THE INFLUENCE OF MYCOTIC BIOLOGICAL COMPOUNDS ON THE GERMINATION OF MAIN CROPS IN THE WESTERN REGION OF ROMANIA

R. C. JURCUȚ[1], F. MARIAN[1], A. I. IBRIC[1], F. IMBREA[1], L. BOTOȘ[1]
[1]University of Life Sciences "King Michael I" from Timișoara, Calea Aradului Street, no.119, Timișoara, Romania
Corresponding author: raul.cristian19@gmail.com

Abstract. *In the context of the growing interest in sustainable and environmentally friendly agriculture, research on the use of biological products containing beneficial fungal organisms has become a central topic in contemporary agriculture. A crucial aspect in ensuring the success of healthy and productive agricultural crops is the selection and preparation of seeds for planting. Germination represents a crucial moment in the development of crop plants, and in the spring of 2023, an experiment was conducted to evaluate the germination power of seeds used in western Romania. These seeds came from crops such as sunflower, rapeseed, wheat, barley, and corn. The experiment was conducted outdoors, using metal containers filled with sand, with seeding depths adapted to the specific requirements of each crop. The seeds were sown at their respective depths in five metal containers with treated seeds and five with untreated seeds. The treated seeds were processed with the biopreparation "Mycofriend" for 24 hours, while the untreated seeds were soaked in water. Throughout the experiment, temperatures remained constant, and the moisture input was uniformly applied to each container. The experiment spanned a period of 18 days, collecting data on the number of germinated seeds and the stage of plant development. This study has significant implications for sustainable agriculture, highlighting the impact of the biopreparation "Mycofriend" on seed germination and crop plant development. The results show promise for these practices in increasing yield and sustainability in today's agriculture.*

***Keywords**: Sustainable Agriculture, Germination, Treated Seeds, Biopreparation, Plant Development.*

INTRODUCTION

Agriculture represents a fundamental part of Romania's economy, and the Western region of the country is one of the most significant agricultural hubs (FEHÉR et al., 2016). With a rich diversity of agricultural crops such as sunflower, rapeseed, wheat, barley, and corn, this region plays a crucial role in ensuring food security and economic well-being (LUBELL, et al., 2011).

Sustainable agriculture promotes ecological food production, the conservation of natural resources, and the reduction of environmental impact, ensuring soil and ecosystem health for future generations (LANG et al., 2014). In recent decades, there has been a growing interest in sustainable agriculture and methods to improve agricultural yields while maintaining soil and environmental health (PIÑEIRO et al., 2020; TURNBULL et al., 2011). An especially important area of research in this context is the influence of biological compounds containing mycorrhizal organisms on crop germination in the Western region of Romania.

Mycorrhizae, which are naturally occurring mycorrhizal symbionts, have become the subject of increasingly in-depth research in agriculture. These mycorrhizal organisms form symbiotic associations with plant roots and play a vital role in water and nutrient absorption from the soil. With their contribution, plants grow healthier and yield better results, while requiring fewer chemical inputs such as fertilizers and pesticides (DONOSO et al., 2008).

Previous studies have revealed the positive impact of mycorrhizal biological compounds on agricultural crops (POPA et al., 2016). They can improve seed germination, root growth, nutrient absorption, and plant tolerance to abiotic stress, such as drought (SHUKLA et al., 2022). Additionally, these compounds contribute to improving soil structure and maintaining biodiversity in agricultural ecosystems, as well as carbon sequestration (SHARMA et al., 2012).

Research on this subject focuses on identifying types of mycorrhizae and how they interact with plants and the environment in the Western region of Romania. Through a deeper understanding of these interactions, farmers and researchers can develop techniques and strategies to harness the potential of mycorrhizae in regional agriculture.

Furthermore, it's essential to note that the impact of mycorrhizal biological compounds can vary depending on the crop species, soil type, and climatic conditions. Therefore, research must be tailored to the specificities of the Western region of Romania to provide practical solutions for farmers.

Hence, the influence of mycorrhizal biological compounds on the germination of agricultural crops in the Western region of Romania is an important research topic in the effort to promote sustainable agriculture and increase crop yields. By identifying and correctly applying these compounds, we can contribute to more efficient and environmentally friendly agriculture in this vital agricultural region. Furthermore, I recommend seeking relevant bibliographic sources to support your research.

MATERIAL AND METHODS

In this section, we will detail the materials, procedures, and objectives of our study, which aims to evaluate the influence of the mycorrhizal biopreparation "Mycofriend" on agricultural crops during the spring of 2023. The study was conducted in a protected environment to ensure controlled conditions.

