Effects Of Electromagnetic Fields On Seed Germination In Urtica Dioica L

Rostami zadeh E., Majd A., Arbabian S

Abstract: The study of electromagnetic fields on plants growth and other living beings are one of the most important subjects which attract manyresearchers, 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 theseconditions, the velocity of germination and percentage of treated seeds were increased againstcontrol. Except on item in which germination percentage was decreased against control about wet seeds which put under electromagnetic field by 0.8 for5 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 andalso 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, includingplants, 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 constants 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 effects normal metabolisms and has impact on cellular division[1],[4].

- *Elham Rostami Zadeh, M.Sc Student of the department, of the biological Science, Islamic Azad university, Science and Research branch, Tehran, Iran. email: elham_rostami34@yahoo.com*
- *Factually of department of biological Science, Islamic Azad university, Tehran North branch, Tehran, Iran*
- *Factually of department of biological Science, Islamic Aazad university, Tehran North branch, Tehran, Iran*

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 1000number of turns.

Fig.1 electromagnetic field exposure arrangement

2.2 Experimental design

Seeds of U. dioica L.were obtained from seed and plant improvement agriculture instate Isfahan,Iran. We worked with two different Electromagnetic induction values (0.8-1.6mt) at 50Hz 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±0.5c). 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 werecompared.

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

Exposure time (min)	State seed	Electromagnetic treatment(mt)
0(control)	Wet	C
	Dry	
5 10 20	Wet	0.8
	Dry	
5 10 20	Wet	1.6
	dry	

3 RESULTS

3.1Electromagnetic fields' effects on seeds' germination

3.1.1Dry 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 1.6mT for 10 minutes and slowest rate of germination was related to treated seeds in fields with the intensity of 0.8mT for 10 minutes. Germination percentage in dry control samples was 30%. Among the treated seeds; the ones that were treated in a field of 0.8mT for 20 minutes had the highest germination percentage (0.67%) and the ones were treated in a field of 0.8mT for 10 minutes had the lowest germination percentage (42%). No group of samples showed 100% of germination. The highest rate of germination for 5 minutes was related to a field of 1.6mT; and for 10 minutes was related to a field of 1.6mT. But for 20 minutes, we notices that a field of 1.6mT had lower germination percentage than a field of 0.8mT(fig.2).

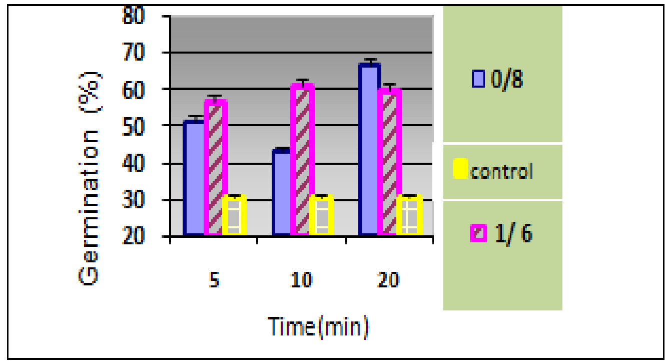

Fig. 2. percent Germination response in U.dioica seeds dry

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 1.6mT for 5 minutes resulted in the fastest germination speed and treating with 1.6mT 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 0.8mT for 5 minutes. Among the treated seeds; the samples treated in field of 0.8mT for 20 minutes had the least germination percentage. No group of samples showed 100% of germination (fig.3) Germination (%)

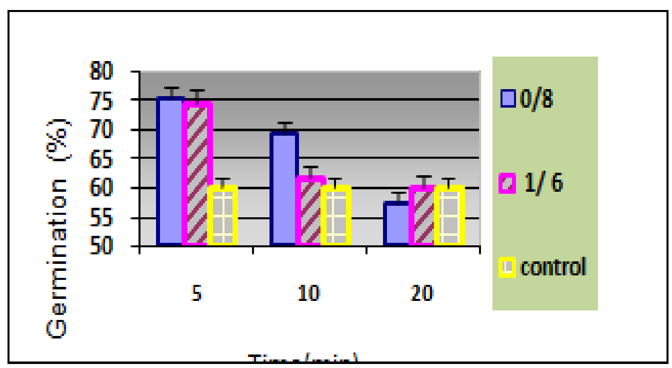

Fig.3. Percent Germination response in U.dioica seeds wet.

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 0.8mT and for treated seeds in 10 minutes, it is related to a field of 0.8mT. The highest percentage of germination for treated seeds in 20 minutes is related to a field of 1.6mT (fig. 4). Germination (%)

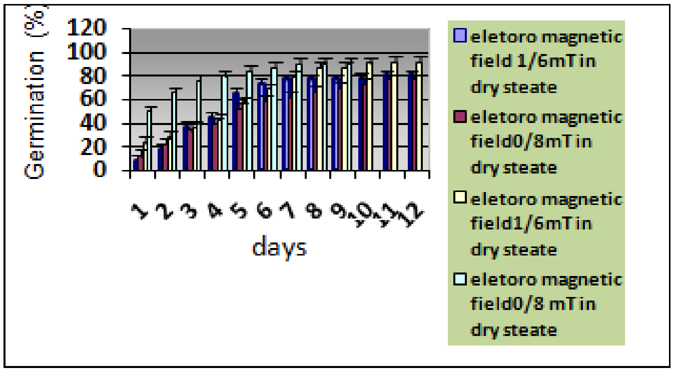

Fig. 4. Comparing graf the average percentage germination U.dioica seeds.

