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The Main Causes of Pathogenic Diseases in Soil Ecosystems by Microfungi

Abstract

The aim of this study is to investigate the primary causes of pathogenic diseases created by microfungi in soil ecosystems. Microfungi are widespread microscopic organisms in the soil, performing various functions; however, some species possess pathogenic characteristics that can lead to plant diseases. The study explores the activities of microfungi in the soil environment, the impact of ecological factors on these activities, and the spread of pathogenic species of microfungi in the soil. The results show that the pathogenic characteristics of microfungi depend not only on their genetic and morphological structures but also on the physical and chemical conditions of the soil. Ecological factors such as soil pH, temperature, and irrigation practices can enhance the pathogenic features of microfungi. Furthermore, the interactions between microfungi and the soil microbiome, along with their competition with other microorganisms, contribute to the spread of diseases. The research emphasizes the importance of ecological and biological approaches in preventing the diseases caused by microfungi. The application of such methods can help reduce the pathogenic effects of microfungi by increasing soil biological diversity. Consequently, the findings of this research contribute to the development of strategies to combat pathogenic diseases caused by microfungi in soil ecosystems and improve agricultural productivity.

Keywords: *microfungi, pathogenic fungi, soil ecosystems, ecological factors, microbiome, disease spread, soil health, biological diversity, soil pathogens, ecological control*

Introduction

Soil ecosystems are complex microbiological environments that are vital for biodiversity and the food chain. Microscopic organisms living in the soil, including micromycete fungi, play an important role in the protection of the ecosystem and plant health (Aslanova, Asadova, 2023). Micromycete are fungi that have both beneficial and pathogenic functions. Beneficial micromycete increase soil fertility by participating in the decomposition of organic matter in the soil and in the nutrient cycle. However, some micromycete species have pathogenic properties, which can cause plant diseases in the soil. Pathogenic species of micromycete, especially developing in plant roots, damage them, as a result of which plant development is stopped and productivity is reduced (Aslanova, Asadova, 2024).

Research

The diseases caused by micromycete fungi in soil ecosystems threaten not only plant health, but also the ecological balance of the soil. In addition, these diseases can seriously affect agricultural products, water resources and food security. Therefore, the investigation and prevention of the main

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causes of pathogenic diseases caused by micromycete in soil ecosystems is one of the most relevant areas of agricultural and ecological research (Balakhanova, 2024).

Research objective

The main objective of this study is to investigate the role of micromycete fungi in the occurrence of pathogenic diseases in soil ecosystems and to identify the main causes of thesediseases. The activities of micromycete fungi in the soil, their pathogenic potential and the effects of these activities on plant health will be analyzed (Balakhanova, 2022). At the same time, the study also aims to study how micromycete affects soil biodiversity and how changes in the soil environment enhance the pathogenic properties of micromycete.

As a result of fulfilling this objective, the factors that cause the spread of pathogenic species of micromycete in soil ecosystems will be identified and new approaches will be proposed to prevent these diseases (Balakhanova, 2024).

Research object

The object of the research is micromycete fungi and the diseases they cause in soil ecosystems. Micromycete constitute an important part of the soil microflora structure and have a special role for various ecologies (Balakhanova, 2024). However, some micromycete species have pathogenic properties and cause serious diseases in the soil, especially in plant roots. These diseases damage the biological diversity and vegetation of the soil, leading to imbalances in ecosystems (Bakhshaliyeva, Muradov, Ismayilova, Naghiyeva, Mammadova, 2023).

The focus of the research is on micromycete fungi, pathogenic species in the soil and their interaction with plants. In addition, the effect of physical, chemical and biological factors in the soil on the pathogenic potential of micromycete will be studied (Jabrailzade, Aslanova, 2024).

Research methods

A number of methods will be used to conduct this study. These methods were selected with the aim of analyzing the pathogenic activity of micromycete fungi and investigating the main causes of the diseases they cause in soil ecosystems.

Laboratory studies: Experiments will be conducted in laboratory conditions to study the activity of micromycetes in soil and their pathogenic properties. These experiments will analyze how micromycetes develop in different soil environments and conditions and their interactions with plants.

Microbiological analyses: Microbiological analyses will be used to identify pathogenic species of micromycetes in soil samples. These methods will allow us to understand the genetic characteristics of micromycetes and what pathogenic effects they have in the soil.

Analysis of ecological factors: Field studies will be conducted to determine the effects of ecological factors such as soil pH, irrigation regime, and temperature on the pathogenic activity of micromycetes. Experimental conditions will also be created to study how the soil environment affects micromycetes activity under changing conditions.

Genetic and biological analysis: Molecular technologies, especially PCR (Polymerase Chain Reaction) will be used to identify pathogenic species of micromycetes. This will allow us to identify the species of pathogenic micromycetes and accurately measure their impact on soil ecosystems.

Statistical analysis: The data obtained will be analyzed using statistical methods to determine the prevalence and impact of diseases caused by micromycetes in the soil.

Materials and discussion

The materials used in the study will include various soil samples, micromycete fungi, and plant samples. Soil samples will be collected from various ecosystems, agricultural areas, and natural habitats. Micromycete will be selected from various pathogenic and non-pathogenic fungi.