1. Mycofriend Biopreparation

Mycofriend is a biopreparation containing a range of beneficial microorganisms and biologically active substances with the potential to stimulate plant growth (https://btu-center.com/en/industrial-sector/crop-production/mycorrhizal-preparations/mycofriend/). Its composition includes the following components:

- Mycorrhizal fungi: *Glomus*, *Trichoderma harzianum*. (https://btu-center.com/en/industrial-sector/crop-production/mycorrhizal-preparations/mycofriend/; SHARMA et al., 2012);
- Microorganisms that support mycorrhiza and plant rhizosphere formation: *Streptomyces* sp., *Pseudomonas fluorescens*. (https://btu-center.com/en/industrial-sector/crop-production/mycorrhizal-preparations/mycofriend/) (15);
- Phosphate-mobilizing bacteria: *Bacillus megaterium* var. *phosphaticum*, *Bacillus Subtilis*, *Bacillus Muciloginosus*, *Enterobacter* sp. (https://btu-center.com/en/industrial-sector/crop-production/mycorrhizal-preparations/mycofriend/);
- Biologically active substances: phytohormones, vitamins, amino acids (https://btu-center.com/en/industrial-sector/crop-production/mycorrhizal-preparations/mycofriend/).

2. Studied Plant Varieties

For this study, we selected the following plant varieties or hybrids with agronomic importance:

- Wheat: "ASPEKT."
- Barley: "SVGB-5355."
- Corn: "P9610."
- Sunflower: "SY ONESTAR CLP."
- Rapeseed: "UMBERTO."

3. Experimental Environment

To obtain relevant data, the plants were cultivated in containers with dimensions of 30 x 20 x 6 cm, ensuring a controlled and uniform environment. This experiment took place outdoors, using metal containers with a sufficient depth to facilitate seedling development. Each type of crop was represented by a single variety or hybrid, based on the assumption that there were no significant differences in how various varieties or hybrids reacted to the specific treatment.

There are two key aspects that make this experiment unique. Firstly, the seeds underwent a pretreatment, being soaked in the "Mycofriend" biopreparation for twenty-four hours for the treated group, while untreated seeds were soaked in water. Secondly, the experiment was conducted outdoors under natural conditions. Plant watering was done manually daily using a handheld sprayer. However, due to heavy rainfall during the experiment, the plants were shielded from direct rain impact.

4. Purpose and Study Objectives

The study focused on evaluating the effects of the "Mycofriend" biopreparation on agricultural crops, with an emphasis on the following objectives:

- Effect on Germination: We monitored whether treatment with "Mycofriend" inhibited or encouraged seed germination compared to the untreated control group.
- Effect on Root Growth: We concentrated on observing the development of plant roots under the influence of the biopreparation.

The study was motivated by the intention to make significant contributions to understanding the physiological and biochemical mechanisms occurring in young plants in response to biostimulants. We concentrated on obtaining relevant data regarding germination, development, and photosynthetic processes for each crop individually.

RESULTS AND DISCUSSIONS

In this study, we analyzed plant development following sowing and data collection at two distinct time intervals: at six days and at eighteen days after sowing. Our aim was to evaluate the impact of a treatment applied to the plants on germination, the development of both above-ground and below-ground parts, as well as the seed germination process.

Our observations revealed significant differences between the treated and untreated groups, suggesting that the treatment had a negative impact on these key aspects of plant development. We will now explore the results of our observations in detail and their implications for crop yield and overall crop success.

At six days after sowing, we observed that the untreated plants had an impressive germination rate of 90%. This substantial rate indicates robust germination in the absence of any treatment. At this stage, the corn had reached a height of two centimeters, rapeseed had grown to just one centimeter, barley measured three centimeters, wheat had reached two centimeters, while sunflower was in the process of sprouting. However, the treated plants showed no signs of germination at this point, suggesting that the applied treatment had a negative impact on initial germination.

Figure 1 - Germinated Seeds after 6 Days of Sowing.

Moving on to the eighteenth day, which represents the harvest point, the observations revealed some interesting aspects. Regarding the development of the above-ground parts of the plants, we did not notice significant differences between the two groups. This suggests that, in terms of height and above-ground development, the treatment did not significantly influence the plants

Figure 2. Plants Sprouted at 18 Days after Sowing.

However, a notable discovery pertains to the underground part of the plants. In the group of untreated plants, the roots and underground development system appear to be better developed than in the treated ones. This difference indicates a negative impact of the treatment on root and underground system development.

Regarding the above-ground part of the sprouted plants, we can observe significantly greater development in the seeds treated compared to the untreated ones. A study conducted in Pakistan in 2021 demonstrated that sunflower plants whose seeds were treated with Trichoderma exhibited a more robust vegetative mass compared to the untreated ones (GUPTA et al., 2021). This can result in better nutrient absorption and a more consolidated photosynthesis process due to the more developed leaf mass (GUPTA et al., 2021). In the case of barley, it has been shown that seed treatment with Trichoderma led to the development of healthy roots with a high level of tolerance to soils with high salt content (WEZEL et al., 2014).

