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OBTAINING EFFECTIVE BIOLOGICALLY ACTIVE COMPOUNDS WITH FUNGICIDAL AND PLANT GROWTH–STIMULATING PROPERTIES

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Abstract

At present, ensuring high crop productivity, preventing plant diseases, and introducing environmentally safe technologies are among the most urgent challenges in agriculture. In particular, diseases caused by phytopathogenic fungi lead to a significant reduction in crop yields, deterioration of product quality, and considerable economic losses. In this context, the study of biologically active compounds that combine fungicidal and growth-stimulating properties is of great importance.

Despite their high effectiveness, conventional fungicides often cause negative environmental impacts, including the accumulation of toxic residues in soil and water resources and the development of resistance in phytopathogens. Therefore, the demand for environmentally friendly preparations based on biologically active compounds has been steadily increasing.

Biologically active compounds, obtained from natural sources or synthesized chemically, are capable of influencing physiological processes in living organisms. In agriculture, such compounds not only protect plants from fungal diseases but also stimulate growth and development processes, enhance photosynthetic activity, improve resistance to environmental stress factors, and suppress root rot development. Modern research indicates that biologically active compounds with combined fungicidal and growth-stimulating effects are particularly promising for sustainable agricultural practices.

The development and practical application of such multifunctional biologically active compounds can significantly increase crop productivity

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while reducing environmental risks, making this research direction highly relevant from both scientific and practical perspectives.

Keywords: biologically active compounds; fungicidal activity; plant growth stimulation; phytopathogenic fungi; sustainable agriculture; environmental safety

Introduction

In modern agriculture, achieving high crop productivity while ensuring environmental sustainability has become one of the key priorities. The rapid growth of the global population, climate change, and increasing pressure on natural resources require the development of innovative and eco-friendly agricultural technologies. One of the most serious challenges in crop production is the widespread occurrence of plant diseases caused by phytopathogenic fungi, which significantly reduce crop yields and negatively affect product quality [1].

Fungal diseases such as root rot, leaf spot, and various wilting infections lead to substantial economic losses in agricultural systems worldwide. These diseases disrupt normal physiological processes in plants, weaken their resistance to external stress factors, and ultimately decrease both quantitative and qualitative yield indicators. Therefore, effective protection of crops against phytopathogenic fungi remains a crucial task for agricultural science.

Traditionally, chemical fungicides have been widely applied to control fungal diseases due to their high efficiency and rapid action. However, long-term and intensive use of synthetic fungicides has revealed several serious drawbacks. These include the accumulation of toxic residues in soil and water ecosystems, adverse effects on non-target organisms, and the development of resistance in phytopathogenic fungi. As a result, the effectiveness of many conventional fungicides gradually decreases, while environmental and health risks increase [2].

In this context, increasing attention is being paid to biologically active compounds that can serve as safer alternatives to traditional chemical agents. Such compounds are considered promising due to their lower toxicity, biodegradability, and multifunctional effects on plants. In particular, biologically active compounds that simultaneously exhibit fungicidal and

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plant growth–stimulating properties are of special interest, as they provide comprehensive plant protection and productivity enhancement.

Main Part

Biologically active compounds are substances of natural or synthetic origin that are capable of influencing physiological and biochemical processes in living organisms even at low concentrations. In agriculture, these compounds play an important role in regulating plant growth, improving resistance to diseases, and enhancing tolerance to unfavorable environmental conditions.

Biologically active compounds with fungicidal properties act by inhibiting the growth and development of phytopathogenic fungi, disrupting their cellular structures, metabolic pathways, or reproductive mechanisms. By suppressing fungal activity, these compounds reduce the spread of infections and protect crops from severe damage. Unlike conventional fungicides, many biologically active substances demonstrate selective action and lower environmental persistence, which significantly reduces ecological risks.

In addition to their antifungal effects, a number of biologically active compounds exhibit pronounced plant growth–stimulating properties. They enhance seed germination, promote root system development, stimulate photosynthetic activity, and improve nutrient uptake. As a result, plants treated with such compounds show improved growth dynamics, increased biomass accumulation, and higher adaptive capacity under stress conditions such as drought, salinity, or temperature fluctuations.

An important advantage of biologically active compounds with combined fungicidal and growth-stimulating effects is their ability to regulate physiological processes in plants in a balanced manner. These compounds not only protect plants from pathogenic microorganisms but also activate internal defense mechanisms and metabolic processes. This integrated mode of action contributes to improved plant vitality and sustainable yield formation.

The evaluation of biologically active compounds requires a comprehensive research approach, including the assessment of fungicidal efficiency, analysis of their influence on plant growth and development, investigation of mechanisms of action, and examination of ecological safety.

Experimental studies in this field provide valuable data for selecting optimal compounds with high efficiency and minimal toxicity.

Scientific research aimed at developing multifunctional biologically active compounds creates opportunities for the production of new-generation agricultural preparations. Such products meet modern requirements for sustainability, reduce dependence on synthetic agrochemicals, and contribute to the preservation of environmental balance.

Conclusion

In conclusion, the development and study of biologically active compounds with fungicidal and plant growth–stimulating properties represent an important and promising direction in modern agricultural science. The application of such compounds allows effective control of phytopathogenic fungi while simultaneously enhancing plant growth and productivity.

The use of biologically active compounds contributes to increasing crop resistance to diseases, improving yield quality, and ensuring stable agricultural production. Moreover, their lower toxicity and environmentally friendly nature significantly reduce negative impacts on ecosystems and human health.

Therefore, further research and practical implementation of multifunctional biologically active compounds are of great scientific and practical significance. This approach supports the transition to sustainable and environmentally safe agricultural technologies and plays a key role in ensuring food security and ecological stability.

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