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 ccomparison 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 EMFr[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].podlesny(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. Researchers believe that water and ions absorption and also increase in amount of amylase enzyme affected by magnetic fields. Some researchers carried out studies on mechanism of magnetic field effect on plants growth. Scientists reported that esterase enzymes increase while germination of wheat seeds treated by magnetic fields. Increase in esterase enzymes quickly eliminates the seeds dormancy. According to some experiences of this researcher, magnetic field induces acidic pH which in turn leads to maximum rate of germination. In fact this change in pH, acidizes cell wall system and consequently eliminates the seeds dormancy. Majd and Shabrangi (2009), studied the effect of magnetic fields on growth and antioxidant systems of agricultural plants, concluded that samples treated by 0.18 T field showed the most rate of growth and biomass. Root had more growth than shoot and leaves size increased. Also seedlings endured draught stress[8]. According to the results of this research, U.dioicaseeds treated by 0.8 mT and 1.6mT magnetic fields showed increase in percentage and rate of germination and better growth of the plants.

REFERENCES

[1]. Belyavskaya, N.A., Fomicheva, V.M., Govorun,R.D., Danilov, V.I., 1992. Structural Functional Organization of the Meristem Cells of pea,Lentil and Flax Roots in Conditions of Screening the Geomagnetic Field. Biophysics.37:657-666

[2]. Bhatnagar, D., Deb, A.R., 1977. Some Effect of Pre-germination Exposure of Wheat Seeds to Magnetic Fields:Effect on Some Physiological Process.seed Res 5(2):129-137

[3]. Carbonell, M.V., Martinez, E., Amaya, J.M., 2000. Stimulation of Germination in Rice (Oryza sativa L.) by a Static Magnetic Field. Electro –and Magnetobiology.19 (1):121-128

[4]. Dhawi, F., Al-Khayri, J.M., Hasan, E., 2009. Static Magnetic Field Influence on Elements Composition in Date Palm (Phoenix dactylifera L.). Research Journal of Agriculture and Biological Sciences.5(2):161-166.

[5]. Esitken, A., Turan, M., 2003. Alternating Magnetic Field Effects on Yield and Plant Nutrient Element Composition of Strawberry. Acta Agric. Scand. Sect. B. Soil and Plant Sci. 54:135-139.

[6]. Fischer, G., Tausz, M., Kock, M.,Grill,D., 2004.Effect of Weak 16 HZ Magnetic Fields on Growth Parameters of Young Sunflower and Wheat Seedlings .Bioelectromagnetics.25(8):638-41.

[7]. Florez, M., Carbonell, MV., Martinez, E., 2007. Eposure of Maize Seeds to Stationary Magnetic Fields:Effects on Germination and Early Growth.Environ Exp Bot 59:68-75.

[8]. Majd, A., Shabrangi, A., 2009. Effect of Seed Pretreatment by Magnetic Fields on Seed Germination and Entogeny Growth of Agricultural plants.Progrees in Electromagnetic Research Mposium.23-27.

[9]. Moon, J.D., Chung, H.S., 2000.Acceleration of Germination of Tomato Seed by Applying AC Electric and Magnetic Fields. Journal of Electrostatics.48:103-114.

[10]. Pietruszewski, St., 1990. Effect of Alternating Magnetic Field on Biological Properties of Buckwheat Seed. Annales UMCS Lublin, Section AAA, XLV, 11:107-111.

[11]. Pietruszewski, St., 1991. Effect of Presowing Magnetic Treatment on Yields of Wheat and Biological Properties of Seed . Annales UMCS,Lublin,Section AAA,XLVI/XLVII,36:369-375.

[12]. Pietruszewski, St., 1993. Effect of Magnetic Seed on Yields of Wheat. SeedSci. and Technolog. 21:621-626.

[13]. Podlesny, J., Pietruszewski, S., Podlesna, A., 2004. Efficiency of the Magnetic Treatment of Broad Bean Seeds Cultivated under Experimental Plot Conditions.18:65-71.

[14]. Podlesny, J., Pietruszewski, S., Podlesna, A., 2005. Influence of Magnetic Stimulation of Seeds on the Formation of Morphological Features and Yielding of the Pea .Int Agrophys.19:1-8.

[15]. Racuciu, M., Creanga, D., 2006. Biochemical Changes Induced by Low Frequency Magnetic Field Exposure of Vegetal Organisms. Journ.phys.52:645-651.

[16]. Racuciu, M., Creanga, D., 2006. Plant Growth Under Static Magnetic Field Influence. Journ.phys.53:353-359.

[17]. shabrangi, A., Majd, A., sheidai, M., 2011.Effects of Extremely Low Frequency Electromagnetic Fields on Growth,Cytogenetic,Protein Content and Antioxidant System of Zea mays L. African Journal of Biotechnology.10 (46):9362-9369.

[18]. Tevini, M., Lwanzik, W., Thoma, U., 1981. Some Effects of Enhanced UV-B Radiation on the Growth and Composition of Plants.Planta.153:388-394.

[19]. Vashisth, A., Nagarajan, sh., 2008. Exposure of Seeds to Static Magnetic Field Enhances Germination and Early Growth Characteristics in Chickpea (Cicer arietinum L.). Bioelectromagnetics.29:571-578.

[20]. Vashisth, A., Nagarajan, Sh., 2010. Effect on Germination and Early Growth Characteristics in Sunflower (Helianthus annuus) Seeds Exposed to Static Magnetic Field. Jornal of Plant Physiology.167:149-156.

[21]. Wojcik, S., 1995. Effect of Pre-sowing Magnetic Biostimulation of the Buckwheat Seeds on the Yield and Chemical Composition of Buckwheat. Current Advances in Buckwheat:667-674.