ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 5, Issue, 12, pp.3908-3911, December, 2013

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

RESPONSE OF STATIC MAGNETIC FIELD TO GERMINATION AND SEEDLING VIGOUR OF WHEAT SEED

[1]Neha Joshi, *[1]Omvati Verma, [1]Sunita T. Pandey, [1]Rashmi Sharma and [2]Srivastava, R. C.

[1]Department of Agronomy, College of Agriculture, G.B.P.U. A. & T., Pnatnagar-263145 (Uttarakhand) India
[2]Department of Physics, College of Basic Sciences and Humanities, G.B. Pant University of Agriculture and Technology, Pantnagar-263145

ARTICLE INFO

Article History:
Received 05th September, 2013
Received in revised form
25th October, 2013
Accepted 30th November, 2013
Published online 25th December, 2013

Key words:
Wheat, Seed germination,
Seedling vigour and Static magnetic field.

ABSTRACT

Seeds of wheat (*Triticum aestivum* L.) were exposed to static magnetic fields of different strength from 100-250 mT in steps of 50 mT for different duration from 1-4 hour in steps of 1 hour. Exposure to static magnetic field significantly increased shoot length, root length, germination index, germination rate, seedling dry weight, seedling vigour index and dehydrogenase enzyme activity of wheat seed over control whereas difference in seed germination was non-significant. Seed coat membrane integrity was significantly improved by magnetic field over control seeds. Different exposure duration did not significantly influence seed germination and seedling vigour of the seeds.

INTRODUCTION

Poor, delayed and erratic field emergence are major problems under late sown condition of wheat crop. These days' agriculture scientists around the world are trying to find out eco-friendly technologies based on physical and biological treatments to enhance the germination and seedling vigour for uniform emergence and better crop establishment of a crop, under adverse environmental condition. Seed quality enhancement treatments might be able to enhance the vigour of low quality seed. There are various physical, physiological and biochemical treatments used to improve seed vigour of poor quality seed. Among them, exposure of seeds to magnetic field is one of the safe and affordable method to increase seed germination and seedling vigour for uniform crop establishment and sustainable crop production (Vashisth and Nagarajan, 2010). Singh (1962) reported that an aquatic plant (*hydrilla verticiliata*) showed an accelerated streaming of cell-protoplasm when exposed to violin music. Singh and his group continued these pioneering stimulation experiments with classical Indian music using other plant species like asters, petunias, onions, sesame, sweet potatoes and radish. Similar successful plant studies have been carried out by Alexander and Doijode (1995) on onion and rice seeds and concluded that when rice seed was exposed to a magnetic field for 12 hours showed significantly increased germination as well as shoot and root length of seedlings. Exposure of maize seeds to a 150 mT magnetic field stimulated shoot development and also led to an increase in germination, fresh weight and shoot length of maize plants (Aladjadjiyan, 2002). Beneficial effect of magnetic field on seed germination and seedling vigour depends on the magnetic field strength, stationary or alternating, time of exposure and frequency. The present study was carried out to study the effect of different magnetic fields of varying strength and duration on germination and seedling vigour parameters of wheat.

Corresponding author: Omvati Verma,
Department of Agronomy, College of Agriculture, G.B.P.U. A. & T., Pnatnagar-263145 (Uttarakhand) India

MATERIALS AND METHODS

Wheat seed of variety UP-2565 was obtained from Breeder Seed Production Centre, GBPUA&T, Pantnagar. Seeds were exposed to the magnetic field of 100-250 mT in steps of 50 mT for 1-4 hour in steps of 1 hour. Five hundred sound seeds were kept in the plastic container between the N-S poles of the electromagnet having a stationary magnetic field for the required duration. By regulating the current in the coils of the electromagnet the required strength of the magnetic field was created. For creating static magnetic fields of 100, 150, 200 & 250 mT, current of 2.1, 2.7, 3.8 & 4.2 Ampere along with voltage of 23, 38, 42 & 46 Volt respectively were supplied. Gauss meter was used to measure the strength of the magnetic field between the north and south poles. A unit of 10^{-4} gauss measures one Tesla Strength. After magnetizing seed with different strength for different duration, germination test was conducted in four replication as per International Rules for

