

Effect of Magnetic Field on Seed Germination of Wheat

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Abstract

The current project studies the influence of the exposure rate of the magnetic field (50 mT/time) upon germination in wheat seeds. Magnetic treatment involved the application of three different exposure rates (0.5, 1, 2 h) respectively. The effect of the exposure rate on the root growth, radicle growth and protein percentage are discussed and statistical significance analysis is assessed for the differences between the average values of samples and controls. The variable magnetic field of exposure rate (50 mT/0.5h) is a very significant factor in influencing the germination process of wheat seeds. It is observed that the root length, radicle length and the protein percentage increase up to 10, 14 and 8 % respectively.

Keywords: Magnetic field, wheat seeds, length root, dose rate, radicle, protein

Introduction

Nowadays, many written scientific works of biologists and biophysics describe the effect of magnetic field on plants. Based on this work, Magnetic Technologies Company came up with a method of magneto-hydrodynamical activation of natural waters and devices. This method is an essential part in the whole complex of using magnetic fields in agriculture. It includes physical-chemical changes of natural water parameters, resulting in improvement in filtration properties and in an increase in the dissolution properties of water. These change result in an increased ability of soil to get rid of salts and results in a better assimilation of nutrients and fertilizer in plants during the vegetation period. Biological stimulation plays an important role in optimizing crops in terms of the maximization of yield, promotion of plant growth, and protection against disease [1]. The main advantage of using electromagnetic stimulation methods over traditional chemical processes is the absence of toxic residues [1]. Savostin [2] observed an increase in the rate of wheat seedling elongation under magnetic conditions. Then, Murphy [3]

reported changes in seed germination due to a magnetic field. Exposure of seeds to a magnetic field for a short time was found to help in accelerating the sprouting and growth of seedlings [4]. They reported the enhancement of plant growth under magnetic conditions. Also, a strong influence on the fast initial growth stages of the plants after the germination is well known [5,6]. The growth of wheat plantlets in a static magnetic field was stimulated [7] by means of different exposure protocols. The present study aims to assess the effects of magnetic field (50 mT/time) on the growth of the primary root length, radicle length and percentage protein in wheat seeds.

Materials and methods

The purpose of this study is mainly to assess the influence on the early growth of the wheat seeds plantlets exposed to (50 mT/time). The equipment needed in this experiment includes an inductor (winding coil), ammeter, voltmeter and power supply. The complete set-up is shown in **Figure 1**.

Wheat seeds are used as the test material subject in this study, and four groups are sprouting with distilled water at an initial temperature of 25 °C through 24 h after germination the samples under study, exposed to round permanent magnets of about 50 mT over different time periods (0.5, 1, 2 h), 20 seeds were placed in each Petri dish and over each one watered paper for support in the Petri dishes. After the water was added, all Petri dishes were rested for 24 h and then divided into four experimental groups, each group consisting of three Petri dishes. From each group one Petri dish was elected as control. We marked the Petri dishes as follows: in the first group the control with A₁ and B₁ and the other groups (A₂, A₃, A₄, B₂, B₃ and B₄) were exposed (50 mT) for different time periods (0.5, 1, 2 h) respectively. The

environmental conditions such as temperature, humidity and illumination of four groups of wheat seeds are maintained, as shown in **Table 1**. After seven days we compared the form of the wheat seeds in all Petri dishes. The percentage of protein in wheat seeds was determined using the Kjeldahl method. The percentage of protein, is calculated using Eq. (1) [8], after exposing the wheat seeds to water or not in a constant magnetic field 50 mT for different time periods 0, 0.5 and 1 h, which we marked a₁, a₂, a₃, b₁, b₂, b₃ respectively. All data analysis was performed using compel random design (C.R.D) and calculated to be 0.05 [9].

$$\text{Percentage of Protein} = [6.25 * N\%] \quad (1)$$

where N is the nitrogen percentage.

