

Chapter 15

Improvement of Technology of Electrical and Magnetic Stimulation of Seeds and Crop Plants


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ABSTRACT

Use of a variety of electrotechnics is a technologically-efficient and environmentally-friendly technique that increases the productivity of cultivated plants. Stimulation of green plants and vegetable crops in electric field with the intensity of 5-50 kV/m made it clear that the maximum efficiency is observed in the growth period – an increase of up to 30%, compared to the control. Plants have been subjected to stimulation for 3 hours twice a day (in the morning and in the evening). Analysis of studies on the pre-seeding seed stimulation showed that the exposure to pulsed magnetic field improves the dynamics of germination and plant growth at the early stages of development by an average of 10-20%, and more uniform germination helps to ensure high yields.

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INTRODUCTION

There is a need to find and use environmentally friendly (organic) technologies to increase the crop yield and improve the product safety. The most promising technology is electrical electrotechnics, designed to stimulate seeds and plants using the electrical and magnetic fields.

The research focuses on improvement of the technology of electric and magnetic stimulation of seeds and plants to obtain high-quality crop products in the required amount.

To achieve the purpose, the following objectives were solved:

- theoretical research of interaction of electric and magnetic fields with plants;
- experimental research of justification of parameters of electric and magnetic fields that give the greatest effect in stimulation and exposure of plant bodies.

BACKGROUND

Currently, there are many studies (mostly carried out with positive result) of application of heat, light, electromagnetic and other physical impacts on seeds and plants for the purposes of improving germination, increasing germinating energy, increasing harvesting and quality of harvested products. It should be noted that such use of given factors for treatment and stimulation of plants allows them to be classified as environmentally friendly methods, thereby giving them additional benefits for use in agriculture against the background of increasing pollution of the environment with pesticides and other chemicals (Marinković, B. et al., 2008; Aladjadjiyan, 2012; Bilalis et al., 2013).

Today there are various ways for the stimulating treatment of seed grains and improvement of growing functions of plants using laser and ultrasonic radiation, cold plasma, electric, magnetic and electromagnetic fields and other impacts of diverse physical nature (Dardeniz, Tayyar & Yalcin, 2006; Spirov et al., 2008; Yan et al., 2009; Cwintal, Dziwulska-Hunek, & Wilczek, 2010; Goussous et al., 2010; Hernandez et al., 2010; Yang & Shen, 2011; Maffei, 2014; Mihai et al., 2014; Jiang et al., 2014; Jedlička, Paulen & Ailer, 2014; Kasakova et al., 2018).

The positive effect of preseeding treatment of seeds was studied and shown in vegetable, grain, industrial and decorative crops in electrostatic field (Yang & Shen, 2011), constant magnetic field (De Souza et al., 2006; Flyrez, Carbonell & Martínez, 2007; Martínez et al., 2009), alternating magnetic field (Racuciu, 2011; Radhakrishnan & Kumari, 2012) and electromagnetic field of industrial frequency (Pietruszewski, Muszynski & Dziwulska, 2007; Mahmood et al., 2011; Molamofrad et al., 2013; Jedlička, Paulen & Ailer, 2014; Kasakova et al., 2018).

Seed treatment using the electromagnetic fields (Goncharov, Berezhnaya & Gursky, 1994; Pietruszewski, Muszynski & Dziwulska, 2007; Kasakova et al., 2018) enhances the growth and organ-forming processes, particularly at later stages of plant development. Magnetic field significantly affects cell division (Novitsky, Strekova & Tarakanova, 1971; Strekova, 1973), their extension (Strekova, 1973), differentiation (Novitsky, 1973; Novitsky, 1987), as well as accelerates seed germination (Vasilev et al., 2018).

Response of the object depends not only on the dose, but also on the environment, state of the object, etc., but it is difficult to record it, because the plants are impacted for a limited time, following which they are placed into optimal conditions. This ensures repair system deployment, and the situation becomes unclear (Batygin, 1986). In case of seed treatment using the electromagnetic field, the increased yields

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