THE EFFECT OF MICROBIOLOGICAL PREPARATIONS ON THE TECHNOLOGICAL CHARACTERISTICS OF SUNFLOWER SEED MATERIAL

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Abstract - Pre-sowing seed disinfection is the most appropriate and effective method for protecting sunflower crops from external and internal infections, soil-borne pathogens, and pests, thereby ensuring consistently high yields. Microbiological preparations, characterized by high specificity of action and strong environmental compatibility, can serve as an alternative to chemical fungicides, which no longer meet contemporary requirements for environmentally safe products with high quality indicators. The assessment conducted in this study on germination energy and laboratory germination of sunflower seed material revealed a significant influence of microbiological preparations on these parameters.

Keywords - Seed material, Sunflower, Laboratory Germination, Microbiological Reagent.

I.INTRODUCTION

Strict quality control of agricultural products is a key prerequisite for the successful development of agricultural production. This requirement is particularly relevant to seed material, as the realization of yield potential and economically valuable traits of agricultural crops largely depends on seed quality [1].

Chemical fungicides have traditionally remained the primary means of protecting sunflower crops from microbiological damage. Although modern products are characterized by low application rates, rapid degradation in soil, and minimal impact on soil biota, they no longer fully meet current demands for environmentally safe, high-quality agricultural products. Moreover, chemical fungicides do not reduce the number of disease-causing agents that persist in soil and plant residues, which significantly limits their effectiveness. As an alternative to chemical agents, microbiological preparations may be used, offering high environmental compatibility and targeted action. In addition, they help address the issue of pathogen populations developing resistance to conventional pesticides [1] – [3].

The aim of this study is to determine the influence of specialized microbiological preparations on the quality of sunflower seed material.

The objective of the research is to examine laboratory germination and germination energy of sunflower seeds treated with microbiological preparations in comparison with the control sample.

The research object consisted of sunflower seeds treated with specialized microbiological reagents. For convenience in conducting experimental work, each seed sample was labeled according to the microbiological reagent used for its treatment.

II. GERMINATION ENERGY AND LABORATORY GERMINATION OF SUNFLOWER SEEDS

Seed germination is defined as the ability of seeds to produce normal seedlings within a specified period under controlled germination conditions. One of the most important indicators of seed quality is germination capacity. Its assessment is performed at two time points, with the results subsequently summed. Several days after the beginning of germination, an intermediate indicator-germination energy-is determined. After the number of days specified in the protocol, the additional number of germinated seeds is recorded, and the total germination percentage is obtained by summing the results from both evaluation periods [4].

Germination energy is no less important as a quality indicator of seed material than germination capacity. It characterizes the ability of seeds to produce uniform and vigorous seedlings. Seeds with low germination energy tolerate adverse environmental conditions poorly, are more susceptible to diseases, and are less competitive against weed seeds and pathogenic organisms present in the field. When germination energy is low, many seeds require a longer time to germinate, and under field conditions they may fail to emerge altogether due to soil surface drying during that period. Even those seeds that eventually germinate, though belatedly, typically suffer from intense competition with weeds, which significantly limits the availability of mineral nutrients, water, and sunlight. Under cold field conditions, seeds with low germination energy may also exhibit reduced germination. Germination energy represents the percentage of seeds that germinate

within a shorter period than that required for determining total germination. Knowing the germination energy allows agronomists to adjust crop cultivation practices to mitigate the consequences of prolonged emergence or to reject seed lots with insufficient germination energy altogether [5].

For laboratory analysis, sunflower seed material treated with specialized microbiological reagents, as well as the control sample, was collected in the form of representative samples. After sampling, the seeds were placed with forceps on double strips of filter paper (200 × 200 mm) moistened with distilled water to full moisture capacity. The seeds were positioned along the paper strip at a distance of 60–70 mm from the upper edge and 10 mm apart, with the embryo facing away from the experimenter (Figure 1).



