Optimal parameters of sunflower seeds complex pre-sowing treatment

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Abstract. The sowing quality of seeds is determined by the conditioning properties, one of which is germination. The potential yield depends on the number of germinated seeds, therefore, increasing the conditional properties of seeds by pre-sowing treatment is an urgent problem in agriculture. The introduction of an integrated method of pre-sowing seed treatment allows to summarize the positive effect of the electrophysical effects of an electric field and a biological preparation. The article presents the results of the studies carried out to establish the optimal treatment regimes for the treatment of sunflower hybrids NK Neoma, LG 5500, ES Petunia seeds in an integrated way. The parameters of seed treatment were determined - electric field strength 8 kV/cm, exposure 60 seconds, semi-dry etching with Zerebra Agro growth regulator with an aqueous solution in a proportion of 10 ml of the preparation, 1000 ml of water. Laboratory germination in relation to control increased in hybrids NK Neoma and LG 5550 by 10%, in hybrid ES Petunia by 12%.

1. Introduction
Sunflower oil occupies over 80% of the vegetable oils market. To meet the growing demand for oilseeds, it is necessary to increase the sunflower seeds gross yield. In order to increase the yield of sunflower, scientists and agricultural producers are continuously working on the development and implementation of new agricultural practices in production that increase the germination and survival of plants during the growing season. Traditional technologies exhausted their possibilities, sowing sunflower hybrids of imported selection with high biological potential are not fully disclosed and do not give the yield declared by the seed manufacturer. The conditional qualities of the seed are the key to obtaining a high yield under favorable weather conditions. It is possible to improve the seeds conditional quality by carrying out pre-sowing treatment. The existing methods of pre-sowing seed preparation are conventionally divided into three groups: mechanical, physical and chemical ones. Mechanical methods are used by seed producers, they include cleaning, sizing, sorting by fractions and sizes. Chemical methods are disinfection, the use of growth stimulants, osmotic treatment, incrustation. The physical ones include: magnetic, radiation, electrophysical [1-5], etc. With a different action mechanism, these methods are aimed at stimulating growth processes in the seed, by introducing nutrients (growth regulator) [6], removing the seed from the state of biological dormancy [7] (electrophysical methods). Each of these methods of pre-sowing treatment has its own advantages, with a complex method of treatment [8], using both a growth regulator by applying to the surface, and
the effect of the electric field, the processing efficiency should increase. 

The analysis of the available information from open sources of information about stimulants of biological nature and the effects on seeds of electrical factors allows to formulate a working hypothesis. Complex sunflower seeds treatment in an alternating voltage electric field, followed by treatment by the growth regulator Zerebra Agro, is a very relevant technological method for pre-sowing seed stimulation, since the electrophysical effect removes the seed from "dormancy", suppresses pathogenic microflora, and thereby lays the foundation for increasing seeds germination at the initial stage of plant growth [9]. Additional treatment by the growth regulator Zerebra Agro will reduce infestation due to the fungicidal action of the active substance [10], which is a part of the biological product, and will give an additional impetus to stimulate growth processes in the seed, due to nutrient chemical compounds applied to the seed shell, moving to the embryo and contributing to its growth.

2. Materials and methods
The laboratory studies of the complex pre-sowing treatment influence on laboratory germination were carried out on sunflower hybrids of imported selection NK Neoma, LG 5550, ES Petunia. According to the experiment plan, three types of experiments were carried out: in the first experiment, the seeds were treated in the electric field of different intensity (from 2 to 10 kV/cm) and the treatment time (from 15 to 105 seconds); in the second experiment, the seeds were treated by the growth regulator Zerebra Agro; in the third experiment, the treatment regimes in the electric field were used at the most effective regimes, followed by treatment by a growth regulator Zerebra Agro. The seeds treatment in the electric field was carried out in a working chamber (Figure 1), the design of which provided for two parallel steel plates, between which the seeds were placed with a layer of 2 cm. The lower plate was grounded, the upper one was supplied with a given high voltage from the high-voltage testing apparatus SKAT-70. After the treatment in all three experiments, the seeds were placed in Petri dishes and placed in a thermostat for germination. The laboratory germination was determined on the 5th day.

