Magnetic Field Effect on Germination of Sweet Corn (*Zea Mays Saccharata Sturt*) using Helmholtz Coil

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Abstract. Studies have been conducted about the effect of magnetic field on the germination of sweet corn seed (Zea Mays Saccharata Sturt) used the Coil Helmholtz. This study to determine the effect and duration of exposure to the magnetic field on the process of germination of sweet corn seed. The method is use the tool coil Helmholtz with fixed parameters, namely the diameter of 15 cm, a distance of 10 cm, and 250 coil at a distance of each coil while the current is varied 0.33 A, 0.46 A and 0.61 A. The magnetic field effect on sweet corn seeds exposed to magnetic field of 0.1 mT, 0.2 mT and 0.3 mT with exposure times of 10 minutes/day, 20 minutes/day and 30 minutes/day more effective than control samples. The germination process in sweet corn seeds of control samples is slower than those given exposure to a magnetic field. The most effective magnitude and duration of exposure to magnetic field radiation for the germination process of sweet corn seeds is 0.3 mT with exposure time of 20 minutes/day.

Keywords: Sweet Corn, Germination, Magnetic Field, Helmholtz Coil.

1 Introduction

The magnetic field can change the rate of movement of electrons in cells so that it affects the process of cell metabolism [1]. The interaction of the magnetic field and the charges that exist in plants can cause energy to be absorbed and converted into chemical compounds that play a role in accelerating the growth process and increasing the germination process [2].

The effect of magnetic fields on plants has been done by several researchers. Exposure to 0.1 mT magnetic field significantly increased the length of mung bean seeds significantly compared to the control. [3]. The magnetic field can accelerate the absorption of water by seeds, stimulate the activity of germination metabolic enzymes in seeds to increase the speed of germination in seeds [4]. Seed immersion and exposure to 0.2 mT magnetic field increased parenchyma cell size, xylem, and stoma width in tomato plants [5]. The exposure time of 0.3 mT magnetic field affected stomata size but had no effect on stomatal index. It is suspected that the magnetic field can add a negative charge to plant cells and can cause particles to move at a certain speed [6]. The positive influence exerted by the magnetic field on the germination of date palms is due to the presence of particles in plant cells that move at a certain speed [7].

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An electromagnetic field is combination of magnetic field and electric field. Electromagnetic radiation has a broad spectrum [8]. A magnetic field can appear on a moving charge, so it is certain that a current-carrying wire will create a magnetic field, because current is a moving electric charge [9]. Helmholtz coils are two Helmholtz coils by varying the number of turns and the current used, then compared with the coils that are series connected and electrified to form a magnetic field. The magnetic field obtained from this coil is small on the order of milliTesla (mT) [10].

Corn in particular is a food plant that is very beneficial for human or animal life. Based on the order of the main food ingredients in the world, corn ranks third after wheat and rice [11]. In this paper, we present the study of magnetic field effect to the germination of sweet corn using Helmholtz coil.

2 Material and Methods

This research method used Helmholtz coil to produce a magnetic field (can be seen Fig.1). Making the Helmholtz coil uses 250 turns in each coil with a distance between the two coils of 10 cm. Corn plant seeds are placed between two coils of Helmholtz.

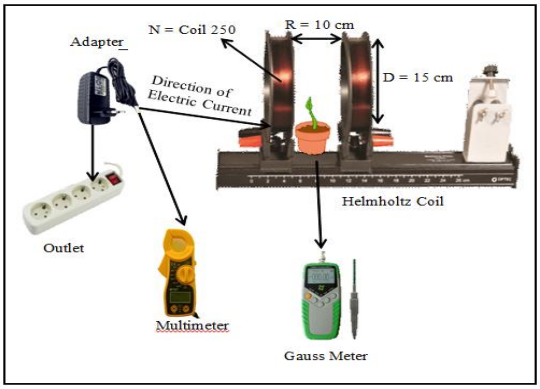

Fig. 1. The coil of Helmholtz tool circuit

The magnetic field exposure given to sweet corn seeds was 0.1 mT, 0.2 mT and 0.3 mT and the time exposure was 10 minutes, 20 minutes and 30 minutes. To get the value of the magnetic field above, electric current of 0.33 A, 0.46 A and 0.61 A are given which is measured using clampmeter. The current value obtained through universal adapter with the voltage value to 6 V, 9 V and 12 V. The Gaussmeter is used to measure magnetic field resulting from Helmholtz coil.