Figure 1. Experimental setup for static magnetic field

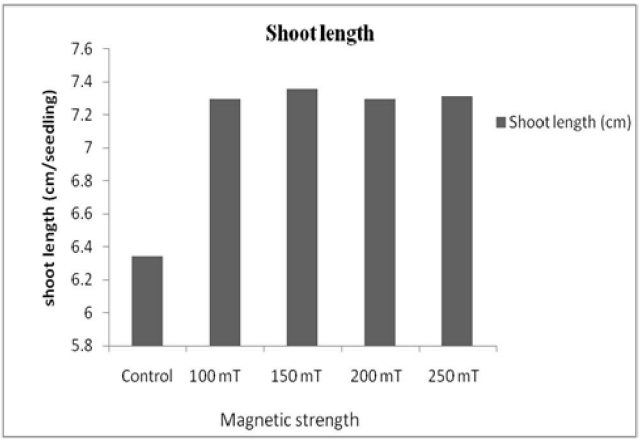
Table 1. Effect of different magnetic field strength on germination percentage, germination index (GI), seedling dry weight (SDW), seedling vigour index (SVI), dehydrogenase activity and electrical conductivity (EC) on wheat seed

Treatments	Germination (%)	GI	SDW (mg/seedling)	SVI	Dehydrogenase activity (O.D./seed)	EC (µS/cm/g of seed)
Control	98.0	19.67	15.10	1480	0.010	33.75
100 mT	98.9	21.11	16.74	1655	0.017	30.82
150 mT	98.6	21.18	16.20	1597	0.016	32.05
200 mT	98.0	21.13	16.38	1606	0.014	29.78
250 mT	99.0	21.16	15.73	1557	0.013	29.93
CD (5%)	NS	0.77	0.89	91	0.004	1.45

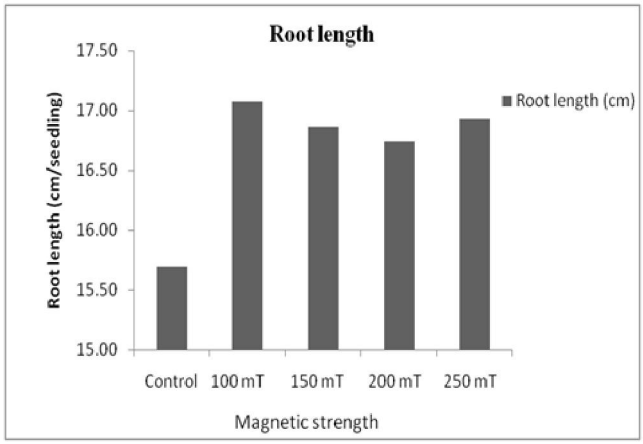
Seed Testing (ISTA, 1993). At the end of the standard germination test, ten normal seedlings were randomly selected for measuring average root length and shoot length separately and seedlings were dried at 70±2^{0}C for 72 hours for measuring seedling dry weight. Seedling vigour index was computed by multiplying seed germination percentage with seedling dry weight (mg/seedling) **(**Abdul-Baki and Anderson, 1973).Time taken for 50% germination (T_{50}) was calculated by the formula described by (Dezfuli *et al*., 2008). Mean germination time was calculated by the formula given by (Bonner, 1983). Germination Index was calculated by the formula described by Government of India, Deptt. of Agriculture and Cooperation, Ministry of Agriculture, 1993. Electrical conductivity of seed leachate was measured with the help of an electrical conductivity meter, by soaking 5 g seed in 50 ml distilled water for 17 hours at 25±1^{0}C temperature. After 17 hrs, seeds were removed from water with the help of forcep and electrical conductivity of left water was measured and expressed in µS/cm/g of seed. Dehydrogenase enzyme activity was measured following the method described by Kittock and Law (1968) and expressed in OD/seed. The data was analyzed in two- factor RBD using STPR-2 software.