Another crucial aspect relates to seed germination. In the group of untreated plants, nearly all the seeds successfully germinated. However, in the case of the treated plants, the number of germinated seeds varies significantly between different plant types. For instance, in sunflower, only fourteen out of twenty seeds germinated, representing a suboptimal germination rate. In the case of rapeseed, no germination was recorded, which is concerning for crop potential. In wheat, only four seeds germinated, in barley, only one seed sprouted, while corn had a significantly higher germination rate, with sixteen seeds successfully germinating.

Table 1

The number of germinated seeds at 18 days after sowing

Treated			Untreated		
Culture	Number of seeds germinated	Germinated (%)	Culture	Number of seeds germinated	Germinated (%)
Sunflower	14 of 20	70%	Sunflower	19 of 20	95%
Rapeseed	0 of 20	0%	Rapeseed	15 of 20	75%
Wheat	4 of 20	20%	Wheat	19 of 20	95%
Barley	1 of 20	5%	Barley	18 of 20	90%
Corn	16 of 20	80%	Corn	20 of 20	100%

These observations raise several questions and potential interpretations. First, the treatment applied to the plants seems to have a negative impact on initial germination. This could be attributed to the chemicals or procedures used in the treatment. A more detailed analysis of the treatment is necessary to understand why it negatively affected plant sprouting. It is also important to investigate whether the treatment had a long-term impact on plant development and crop yield.

A study conducted in Italy demonstrated that the application of Trichoderma-based preparations had both beneficial and negative effects on rapeseed plants regarding nutrient absorption from the soil (CAPORALE et al., 2019). The primary influencing factor was the type of soil in which rapeseed was cultivated (CAPORALE et al., 2019; POPA et al., 2016).

Regarding the development of roots and the underground system, the observed differences between the treated and untreated groups can have significant implications. A study conducted by Björkman, T supports the obtained results, showing that the development of corn roots is directly influenced by the use of Trichoderma-containing products (BADAR and QURESHI, 2012). A more developed root system in untreated plants can provide them with an advantage in nutrient and water absorption from the soil, potentially leading to healthier growth and better crop yields. However, it is important to note that this excessive development of the underground system can also have disadvantages, such as a potential decrease in plant stability in unfavourable weather conditions or other environmental factors.

Table 2

Biometric measurements of the plants sprouted at 18 days after sowing

Treated			Untreated		
Culture	Stem	Root	Culture	Stem	Root
Sunflower	9 cm	12 cm	Sunflower	10 cm	24 cm
Wheat	14 cm	21 cm	Wheat	14 cm	30 cm
Barley	13 cm	20 cm	Barley	13 cm	29 cm
Corn	15 cm	18 cm	Corn	17 cm	26 cm

Regarding seed germination, the discrepancies between the treated and untreated groups once again indicate a negative effect of the treatment on this essential process. The low germination rate in treated plants can significantly impact crop yields. It is necessary to investigate why the treatment had this impact on germination and how it can be corrected to ensure more efficient germination in the future.

In conclusion, our observations at six days and eighteen days after sowing indicate that the treatment applied to the plants had a negative impact on initial germination, root development, and the seed germination process. These findings can have significant implications for crop yields and overall crop success. Therefore, it is essential to continue research to better understand the reasons for these differences and to develop strategies that optimize plant development and crop yield.

CONCLUSIONS

Based on the results obtained in this study, several important conclusions can be drawn:

Treatments with the biopreparation "MYCOFRIEND" had a significant impact on the plants, influencing their root system and development.

The experiment demonstrated that the treatment led to the inhibition of germination in the case of the plants treated in the third experiment. However, a significant improvement in their growth and development was not observed.

The discovery that the biopreparation "MYCOFRIEND" completely inhibited the germination and growth of rapeseed plants in all three experiments generated interest and curiosity. This substance is recommended for use in this crop by the manufacturer, but the results of this study raise questions about its effectiveness.

Although the biopreparation "MYCOFRIEND" is a 100% natural product based on "Bacillus," this study suggests that the dosage used was not favourable for plant development. The results may be influenced by various other factors, but the central conclusion is that the dosage used did not produce beneficial effects on the tested plants.

As a direction for future research, testing other "Bacillus"-based products at the recommended dosages by the manufacturer could be considered to evaluate whether other variants of this substance may have a more positive impact on plant development. This could provide a clearer perspective on the potential use of these biopreparations in agriculture.

Overall, this study highlights the importance of carefully investigating the effects of treatments on plants and the need to adjust dosages and products based on plant species and specific crop conditions.

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