EFFECTS OF PULSED VARIABLE MAGNETIC FIELDS OVER PLANT SEEDS

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Abstract. The therapy with magnetic fields evolved a few years ago to a constant practice in modern recovery medicine. The goal of our study was to determinate if the same types of magnetic fields used in medicine have the potential to increase metabolic rate in germinating plant seeds. The machine used for this study was a *Vita-life eMRS* computer controlled device with a versatile programming system. Pulsed variable magnetic fields, if correctly administered, have a very high stimulating effect on cell multiplication, growing and development. Also, the growing of mould was stimulated. The stimulation of mould growing and acceleration of plant development may be used for industrial purposes, production of pharmaceutics and agriculture.

Key words: magnetic fields, plant seeds, stimulating effect, cell multiplication.

INTRODUCTION

The therapy with magnetic fields evolved from a barely known technique a few years ago to a constant practice in modern recovery medicine. Known effects are the growing of local blood circulation, analgesic, and compensation of vegetative nervous system [2, 4, 5]. The goal of our study was to determinate if the same types of magnetic fields used in medicine have the potential to increase the metabolic rate in germinating plant seeds. This kind of experiments are not mentioned in specialty literature, or the results on this topics are very hard to find. This was the principal motivation for our own study with magnetic fields.

MATERIALS AND METHODS

To maintain accuracy in the study, a human medical device was used for magnetic field generation. The machine was a *Vita-life eMRS* computer controlled device with a versatile programming system. The existence of the magnetic field

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was verified with a coil connected to a digital multimeter with computer interface. The multimeter was set to measure electrical tension (Volt). A digital thermometer with computer interface was used to monitor the room temperature, and the readings were recorded for further control. The goal was not to have serious temperature variations in the experiment room. The nictemeral rhythm was respected, and a hygrometer for room humidity was also monitorized. The average relative humidity of the experiment room was 60%. Two experiments have been made on wheat seeds and on sunflower seeds.

EXPERIMENT 1

Eight Petri dishes with cotton pads were used as germinators. The Petri dishes have been sterilized at 180°C, the cotton pads too. The wheat seeds (800 pcs.) have been washed with sterilizing liquids at room temperature (240 ºC). After these procedures the same temperature was maintained over the entire time of the study. 100 seeds have been placed in each Petri dish and over each cotton pad (one in each Petri dish) 5 ml of water was added. After the water was added all Petri dishes have been let to rest 24 h . The Petri dishes were divided in two experimental groups, each group consisting in four 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 M1 and the other dishes with P1, P2 and P3. In the second group the control was marked with M2 and the other dishes with P12, P22, P32. In both groups the control dishes were not exposed to magnetic fields. The frequency of the pulsed magnetic field used for exposure with the *Vita-life eMRS* has a variation from 0.01 to 20000 Hz. The Petri dishes P1, P2 and P3 were exposed to a constant magnetic field intensity of 400 μT. P1 was exposed 8 minutes, P2 16 minutes, and P3 24 minutes [3]. For the second experimental group the intensity of the magnetic field was different for each dish but the exposure time was constantly 8 minutes. P12 was exposed to 100 μT, P22 to 200 μT and P32 to 400 μT. The wave shape had a triangular form, saw tooth like. The exposure to an additional magnetic field, over the terrestrial one, was singular [7]. After 5 days we compared the form of the wheat seeds in all 8 Petri dishes. The average mass and length of the young plants was measured.

EXPERIMENT 2

Four Petri dishes with cotton pads were used as germinators. The Petri dishes have been sterilized at 180 ºC, the cotton pads also. The sunflower seeds (200 pcs.) have been washed with sterilizing liquids at room temperature (24 ºC). After these

procedures the same temperature was maintained over the entire time of the study. 50 seeds have been placed in each Petri dish and over each cotton pad (one in each Petri dish) 4ml of distillated water have been added. One Petri dish was used as a control and the others have been exposed to magnetic fields. One Petri dish was exposed 24 minutes, the second dish for 48 minutes and the third dish for 72 minutes. The chosen parameters of the magnetic field were: intensity 400 μT at a variable frequency in an interval of 0.01 till 20000 Hz. The wave shape had a triangular form saw tooth like. The exposure to an additional magnetic field, over the terrestrial one, was singular. After 12 days we compared the form of the sunflower seeds in all four Petri dishes. Results and dicussions

RESULTS AND DISCUSSIONS

EXPERIMENT 1

After 5 days the wheat seeds have germinated in all eight Petri dishes but at the first sight we could observe significant differences [6]**.** In the control dish most of the seeds have germinated but the length of the young plants was max. 0.5 cm. In P1 we could measure astonishing 3 cm in average length. P2 has just 0.5 cm, and P3 0.7 cm. We will note the standard deviation from now on with S. $S_{lenght\ after\ 5\ days} = 1.21$.

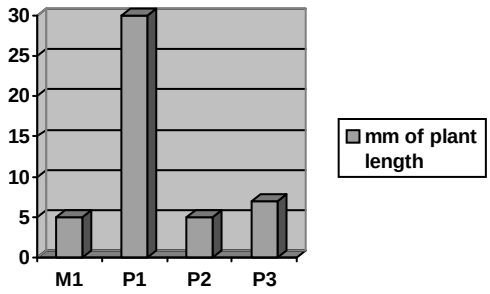

Fig. 1. Comparison of plant length.

The initial masses of the seeds were as followed: in M1 10.07 g in P1 11.2 g, in P2 9.17 g, and in P3 we had 9.6 g. After 5 days the mass was: in M1 92 g, in P1 102 g, in P2 96 g and in P3 98 g. $S_{initial}$ (standard deviation) = 0.93; $S_{after\ 5\ days} = 4.16$.