RESULTS AND DISCUSSION

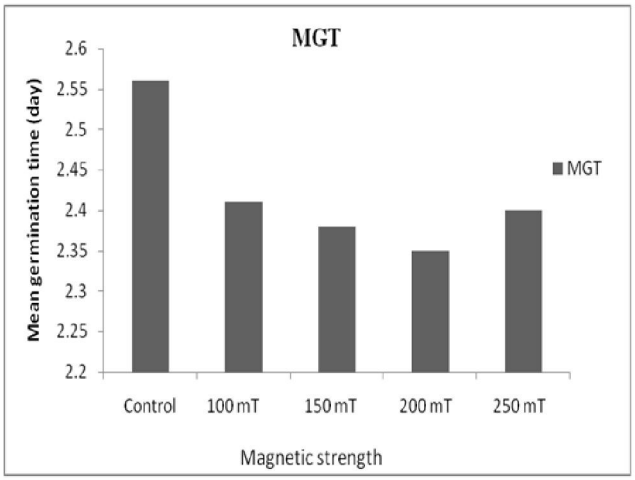
The results revealed that the exposure of wheat seeds to different magnetic field strengths significantly improved seedling vigour indices over untreated control seeds (Table 1). However, the effect of exposure duration on these parameters was non-significant. The improvement over untreated control seeds was 15-16 % for shoot length and 7-9 % for root length. Seeds exposed to static magnetic fields took less time to emerge than untreated control seed. Mean germination time and time taken to 50 % germination were decreased by 6-8 % and 8-10% respectively (Fig. 2). Germination index and seedling dry weight were increased by 7-8 % and 4-11 % respectively. It has been stated that positive effect of magnetic treatment may be due to paramagnetic properties of some atoms in plant cells and pigments such as chloroplasts. Magnetic properties of molecules determine their ability to attract and then change the magnetic energy in other type of energy and to transfer this energy afterward to other structures in plant cells, thus activating them (Aladjadjiyan, 2010). Seedling vigor index was also increased by 5-12 % over untreated control seed (Table 1). It may be because of increase in the root growth of plants. Roots of plant contain starch molecule that determine the effect of the earth's magnetism. (www.buzzle.com). Our results are in agreement with Aksyonov *et al.* (2001) who showed that 15 min exposure of wheat seed by 30 m T magnetic field followed by 17 h imbibition increased the root formation by nearly 25 %. The length of 6 days seedling displayed a 40 % increase. Alexander and Doijode, (1995) noted that the application of an external magnetic field as a pre-germination treatment improved the germination and seedling vigour of low viability rice and onion seeds.



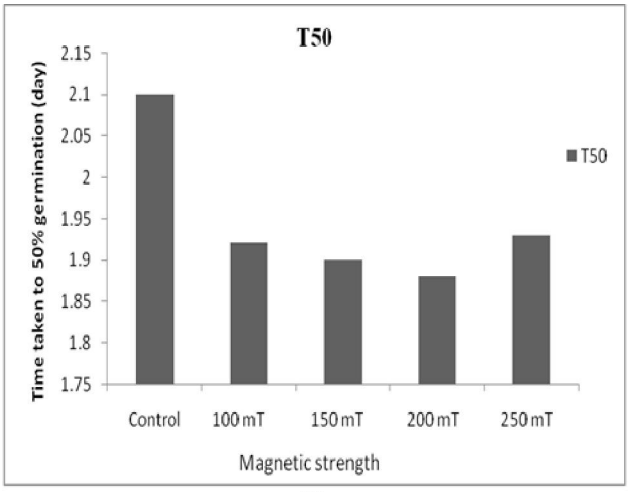
(a)



(b)



(c)



(d)

Fig 2. Effect of different magnetic field strength on (a) shoot length, (b)root length, (c) mean germination time, (d) time taken to 50% germination of wheat seed

The highest germination per cent was observed with exposing the seed to 250 mT strength and the lowest germination per cent recorded with untreated control seeds, however, these differences were non-significant (Table 1). The highest seedling vigour index was recorded in 100 mT and followed by 200 mT, 150m T and 250 mT, which were at par with each other and significantly higher than the untreated control seed. Untreated control seed showed the lowest seedling vigour index. It may be attributed to lowest seedling dry weight in control seed (Table 1). Sanker Narayan *et al*. (2001) reported an increase in germination of paddy seed exposed to magnetic field. The effects can be explained with stimulus-dependent oscillations of the cell's xylem and phoelem, that vibrate more intensely resulting in faster movement of cell fluids which means an increase in uptake of the essential nutrients. Membrane integrity and dehydrogenase enzyme activity of seed exposed with static magnetic fields improved significantly over control seed. Exposure of seeds to magnetic fields significantly improved seed coat membrane integrity and reduced cellular leakage and electrical conductivity of seeds over control (Table 1). Balouchi *et al*. (2007) reported that magnetic field influences the structures of cell membrane and increases their permeability and ion transport, which then affects some metabolic pathways. Dehydrogenase enzyme activity was significantly highest in seeds exposed to 100 mT static magnetic field (.017 O.D./Seed) which was at par with 150 mT and 200 mT. The lowest enzyme activity was measured in control seed. The higher activities of hydrolyzing enzymes are responsible for breakdown of stored food material resulting in faster seedling emergence and improved seedling vigour indices of treated seeds. Enzyme activity decreased with increase in magnetic strength (Table 1). Increased dehydrogenase activity and improved seed coat membrane integrity in sunflower seeds exposed to magnetic field was also reported by Vashisth and Nagarajan, (2010).

