ON THE EFFECT OF ADVERSE FACTORS IN THE PRESOWING SEED TREATMENT WITH A LOW-FREQUENCY MAGNETIC FIELD

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Introduction

In the development of life throughout the Earth's history, during a long-term evolution, all existing organisms, in one way or another, have fully adapted to the various environmental conditions on our planet [1]. The living organisms have had to adapt not only to the physicochemical conditions, such as temperature, pressure, composition of the atmosphere, light, and humidity, but also to the natural fields of the Earth: geomagnetic, gravitational, electrical, and electromagnetic fields. The living organisms have evolved in an environment characterized by the presence of low-intensity electromagnetic fields, such as the Schumann waves (7.8-0.8 Hz) [2]. Everything that happens in the cells of living organisms is associated with these natural fields.

Within a relatively short historical period, the technogenic human activities have had a significant impact on natural objects and thus dramatically upset the delicate balance between the living organisms and the environmental conditions, which has been formed over thousands of years. This factor has led to many irreparable consequences, in particular, to the extinction of some animals and plants, numerous diseases, a reduction in the average duration of life of people in some regions, and infertility. In recent decades, research into the effect of natural and anthropogenic factors on the human body and other living organisms has been conducted [3].

In modern life, people are constantly being faced with the conditions in which the natural electric field of the atmosphere can be shielded or distorted by metal roofs of houses, reinforced-concrete buildings, vehicles, etc. Electric fields are absent in submarines and spacecrafts, where the plants will play an important role in the regeneration of the gas composition and the replenishment of food products in the future [4, 5]. Therefore, the biological role of natural electric fields in the life of organisms, in particular plants, is an urgent problem.

Along with the natural fields, there are artificial technogenic fields produced by the operation of commercial frequency generators, microwave and EHF devices, transmitters, etc. In addition, the frames of reinforced-concrete buildings partially shield and partially distort natural electromagnetic fields [6, 7] and thus inflict harm to living organisms. This effect is of particular importance to growing organisms which undergo constant cell division and to the regeneration and reproduction processes in mature organisms.

In recent decades, these processes have been the subject of many scientific studies.

It is known that exposure to low-frequency low-intensity fields has beneficial effects on seed germination and plant growth [8, 9]. In our studies of this phenomenon, we used a magnetic field with a flux density of 40-50 μT and a frequency of 1-10 Hz for the pre-germination treatment of dry seeds for 1 h. Positive results were obtained with respect to some parameters, such as seed germination, growing capacity, germination uniformity, yielding capacity, and growing season length. In addition, the differences induced by the energy component in the zone of seed treatment with a field with the above parameters were identified.

Treatment was conducted in buildings made of white ashlar limestone in environmentally safe regions of the city, in open areas in the field, in various parts of an industrial reinforced-concrete building with a high level of electromagnetic interference, and

in a special shielded room. Despite the fact that a magnetic field with fixed parameters was used in all the experiments, results of these experiments were different.

Material and methods

Seeds of wheat of the Odesskaya 51 cultivar were taken for the experiment. Seed germination was conducted in Petri dishes on moist filter paper. The seeds taken as a reference sample were not subjected to any treatment. Ordinary tap water was used for moistening. In the experiments, dry seeds placed in Petri dishes were treated for 1 h; after that, the seeds were moistened and left to germinate.

Experiment 1: treatment and germination in limestone house no. 1 in an environmentally safe region of the city.

Experiment 2: treatment and germination in a room in an industrial reinforced-concrete building on the side facing the television tower located at a distance of 300 m from the building.

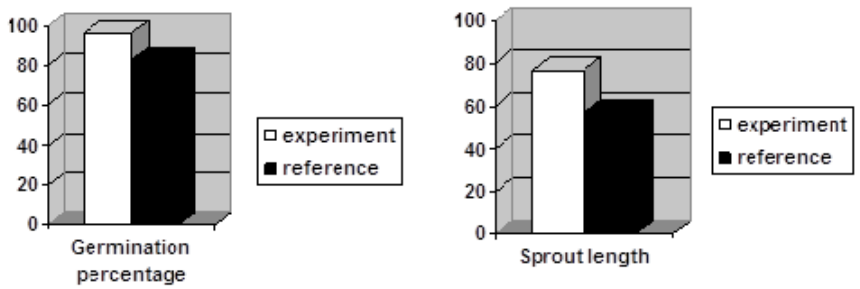
Experiment 3: treatment in a room in an industrial reinforced-concrete building on the side facing the television tower; germination in a grounded metal cabinet.