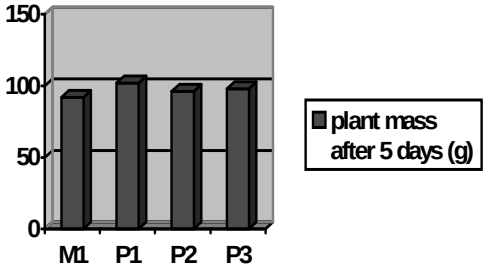

Fig. 2. Plant mass after 5 days in grams.

In the dishes P1, P2 and P3 we could observe also the growth of mould. In M1 no mould was observed without optical instruments.

After 5 days in M2 no significant differences from M1 could be seen. In P12 the length of the plants was 2.8 cm, in P22 3.35 cm and in P32 2.99 cm. $S_{\text{after 5 days}}$ = 12.22.

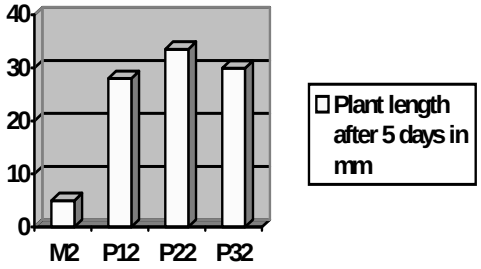

Fig. 3. Plant length after 5 days in mm.

The mass in M2 was 102.7 g in P12 107.6 g in P22 127.5 g and in P32 118.5 g. $S_{\text{after 5 days}}$ = 11.12.

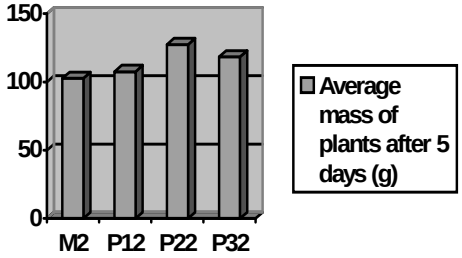

Fig. 4. Average mass of plants after 5 days.

The same observation about mould growing was also observed. M2 was free of mould but in P12, P22 and P32 mould could be observed.

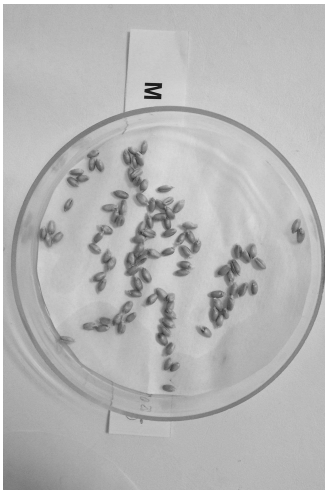

Fig. 5. Control Petri dish.

Fig. 6. P1 Petri dish in day 3.

EXPERIMENT 2

After 12 days the sunflower seeds have germinated in all 4 Petri dishes but at the first sight we could observe significant differences. In the control dish most of the seeds have germinated but the length of the young plants was max. 1.5 cm. In the second dish we could not detect significant statistical changes. In the third dish the average length of the young plants was 3 cm, 2 times bigger than in the control one. In the fourth dish the difference was dramatic: all seeds have germinated and the average length of the young plants was over 5 cm. $S_{\text{after 12 days}} = 14.36$

Fig. 7. At the left the control dish, at the right the fourth dish.

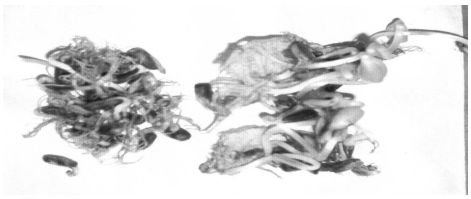

Fig. 8. At the left – seeds from the control dish, at the right – seeds from the fourth dish.

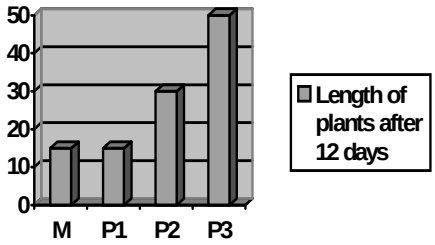

Fig. 9. Length of plants after 12 days.

DISCUSSIONS REFERING OTHER RESEARCHERS RESULTS

In the studied literature other researchers have also exposed plant seeds to magnetic fields. The main differences between our research and the studied articles is the exposure time: we have exposed the seeds to a single burst a relatively short period of time, no other kind of stress was added to the plant seeds. Some researchers have also added a temperature stress of 45 degrees Celsius, and longer times of exposure to magnetic fields. Our experience shows that longer exposures will bring no significant results or it may harm the seeds germinating capacity [6]. The intensity of the used magnetic field is comparable with other researches, but the magnetic field that we have used is not stable in frequency, it is an oscillating, pulsed magnetic field. The used plant seeds in our experiment are also used from other authors [1].

CONCLUSIONS.

Pulsed variable magnetic fields if correctly administrated have a very high stimulating effect on cell multiplication, growing and development [8]. The metabolic rate was accelerated in the exposed seeds compared with the non exposed ones, fact proven by the big difference achieved in the maturation process.

The exposure time of 8 minutes demonstrated the most benefic influence. Longer periods have proven to cancel the stimulating effects. The magnetic field intensity of 200 μT has achieved the best results in plant length development and also in mass growing of the young plants. Also the growing of mould was stimulated. The stimulation of mould growing and acceleration of plant development may be used for industrial purposes, production of farmaceutica, and agriculture.

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