Fig. 1 – Image of the process of preparing sunflower seeds for phytopathological examination using the "roll" method

The seeds laid out on the paper were covered with a third sheet of filter paper, also moistened to full water-holding capacity. A strip of polyethylene film treated with alcohol was then placed on top, after which the layers were rolled into a loose cylinder. To maintain experimental accuracy, the rolls were placed in separate containers with a small amount of distilled water added to the bottom, while the seeds remained in the upper part of the roll with the embryonic side facing upward (Figure 2).



Fig. 2 – Image of sunflower seed samples during phytopathological examination using the "roll" method

The container was placed in a thermostat at a temperature of 25 ± 5 °C, and water was periodically added. During inspection and data recording, the roll was unwrapped on a clean, alcohol-treated table, and the upper paper layer (corex) was removed to expose the seedlings for examination. Germination energy was determined on the third day and calculated using the following formula [4]:

$$E = A \times 100\% / a \qquad (1)$$

Where, E - is the germination energy of the seeds; A - is the number of non-germinated seeds on the third day; a - is the total number of seeds placed for germination.

Seed germination was determined on the fifth day, using the following formula for analysis [5]:

$$P = n \times 100\% / N \qquad (2)$$

Where R - is the seed germination (%), n - is the number of non-germinated seeds on the fifth day, N - is the total number of seeds in the sample.

It should be noted that the day of seed placement for germination and the day of counting germination energy or total germination were considered as full 24-hour periods. Images illustrating the process of determining germination energy in samples of sunflower seeds treated with microbiological reagents, in comparison with the control sample, on the third day after the start of the experiment, are presented in Figure 3.

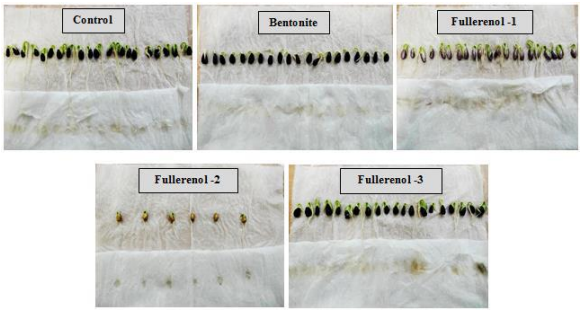


Fig. 3 – Process of determining germination energy in sunflower seed samples

The results of determining the germination energy of sunflower seed samples treated with specialized reagents, in comparison with the control sample, are presented in Table 1.

Sample name	*Number of seeds sampled, pcs*	*Number of germinated seeds, pcs*	*Germination energy, %*
Control	20	20	100
Bentonite	20	20	100
Fullerenol -1	21	21	100
Fullerenol -2	6	6	100
Fullerenol -3	20	20	100

Table 1 – Results of determining germination energy in sunflower seed samples

It should be noted that, based on external appearance, the sunflower seed samples treated with the "Bentonite" and "Fullerenol-2" reagents showed a pronounced developmental delay in both the root system and the shoot compared with the control sample, with the "Fullerenol-2" sample exhibiting the most severe retardation. This observation is clearly illustrated in Figure 4.

During the assessment of germination energy, signs of infection by pathogenic microorganisms were detected in the sunflower seed sample treated with the "Fullerenol-3" reagent. The symptoms appeared as moldy lesions at the root collar, characteristic of Fusarium disease. No diseases were identified in the other sunflower seed samples at this stage of the experiment.



Fig. 4 – Sunflower seed samples treated with microbiological reagents on the 3rd day of phytopathological examination using the "roll" method

Images illustrating the process of determining laboratory germination of sunflower seeds on the 5th day after the start of the experiment are presented in Figure 5.

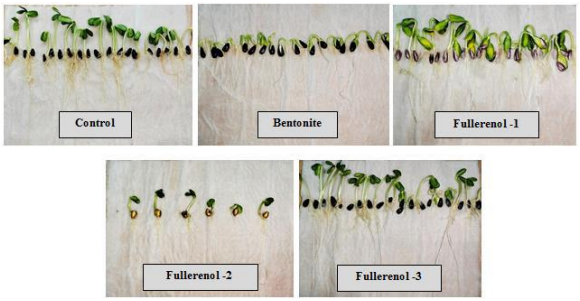


Fig. 5 – Process of determining laboratory germination of sunflower seed samples

The results of determining the laboratory germination of sunflower seed samples treated with microbiological reagents, in comparison with the control sample, are presented in Table 2.

