plant nutrient uptake [4],[5]. Studies on the meristematic cells of plants have shown that magnetic field affects normal metabolisms and has impact on cellular division[1],[4].

Magnetic fields affect the synthesis of DNA and RNA as well as the cellular proliferation. Mitotic analyses indicated a positive influence of EMF on the rate of cell proliferation in pretreated seeds with 3mT intensity for a 4h exposure time, and showed decrease in chromosomal aberrations[17]. Racuciu (2006) observed that the magnetic field stimulated the shoot development of maize and led to an increase in germinating energy, germination, fresh weight and shoot length[15]. Still the mechanism of action of magnetic field on plants are not well known. Beneficial effects of magnetic fields on different crops and yields have been reported. An increase of crops of different species subjected to magnetic field has been found. EMFs in both extremely low frequency (ELF) and radio frequency (RF) ranges activate the cellular stress response, a protective mechanism that induces the expression of stress response genes. EM fields bring about oxidative stress: they increase in the activity concentration and lifetime of free radicals.

2 MATERIALS AND METHODS
2.1 Electromagnetic field exposure
The magnetic field was generated by means of a pair of Helmholtz coils system that creates a uniform magnetic field into a relatively large space volume allowing the Each Helmholtz coil from exposure device has a diameter by 260mm and 1000 number of turns.
2.2 Experimental design
Seeds of U. dioica L. were obtained from seed and plant improvement agriculture institute Isfahan, Iran. We worked with two different Electromagnetic induction values (0.8-1.6 mT) at 50 Hz frequency for duration of 5-10-20 minutes (table.1) this test also performed on dry seeds and also after 48 hours wet seeds. While the control sample was let to develop in absence of the external magnetic field. Three replicates were used in the experiment with 10 seeds in each treatment. During the experiment, the ambient temperature was the same for the control and the exposed samples (24±0.5°C). U. dioica seeds were let to germinate, freshly germinated plantlets being then exposed to electromagnetic field for 14 days. Then, the percentage and speed seed germination of treated seeds and controls were compared.

Table 1. Effect of electromagnetic field exposure time to the u.dioica seed as follows:

<table>
<thead>
<tr>
<th>Exposure time (min)</th>
<th>State seed</th>
<th>Electromagnetic treatment (mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (control)</td>
<td>Wet</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Wet</td>
<td>0.8</td>
</tr>
<tr>
<td>10</td>
<td>Dry</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Wet</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>dry</td>
<td></td>
</tr>
</tbody>
</table>

3 RESULTS

3.1 Electromagnetic fields’ effects on seeds’ germination

3.1.1 Dry seeds
Investigating germination in U. dioica seeds was done after special treating. Control samples germinated after 14 days from beginning but germination in treated seeds started sooner about 10 days after treating. Germination in treated samples was quicker than control samples. After 3 days from beginning time, about half of the samples were germinated but in control samples it took about 5-7 days after beginning time. Germination in most of the dry samples started 19 days after treating. Fastest rate of germination was related to treated seeds in fields with the intensity of 1.6 mT for 10 minutes and slowest rate of germination was related to treated seeds in fields with the intensity of 0.8 mT for 10 minutes. Germination percentage in dry control samples was 30%. Among the treated seeds; the ones that were treated in a field of 0.8 mT for 20 minutes had the highest germination percentage (0.67%) and the ones were treated in a field of 0.8 mT for 10 minutes had the lowest germination percentage (42%). No group of samples showed 100% of germination. The highest germination percentage for 5 minutes was related to a field of 1.6 mT; and for 10 minutes was related to a field of 1.6 mT. But for 20 minutes, we notices that a field of 1.6 mT had lower germination percentage than a field of 0.8 mT (fig.2).

Fig. 2. percent Germination response in U. dioica seeds dry

3.1.2 Wet seeds
U. dioica seeds were soaked for 48 hours in urban water and then were treated under electromagnetic fields and then they were planted in plates. Both control and treated groups began to germination simultaneously. Needed time for germinating 50% of the seeds for treated seeds in wet condition was 3-4 days after beginning of germination and was 5 days for control samples. Treating with a field of 1.6 mT for 5 minutes resulted in the fastest germination speed and treating with 1.6 mT for 10 minutes resulted in slowest germination speed. Germination percentage in control samples was 60%. The most germination rate was related to treated samples in a field of 0.8 mT for 5 minutes. Among the treated seeds; the samples treated in field of 0.8 mT for 20 minutes had the least germination percentage. No group of samples showed 100% of germination (fig.3)

Fig. 3. Percent Germination response in U. dioica seeds wet.

Generally, germination in seeds that treated in wet condition was faster than dry seeds. Highest percentage of germination for treating in 5 minutes is related to a field of 0.8 mT and for treated seeds in 10 minutes, it is related to a field of 0.8 mT. The highest percentage of germination for treated seeds in 20 minutes is related to a field of 1.6 mT (fig. 4). Germination (%)
Investigating seeds germination
We counted the germinated seeds on the plates every day to calculate the germination speed. It was done until about the half of seeds was germinated. For calculating the germination percentages, counting had to be continued until no more seeds germinated. Then we used related formulas for calculating germination speed and germination percentages.

4 CONCLUSION
Exposure of U.dioica seeds to different magnetic fields showed an overall stimulating effect with respect to percent germination(fig.4).Such enhanced performance of seeds exposed to magnetic fields has been reported previously by scientists dealing with various crop seeds [7], [20].Florez et al (2007) reported faster germination of maize seeds when exposed to magnetic field of 125 or 250 mT for varying periods of time. Fischer et al.(2004) reported that sunflower seedling exposed to magnetic fields showed low but significant increase in total fresh weight, whereas dryweight and germination rates remained unaffected[6]. In our research the treatment samples in comparison to control, showed that the percentage of seed germination increased the possible reason for intensification of germination, may be the increasing of substances consumption and more water absorption under effect of EMF[9],[18]. The interaction of magnetic field and exposure time indicates that certain combination of magnetic field and duration, such as 0.8 mT for 20 min is highly effective in enhancing germination (fig.2).This observation indicates that the internal energy of the seed responds positively when there is an appropriate combination of magnetic field and exposure time[2]. Vashisth (2010) reported that in Ragi (Eleusine coracana) seeds exposed to 100mT magnetic field changed the internal potential energy, and suggested that by selecting a suitable combination of magnetic field and exposure time, it may be possible to obtain higher yields[20]. Also, it appears that there is a window at 150 mT and 3h exposure where the magnetic field negatively interacts and reduces the seedling traits compared to untreated controls[19]. Germination in treated samples was quicker than control samples. Similar enhancement in speed of germination due to magnetic field exposure of seeds has been reported in maize[7] in rice[3], and in wheat[2]. podlesnsy (2004, 2005) confirmed the positive effect of the magnetic treatment (30 and 85mT) on the germination and emergence of both Broad bean and Pea cultivars[13],[14]. Results of our experiment indicated that wet U.dioica seeds germinate faster than dry seeds.

REFERENCES