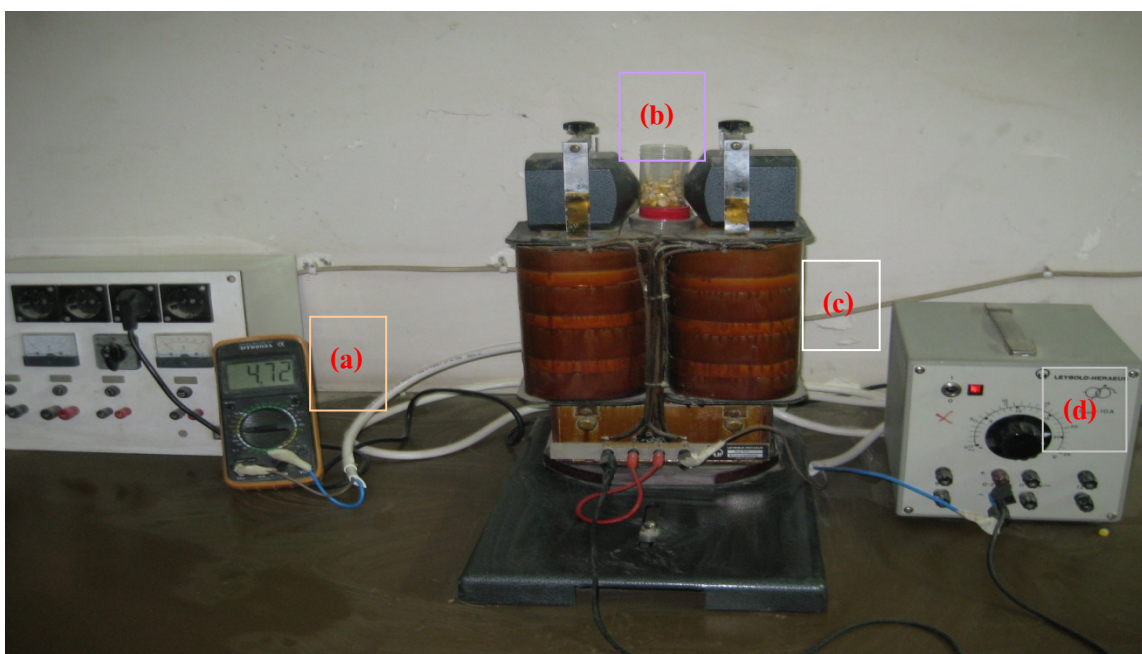


Figure 1 Photograph of exposure system, (a) voltmeter, (b) sample, (c) inductor and (d) power supply.

Table 1 The temperature, humidity, and illumination conditions in each groups.

Item	Exposed 1	Exposed 2	Exposed 3	Control
Position	In the air room	In the air room	In the air room	In the air room
Temperature °C	28 ± 5	28 ± 5	28 ± 5	28 ± 5
Humidity %	46 ± 4	46 ± 4	46 ± 4	46 ± 4
Illumination (LUX)	599 ± 4	598 ± 4	601 ± 4	597 ± 4

Results and discussion

After seven days the wheat seeds germinated in all Petri dishes but at the first sight we could observe significant differences. In the control dish most of the seeds have germinated but the root length of the young plant was a maximum of 5.7 cm in the control (A₁). In A₂, A₃ and A₄ we measured an astonishing 6.3, 5.8 and 5.9 cm for A₂, A₃, A₄, respectively. The control groups of the three tests are sketched in **Figure 2**. It is clear that the root length of the wheat seeds increases by 10 % at a dose rate of 50 mT/0.5h for group A₂ compared with the control A₁.

In order to investigate the effect of different exposure times at a fixed magnetic field intensity (50 mT/time) on radicle length growth and protein percentage of wheat seeds for each group, the set of groups (B₂, B₃ and B₄) were exposed for 0.25, 0.5, 1 h, respectively. **Figure 3** represents the different radicle lengths of wheat seeds. The radicle length of the wheat seeds plantlets increases at the dose rate 50 mT/0.5h for groups B₂ compared with the control B₁ by 14 %. The changes in the protein of wheat seeds for groups (a₁, a₂, a₃, b₁, b₂ and b₃) exposed to a 50 mT

magnetic field for 0, 0.5, 1, 2 h, respectively compared to the control (a₁, b₁) are presented in **Figures 4** and **5**. It can clearly be seen that, the protein percentage of the wheat seeds increases at a dose rate of 50 mT/0.5h with and without water for groups a₂, b₂ compared with control a₁, b₁. Magnetic field treatment of seeds leads to acceleration of plants growth, protein biosynthesis and root development [10,11]. In addition, more accelerated plant growth which we believe is directly due to the reunion of north and south magnetic monopole and the energy that is released with their reunion. In the literature other researchers have also exposed plant seeds to magnetic field. The main difference between our research and the studied articles is exposure time, we have exposed the seeds to 50 mT/time, no other kind of stress was added to the plant seeds. Some researchers have also added a temperature stress of 45 °C, and longer times of exposure to magnetic fields. Our experience shows that longer exposures will bring no significant results and may harm the seeds germinating capability [12].

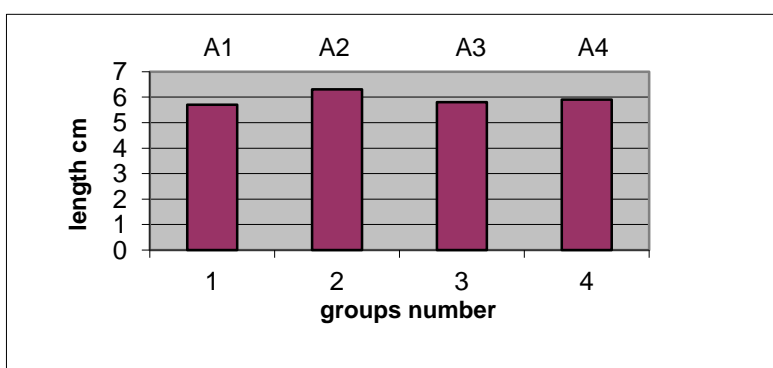


Figure 2 Comparison of the root length.