3 Results

The result of this research is that the Helmholtz coil device that was made succeeded in producing a magnetic field of 0.1 mT, 0.2 mT and 0.3 mT. Then this tool is used to

provide exposure to a magnetic field on sweet corn seeds. The results of magnetic field exposure to sweet corn seeds can be seen in Fig. 2(a), Fig. 2(b) and Fig. 2(c).

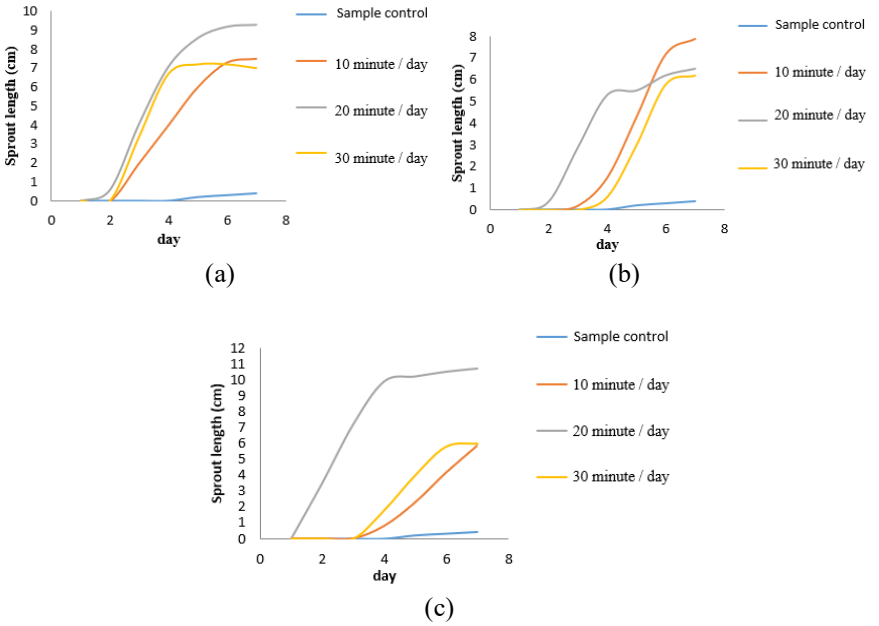

Fig. 2. Exposure to magnetic field on sweet corn seeds : (a). 0.1 mT, (b). 0.2 mT, (c). 0.3 mT

In Fig. 2(a) it can be seen the magnetic field exposure of 0.1 mT has a good effect on the growth of sweet corn seedling for exposure times of 10 minutes, 20 minutes, or 30 minutes when compared to the control sample. The best germination length at 0.1 mT exposure for 20 minutes was 9.3 cm. In Fig. 2(b) it can be seen the magnetic field exposure of 0.2 mT had a good effect on the growth of sweet corn seedlings when compared to the control sample. The best length for exposure to 0.2 mT samples for 10 minutes per day was 7.9 cm. In Fig. 2(c) it can be seen that magnetic field exposure of 0.3 mT had a good effect on the growth of sweet corn seedlings compared to the control sample. The best germination length in the treatment of sample was 0.3 mT for 20 minutes per day, which was 10.7 cm.

This shows that magnetic field can accelerate the germination process of sweet corn seeds in accordance with the literature of Nevi Setyasih [6] which states that the length of exposure to magnetic field affects stomata size but has no effect on stomatal index. It is suspected that the magnetic field can add a negative charge to plant cells and can cause particles to move at a certain speed.

Based on this research, all magnetic fields exposure had a favorable effect on germination length compared to seeds were not exposed the magnetic fields. Sweet corn seeds that experienced the best growth in length were sweet corn seeds exposed magnetic field of 0.3 mT for 20 minutes/day.

4 Conclusion

Influence of the magnetic field to sweet corn seeds exposed of 0.1 mT, 0.2 mT and 0.3 mT with magnetic field exposure times of 10 minutes/day, 20 minutes/day and 30 minutes/day more effective than control samples. Because the germination process in sweet corn seeds is slower than those given exposure the magnetic field. The most effective magnitude and duration of exposure the magnetic field radiation for the germination process of sweet corn seeds is 0.3 mT with exposure time of 20 minutes/day.

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