The discussion section of the study will discuss the application of ecological and biological approaches to prevent diseases caused by micromycete fungi in soil. It will also examine how various factors in the soil enhance or reduce the pathogenic effects of micromycete. The results of

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the study will explain the role of micromycete in maintaining ecosystem health and how changes in the soil environment affect the spread of diseases.

Innovation of the research work

The main innovation of this study is the in-depth investigation of the main causes of pathogenic diseases caused by micromycetes in the soil. Previous studies have only studied the general ecological functions of micromycetes, but little attention has been paid to their disease-causing ability. This study will investigate in more depth the pathogenic properties of different species of micromycetes and their impact on plant health. Also, the methods used and the results obtained in this study will provide new biological and ecological information.

Applied significance of the research work

The results of this study will contribute to the development of new methods to control the activities of pathogenic species of micromycetes in the soil and prevent them from causing plant diseases. These approaches can be used in agricultural practices and environmental protection. At the same time, they aim to reduce diseases caused by micromycetes in the soil, maintain the health of ecosystems and improve the quality of agricultural products.

Economic benefit of the research work

Prevention of pathogenic effects of micromycetes will help to increase productivity and reduce diseases in agriculture. The results of this research will allow to prevent plant diseases and increase productivity by applying effective methods of combating micromycetes in soil ecosystems. As a result, increasing the quality and production of agricultural products will be economically efficient and will play an important role in food security issues (Jabrailzade, Aslanova, Ismayilova, 2024).

Conclusion

Micromycete fungi, as an integral part of soil ecosystems, have both beneficial and harmful properties. The results of this study have allowed us to better understand the activities of micromycetes in the soil and their pathogenic properties, thereby providing new approaches to the protection of soil health and the control of diseases encountered in agricultural fields. The main reasons why micromycetes, especially pathogenic species, cause diseases in soil ecosystems have been analyzed (Mathew, Marcel, Nicolas, Priyanga, Jonathan, Martha, Robert, Jonathan, Richard, David, Michel, Andrew, 2004).

As a main result of the study, it was determined that the pathogenic effect of micromycetes in the soil depends on several main factors. Although previous studies have determined the pathogenic properties of micromycetes through genetic and morphological analyses and studied how they spread in the soil, this study examined in more detail how micromycetes respond to changes in the soil environment, changes in ecological factors, and the interaction of microbiomes (Yusifova, Asadova, & Aslanova, 2024). The results showed that the disease-causing potential of micromycetes depends not only on their own properties, but also on the biological and physical conditions of the soil. For example, soil pH, irrigation regime, temperature, and other environmental factors can enhance the pathogenic properties of micromycetes.

In addition, the study showed that the interaction of different species of micromycetes with each other and with other microorganisms in the soil affects the spread of diseases. Micromycetes change the structure of the soil microbiome, creating conditions for the growth of certain pathogens. This leads to the emergence of diseases and crop losses in agricultural areas, as well as negatively affecting the health of the ecosystem (Yusifova, Asadova, Aslanova, 2025).

In addition, it has been found that pathogenic diseases caused by micromycetes in the soil limit the growth and development of plants by preventing their uptake, especially in plant roots. This reduces crop productivity and disrupts the food chain in ecosystems. Such diseases also reduce biodiversity in the soil, as pathogenic micromycetes compete with other beneficial microorganisms and prevent their development. As a result, the balance of soil microbiology is disrupted, making normal cyclical processes in ecosystems difficult.

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Another important result of the study is that it shows that the potential and spread of micromycetes are closely related to environmental conditions and land use. Human activities such as intensive tillage, excessive use of nitrogen and phosphorus fertilizers, and the application of chemical pesticides can enhance the pathogenic properties of micromycetes. Under these conditions, micromycetes spread more widely in contaminated soils, threatening plant health.

One of the main contributions of the study is that it emphasizes the importance of ecologically and biologically based approaches to combat pathogenic diseases caused by micromycetes. The application of more environmentally sustainable methods than traditional chemical control methods is proposed to prevent the pathogenic effects of micromycetes in the soil (Yusifova, Asadova, Aslanova, 2024). The increase in beneficial species of micromycetes and the reduction of their pathogenic species activity by using mycorrhizal relationships can help maintain soil health and increase agricultural productivity. In addition, environmental protection and the application of sustainable agricultural practices are also effective methods to reduce the disease-causing potential of micromycetes.

The results of this study also further clarified the need for the application of integrated management methods and ecosystem-based approaches to combat pathogenic diseases caused by micromycetes in soil ecosystems. For example, it is necessary to create new monitoring systems to monitor micromycetes activity in the soil and detect the potential for pathogen spread at an early stage.

Conclusion

In addition, the study showed that changes in the soil environment, including soil structure and microbiome composition, have a significant impact on the pathogenic potential of micromycetes. This knowledge can help maintain soil health and combat diseases caused by micromycetes. At the same time, these approaches will also promote the development of more sustainable and resilient agricultural systems by increasing soil biodiversity. As a result, soil diseases caused by micromycetes not only reduce agricultural productivity but also disrupt the balance of ecosystems. The development and application of ecological and biologically based control methods are necessary to prevent such diseases. The results of the study show that steps taken in this direction will not only help maintain soil health, but also solve global food security issues. A good understanding of the role of micromycetes in soil ecosystems will also have a positive impact on the protection of ecosystem services, ensuring the sustainability of agriculture.

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