Experiment 4: treatment in a room in an industrial reinforced-concrete building on the side opposite of the television tower; germination in a grounded metal cabinet.

Experiment 5: treatment and germination in limestone house no. 2 in an environmentally safe region of the city in the zone of action of a constant magnetic field generated by home appliances (column loudspeakers).

Seed germination percentage and sprout length were measured in the experiments.

Results



Fog. 1. Experiment 1.

The “Germination percentage” diagram shows the results of comparative calculation of the percentage of germinated seeds on the 7th day in the experimental and reference samples.

The “Sprout length” diagram shows the results of calculation of the percentage of seeds in which the sprout length is greater than the average sprout length in this experiment.

The results show that, under natural environmentally safe conditions, the seeds in the experimental sample exposed to a positive effect of the magnetic field give better results than the seed of the reference sample.

The “Germination percentage” diagram shows the results of the comparative calculation of the percentage of germinated seeds on the 7th day in the experimental and reference samples.

The “Sprout length” diagram shows the results of calculation of the percentage of seeds in which the sprout length is greater than the average sprout length in this experiment.

The experiment was conducted in the presence of various technogenic fields (elec-

trical power cables, reinforced-concrete building fittings, emissions of television transmitters and retransmitters). The results show that the seeds in the experimental sample were more sensitive to external fields, including harmful technogenic emissions.

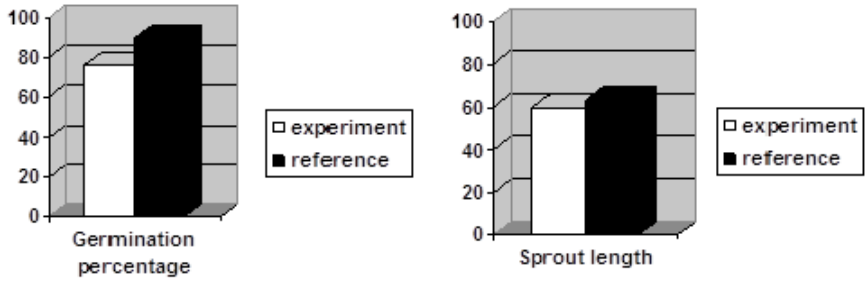


Fig. 2. Experiment 2.

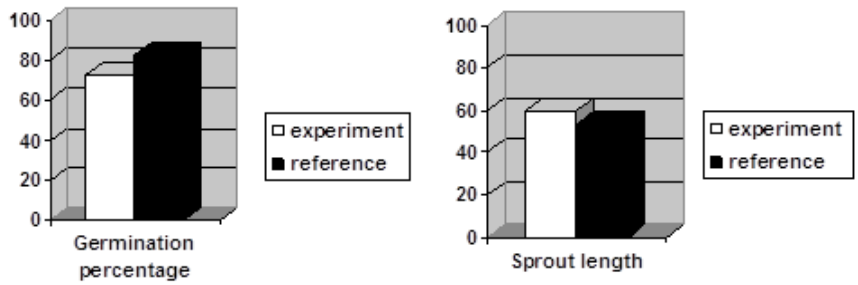


Fig. 3. Experiment 3.

The "Germination percentage" diagram shows the results of the comparative calculation of the percentage of germinated seeds on the 7th day in the experimental and reference samples.

The "Sprout length" diagram shows the results of calculation of the percentage of seeds in which the sprout length is greater than the average sprout length in this experiment.

In the experiment, the magnetic field treatment was conducted with the above parameters in the presence of technogenic fields (similar to Experiment 2), while germination was conducted in a grounded steel cabinet to exclude the impact of any external fields.

The results on the germination percentage were better in the reference sample. The data on the sprout length in the experimental sample were better than in the reference sample.

The "Germination percentage" diagram shows the results of the comparative calculation of the percentage of germinated seeds on the 7th day in the experimental and reference samples.

The "Sprout length" diagram shows the results of calculation of the percentage of seeds in which the sprout length is greater than the average sprout length in this experiment.

In this experiment, treatment was conducted under conditions of a significant weakening of the effect of the television tower, while maintaining all other technogenic fields. Germination was conducted in a grounded steel cabinet similar to Experiment 3.

The results show that there is no difference in the germination percentage of the experimental and reference samples, while the number of sprouts with a length greater

than the average sprout length in the experiment is larger in the experimental sample.

