Chapter 14
Seed pre-Activation Study by Means of LED Radiation

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ABSTRACT

To study the possibilities of pre-sowing seed activation, irradiation with LEDs emitting in the visible, violet, and near-ultraviolet ranges with a maximum of 405 nm was carried out. As a result of the growing experience, it was found that the height of wheat plants grown from the treated seeds significantly exceeds the control indicators except for the period of 45-55 days. To implement the flow, technology of seed activation with LEDs optoelectronic irradiation unit was developed. The advantages of the given installation are the energy efficiency and of seed treatment efficiency, due to of the optimal radiation spectrum selection and treatment doses.

INTRODUCTION

In the modern world there is a constant growth of the population and, as a consequence, the growing demand for quality food. One of the reserves of productivity growth is the use of presowing activation of seeds, including with the help of optical radiation (Kondrat'eva, Krasnolutskaya, Dukhtanova, & Obolensky, 2019, Blaszczak, Aziz, & Gryko, 2017, Hu, Li, & Jiang, 2007, Li, Ji, & Xu, 2013, Wu et al., 2013, Tsai, Huang, Chen, & Yue, 2017, Kakinoki, Kato, Ogawa, Nakao, Okai, & Katsuyama, 2013). Activation of plant seeds by led radiation is energy-efficient, environmentally safe, technological and economically justified. This study is devoted to solving the problem of choosing the optimal modes of led processing of plant seeds, including the optimal processing time, mode (continuous or pulse) and others.

Almost all known sources of radiation from discharge lamps to lasers were used for pre-sowing treatment of plant seeds (Borodin, 1996, Kondrat'eva, 2001, Loginov, 1986, Filippov, Bityuckij, &

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Fedorov, 1997). However, an increasingly important role in lighting and irradiation techniques begin to play the light-emitting diodes (LEDs) – light sources, the generation of which occurs at the energy expense released by re-combination of carriers – electrons and holes – on the border of semiconductor materials with different character conductivity (Shubert, 2008). Particular interest as radiation sources for pre-sowing plant seeds treatment are LEDs of violet and near ultraviolet ranges (about 250-420nm).

In resistance terms to mechanical loads SD significantly exceed all other radiation sources. The service life of most modern LEDs in nominal mode exceeds 50,000 hours. this parameter is superior to all other LEDs types. Circuit SD is very simple. The advantages of LEDs are also: extremely high reliability, small size, environmental friendliness associated with the absence of mercury and other harmful substances, electrical safety (Ajzenberg, 2006).

Materials and Methods of Research

To study the possibilities of pre-sowing seeds activation, irradiation with LEDs emitting in the visible purple and near ultraviolet ranges with a maximum of 405 nm was carried out, which together with the power supply led module (Gaska, & Zhang, 2007, Bashilov, & Belyakov, 2011) (Fig 1). The optoelectronic module with sixteen LEDs creates irradiation of the working surface of 34 mW/m^2 at a distance of 55 cm.

During irradiation, the time of seed illumination was established and the exposure treatment dose was determined from the expression:

$$H = \int_0^{\tau} E(t)dt \tag{1}$$

where $E(t)$ – is the time dependence of irradiation in the seed treatment zone, τ-processing time.

In the simplest case, when the irradiation is constant during the exposure time, formula (1) takes the form:

Figure 1. Led matrix