![Figure 1. Working chamber for seed treatment in the electric field](image)

3. Results and Discussion
Laboratory germination of sunflower hybrids untreated seeds was: NK Neoma - 87%, LG 5550 -85%, ES Petunia - 83%. During the first experiment, the seeds were treated at the electric field intensity of 2, 4, 6, 8, 10 kV/cm and an exposure time of 15, 30, 45, 60, 90, 105 seconds. Dependences of sunflower hybrids NK Neoma, LG 5500 and ES Petunia laboratory germination on the treatment mode and time are shown in Figure 2. Seed treatment at the intensity of 2 kV/cm with an exposure of 15 to
60 seconds, had no effect, at an exposure of 75 to 105 seconds laboratory germination increased in all hybrids by 1 ... 2%. With the increase in the electric field intensity to 4 kV/cm, with an exposure of 15 seconds, responsiveness was not observed, from 30 to 105 seconds, laboratory germination increased in proportion to the treatment time by 4 ... 5%, the maximum increase in germination was in the ES Petunia hybrid - 5%. With treatment modes of 6 and 8 kV/cm, the responsiveness of all the studied sunflower hybrids manifested itself already at 15 seconds - 1 ... 2%, the effect of the electric field with an exposure of 60 ... 75 seconds increased laboratory germination relative to control variant by 7 ... 10%. The laboratory germination rate corresponded to those obtained with the exposure of 75 seconds at the maximum exposure, 90 ... 105 seconds for the specified modes of the electric field intensity.
Figure 2. Dependence of sunflower hybrids laboratory germination on the electric field intensity and treatment time: a) NK Neoma, b) LG 5550, c) ES Petunia

The processing mode at the intensity of 10 kV/cm, with exposures of 45 seconds or more, graphically completely coincides with the mode of 8 kV/cm, which indicates the inexpediency of increasing the electric field intensity above 8 kV/cm. The optimal parameters of treatment by the electric field are a range of intensities of 6 ... 8 kV/cm and an exposure of 60 ... 90 seconds.

The second experiment consisted in applying the growth regulator Zerebra Agro to the seeds. The seeds were treated by the method of semi-dry etching, dried, placed in Petri dishes and placed in a thermostat for germination. The concentration of the prepared solution corresponded to that established by the manufacturer, 10 ml of the preparation per 1 liter of water. Laboratory germination increased relative to control variant by 5% in the NK Neoma hybrid to 92%, by 5% in the LG 5550 hybrid to 90% and by 6% in the ES Petunia hybrid to 89%.

In the third experiment, the seeds were first exposed to the electric field with intensities of 4, 6, 8 kV/cm and an exposure of 30, 60, 90 seconds, then they were treated by a Zerebra Agro growth regulator and placed in a thermostat for germination. The dependence of laboratory germination on intensity and treatment time are presented in Table 1.

Table 1. Laboratory germination of sunflower hybrids seeds at complex pre-sowing treatment

| Exposure time, sec | Electric field strength, kV/cm | Laboratory germination, % |
|-------------------|-------------------------------|---------------------------|
|                   |                               | NK Neoma | LG 5550 | ES Petunia |
| 30                | 4                             | 91       | 85      | 90         |
| 60                | 6                             | 92       | 94      | 95         |
| 90                | 8                             | 95       | 94      | 95         |

With complex treatment, laboratory germination at 4 kV/cm mode and exposure for 90 seconds exceeded the control variant by 5 ... 10%, depending on the hybrid, at the intensity of 8 kV/cm and exposure for 60 ... 90 seconds, in the NK Neoma hybrid, laboratory germination reached 97%, in the
LG 5550 hybrid - 95%, in the ES Petunia hybrid - 95%. Considering that the same results were obtained at 60 and 90 seconds, the optimal processing mode is 8 kV/cm, exposure 60 seconds, subsequent treatment by Zerebra Agro growth regulator.

4. Conclusion
Complex pre-sowing treatment of sunflower seeds by electrophysical and biological methods increases the sunflower seeds laboratory germination. Seeds treatment by the growth regulator after exposure to the alternating voltage electric field increased germination and reduced the time of treatment by the electric field. The optimal mode of sunflower seeds complex pre-sowing treatment is the effect of the alternating voltage electric field with the strength of 8 kV/cm, exposure time of 60 seconds, followed by seed treatment by the Zerebra Agro growth regulator.

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