Sample name	*Number of seeds sampled, pcs*	*Number of germinated seeds, pcs*	*Laboratory germination, %*
Control	20	20	100
Bentonite	20	20	100
Fullerenol -1	21	21	100
Fullerenol -2	6	6	100
Fullerenol -3	20	20	100

Table 2 – Results of determining laboratory germination of sunflower seed samples

A comparative analysis of germination energy and laboratory germination of sunflower seeds treated with specialized preparations, in comparison with the control sample, is presented in Figure 6.

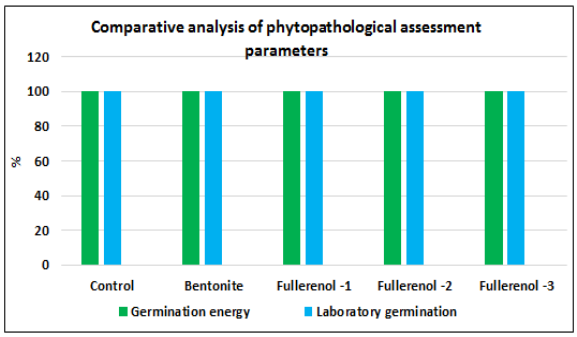


Fig. 6 – Diagram of germination energy and laboratory germination of sunflower seeds depending on treatment with specialized preparations

According to the data presented in Tables 1 and 2, as well as the diagram in Figure 6, the parameters of germination energy and laboratory germination for all sunflower seed samples fall within the same range and equal 100%, which indicates high seed quality. However, it must be taken into account that under unfavorable field conditions, field germination is typically 20–25% lower than laboratory germination. Approximately 8–15% of plants are lost during harrowing, and up to 15% during inter-row cultivation. Therefore, when sowing, an increase of 20–40% above the recommended seeding rate may be required.

Figure 7 shows that, as in the measurements of germination energy, the least developed seedlings are those treated with the "Bentonite" and "Fullerenol-2"

preparations. However, on the 5th day of the experiment, the most pronounced developmental delay of both the root system and the shoot is observed in seeds treated with bentonite.

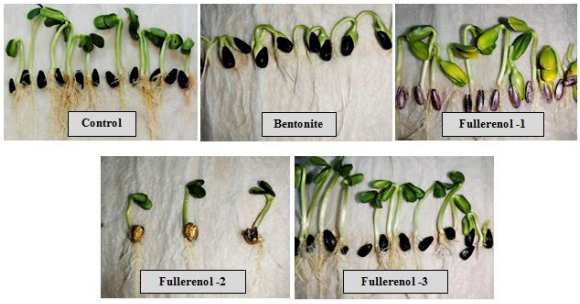


Fig. 7 – Sunflower seed samples treated with microbiological reagents on the 5th day of phytopathological examination using the "roll" method

Based on the results of the external assessment shown in Figure 7 and in Table 10, it can be concluded that the most developed seedlings were obtained from the seed material treated with the "Fullerenol-1" preparation. In these samples, in addition to the first pair of leaves, a second pair is already in the stage of formation. The shoots also demonstrate the greatest height compared with the other samples.

Seedlings from the control sample, as well as those treated with "Fullerenol-2," are at a relatively similar stage of development. The shoots of both samples exhibit comparatively tall and sturdy stems with a single pair of leaves.

III. CONCLUSION

Among the factors determining crop yield formation, seed quality plays a crucial role. Achieving high and stable yields of agricultural crops requires timely and accurate assessment of key characteristics of seed material. The examination of the influence of biologically derived preparations on the quality of sunflower seed material revealed a significant effectiveness of these agents in shaping the technological characteristics of the studied sunflower variety.

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