Conclusion

Exposure of wheat seeds to different static magnetic field significantly improved germination index, shoot length, root length, seedling vigour index and dehydrogenase enzyme activity as compared to untreated control seeds. Among various combinations of magnetic field and exposure duration 100 mT and 200 mT for 1 hr yielded superior root length, mean germination time, time taken for 50 % germination, seedling vigour index and enzyme activity. Our results revealed that exposure of seeds to100 and 200 mT magnetic field for 1 hr duration could be a suitable, cheap and easy seed invigoration treatment for seedling establishment and improving seedling vigour of low viability seed. However, it needs further confirmation.

REFERENCES

Abdul-Baki, A.A. and Anderson, J.B. 1973. Vigour determination in soybean seed by multiple criteria. *Crop science*, 13: 630-632.

Aksyonov, S.I., Bulychev, A.A. and Grunina, T. 2001. Effects of ELF-EMF treatment of wheat seeds at different stages of germination and possible mechanism of their origin. *Electromag Biol Med.,* 20:231-253.

Alajadjiyan, A. 2002. Study of the influence of magnetic field on some biological characteristics of *Zea mays*. *J. Central Euro. Agric.,* 3(2): 89-94.

Aladjadjiyan, A. 2010. Influence of stationary magnetic field on lentil seeds. *Int Agrophysics,* 24:321-324

Alexander, M.P. and Doijode, S.D. 1995. Electromagnetic field, a novel tool to increase germination and seedling vigour of conserved onion (*Allium cepa* L.) and rice (*Oryza sativa* L.) seeds with low viability. *Plant Genet. Res. News*., 104: 1.

Balouchi, H.R.; A.M. Seyed and B. Mahdavi. 2007. Electromagnetic Field Influence on Annual Medics, Barley, Dodder and Barnyard Grass Seed Germination. *Pakistan Journal of Biological Sciences,* 1: 1-6.

Bonner, F.T. 1983. Germination responses of loblolly pine to temperature differences on a two-way thermogradient plate. *J. Seed Technol*., 8(1):6-14.

Dezfuli, P.M., Sharif-Zadeh, Farzad and Janmohammadi, Mohsen. 2008. Influence of priming techniques on seed germination behaviour of maize inbred lines (*Zea mays* L.) *ARPN Journal of Agricultural and Biological Science*, 3(3): 22-25.

Government of India. Department of Agriculture and Cooperation, Ministry of Agriculture.1993. Handbook of seed testing (Agrawal, P.K.ed.) New Delhi.

International Seed Testing Association, 1993. International Rules for Seed Testing. *Seed Science and Technolog,*13: 299-355.

Kittock, D.L. and Law, A.G. 1968. Relationship of seedling vigour to respiration and tetrazolium chloride reduction by germinating wheat seeds. *Agron J*., 60: 286–288.

Tahir, N.A.R. and Karim, H.F.H. 2010. Impact of magnetic application on the Parameters related to growth of Chickpea (*Cicer arietinum L.*). *Biological Sciences*, 3(4): 175-184.

Vashisth, A. and Nagarajan, S. 2010. Effect on germination and early growth characteristics in sunflower (*Helianthus annuus*) seeds exposed to static magnetic field. *J Plant Physiol.,* 167:149-156.

Singh, T.C.N. 1962. On the effect of music and dance on plants. Bihar Agricultural College. Magazine, 13 (1), Sabour, Bhagalpur, India.

Sanker Narayan, P., Leelapriya, T. and Blum, T. 2001. Effects of pulsed ELF magnetic fields and music on the germination of paddy (*Oryza sativa*) and green gram MIM, Chennai (*Phaseolus vulgaris*) (leonardoevolution.com/ projects/magneto-E.html) http://www.buzzle.com/article /the effect of magnetism on plant growth.

****