support, human capital development, and environmental transformation creates the preconditions for a resilient, competitive, and socially oriented economy.

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Вовчек А.
Тішечкіна К.В.

THE ROLE OF BIOTECHNOLOGY IN MODERN AGRICULTURE AND SUSTAINABLE DEVELOPMENT

У роботі розглянуто роль біотехнології в сучасному сільському господарстві, її вплив на продовольчу безпеку, екологічну стійкість та економічний розвиток. Проаналізовано основні переваги, ризики та перспективи застосування біотехнологічних методів у аграрному секторі.

***Ключові слова**: біотехнологія, сільське господарство, генетична інженерія, сталий розвиток, продовольча безпека, ГМО, екологія.*

The paper examines the role of biotechnology in modern agriculture, focusing on its impact on food security, environmental sustainability, and economic development. The main advantages, risks, and future prospects of biotechnological applications in the agricultural sector are analyzed.

***Keywords:** biotechnology, agriculture, genetic engineering, sustainable development, food security, GM crops, environment.*

In recent decades, biotechnology has become one of the most important scientific fields influencing the development of agriculture. With the rapid growth of the global population, ensuring food security has become a critical challenge. Traditional farming methods are often insufficient to meet increasing food demands, especially under conditions of climate change, soil degradation, and limited natural resources. In this context, biotechnology provides innovative solutions aimed at improving agricultural productivity and sustainability.

Biotechnology in agriculture involves the use of living organisms, cells, and biological systems to develop or modify products and processes. One of the most significant achievements in this field is genetic engineering, which allows scientists to create genetically modified (GM) crops with desirable traits. These traits may include resistance to pests and diseases, tolerance to drought and extreme temperatures, and improved nutritional value.

One of the main advantages of biotechnology is the ability to increase crop yields. GM crops can grow more efficiently and produce higher outputs compared to traditional varieties. This is particularly important in regions where agricultural productivity is limited by environmental factors. Moreover, biotechnology helps reduce the use of chemical pesticides and fertilizers, which has a positive impact on the environment and human health.

Another important aspect is environmental sustainability. Biotechnological methods contribute to the conservation of natural resources by promoting more efficient use of water and soil. For example, drought-resistant crops require less irrigation, which is crucial in areas facing water scarcity. In addition, reduced pesticide use helps preserve biodiversity and prevent soil and water contamination.

However, despite its numerous advantages, biotechnology also raises several concerns. One of the main issues is the potential impact of genetically modified organisms on ecosystems and human health. Although many studies confirm the safety of GM crops, public skepticism and ethical debates still exist. Another challenge is the economic aspect, as biotechnology technologies can be expensive and not equally accessible to all farmers, especially in developing countries.

Furthermore, there are concerns related to the loss of biodiversity and the dominance of large agricultural corporations. The widespread use of genetically modified crops may lead to the reduction of traditional plant varieties, which are important for maintaining genetic diversity.

To address these challenges, it is essential to implement proper regulations and ensure responsible use of biotechnology. Governments and international organizations should develop policies that promote safe and equitable access to biotechnological innovations. Education and awareness are also important, as they help society better understand the benefits and risks associated with biotechnology.

In conclusion, biotechnology plays a crucial role in the development of modern agriculture and sustainable food systems. It offers effective solutions to global challenges such as food security, climate change, and environmental protection. However, its application must be carefully managed to minimize risks and ensure long-term benefits for society and the environment. The future of agriculture largely depends on the successful integration of biotechnology with sustainable practices.

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Гаврилюк А. М.
Саламатіна О. О.

BIOREMEDIATION: USING MICROORGANISMS TO CLEAN THE ENVIRONMENT

У публікації проведено огляд методу біоремедіації, який використовує мікроорганізми для видалення або нейтралізації забруднювачів навколишнього середовища. Було проаналізовано використання бактерій, грибів та водоростей для відновлення середовища та економічна ефективність даного методу.

Ключові слова: *біоремедіація, мікроорганізми, забруднення навколишнього середовища, біодеградація, рекультивація ґрунту, очищення води, екологічні технології.*

The publication reviews the bioremediation method, which uses microorganisms to remove or neutralize environmental pollutants. The use of bacteria, fungi and algae for environmental restoration and the economic efficiency of this method were analyzed.

Keywords: *bioremediation, microorganisms, environmental pollution, biodegradation, soil remediation, water treatment, eco-friendly technology.*