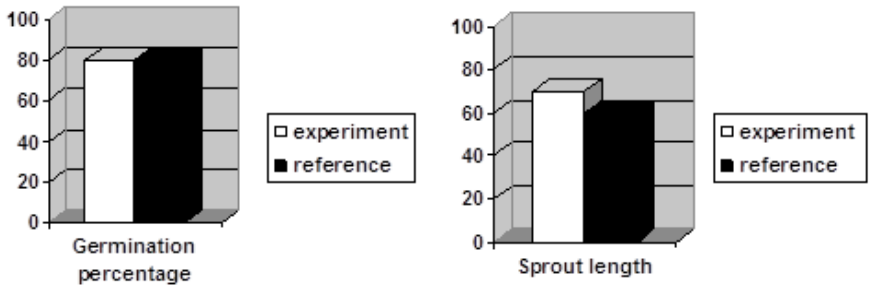


Fig. 4. Experiment 4.

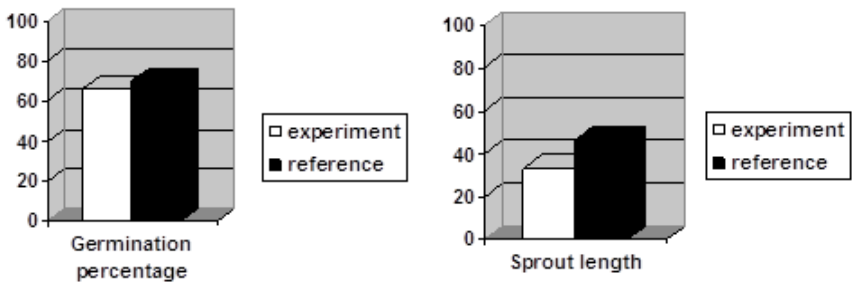


Fig. 5. Experiment 5.

The "Germination percentage" diagram shows the results of the comparative calculation of the percentage of germinated seeds on the 7th day in the experimental and reference samples.

The "Sprout length" diagram shows the results of calculation of the percentage of seeds in which the sprout length is greater than the average sprout length in this experiment.

In this experiment, the effect of a constant magnetic field induced by the magnets of a home audio system was studied. Treatment and germination were conducted in close vicinity (0.7 m) to the magnetic field source. The germination percentage of the experimental sample was lower than that in the reference sample. With respect to the number of seeds with the sprout length greater than the average sprout length in this experiment, the results of the experimental sample were also worse than in the reference sample.

Discussion

To optimize the technique of exposing dry seeds to a low-frequency low-intensity magnetic field, experiments were conducted under different environmental conditions associated with the presence of natural and technogenic electromagnetic fields. In the development of the technique, it was found that the magnetic field treatment of seeds leads to an increase in the sensitivity of the seed cells to external fields. Seed treatment with a low-frequency magnetic field under natural conditions and germination under the same conditions (Experiment 1) give a positive effect in the development of spouts compared to the reference sample because the cells of the germinating seed receive an additional stimulation pulse. In addition, the response to the harmful effects of technogenic fields increases. This fact is illustrated by Experiments 2-5, which were conducted in the presence of various technogenic fields. The development of seeds in

the experimental samples was worse than that in the reference sample. Thus, seed treatment and germination under the same conditions with exposure to technogenic fields (Experiment 2) shows a delay in development in the experimental sample with respect to both seed germination and sprout length in comparison with the reference sample. In the case of treatment in the zone of action of technogenic fields and germination under neutral conditions in a grounded metal cabinet (Experiment 3), the results show that, in the absence of technogenic fields, the experimental sample is superior to the reference sample in the sprout length and inferior in the germination percentage. In Experiment 4, treatment was conducted at a distance from the television tower; this condition led to the same results on the germination percentage in the experimental and reference samples; germination under neutral conditions of a metal cabinet also showed the advantage of the experimental sample. The experiment (seed treatment and germination) conducted under the action of a constant magnetic field generated by a home audio system yielded results identical to those of Experiment 2, where the seeds were subjected to technogenic fields of industrial origin.

These facts suggest that, at the initial stage of development of an organism, in the period of active cell division, the role of the energy component of the environment becomes more significant. Therefore, the absence of any field of artificial technogenic origin is of particular importance in this period.

Taking into account the general laws governing the development of organisms at the cellular level, we can assume that technogenic fields play a particular role for a human body at the moment of impregnation and initial development of the body when the cells of the embryo most actively respond to the surrounding fields.

Conclusions

The exposure of dry seeds to a low-frequency low-intensity magnetic field of natural origin has a positive effect on the development of plants.

Technogenic fields of industrial and domestic origin negatively affect the growth and development of organisms.

It is necessary to take into account the negative impact of artificial technogenic fields on the human body, especially during pregnancy.

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