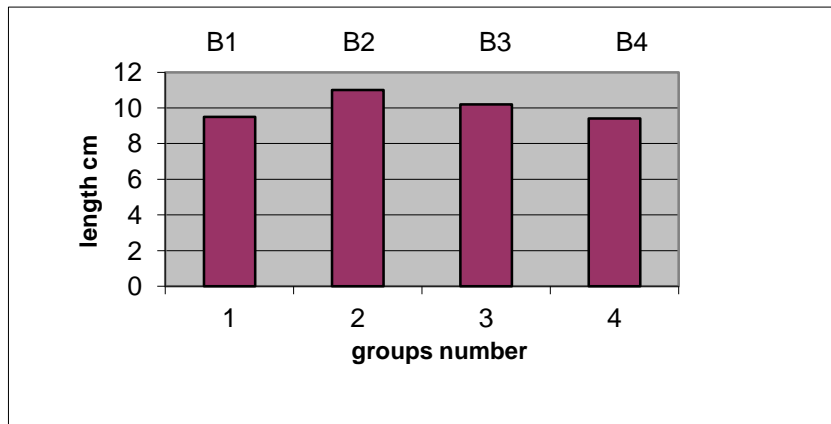


Figure 3 Comparison of the radicle length.

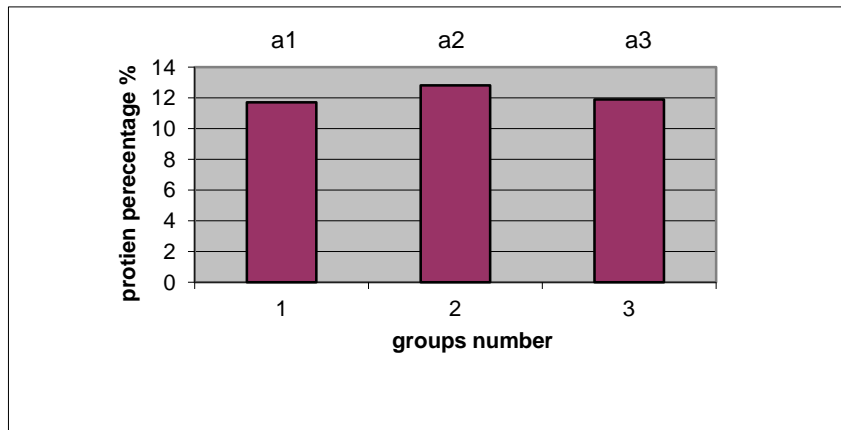


Figure 4 Comparison of the protein percentage of wheat seeds without water after exposure 50 mT/time.

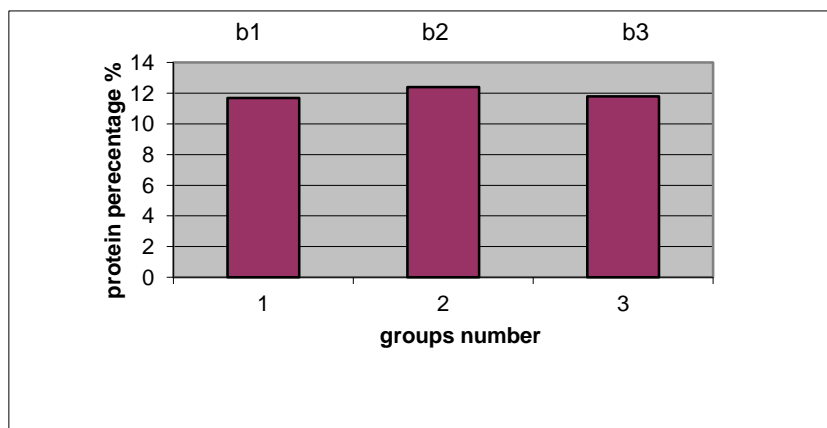


Figure 5 Comparison of the protein percentage of wheat seeds with water after exposure 50mT/time.

Conclusions

The results allow the following conclusions to be presented:

1. The root length of wheat seeds increases by 10 % at a dose rate of 50 mT/0.5h for each group compared with the control.

2. The radicle length of the wheat seeds plantlets increases by 14 % at 50 mT/0.5h for each group compared with the control.

3. The protein percentage of the wheat seeds increase by 8 % at a dose rate of 50 mT/0.5h for each group compared with the control.

4. A magnetic field with a dose rate of 50 mT/0.5h has a strongest positive effect.

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