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Abiotic Stress Mitigation Strategies for Enhancing Crop Resilience in a Changing Climate

Abiotic stress poses a significant threat to agricultural productivity, particularly as climate change intensifies environmental challenges such as drought, salinity, and extreme temperatures. This abstract examines recent advancements in mitigating abiotic stress in crop plants, through the application of plant growth-promoting rhizobacteria (PGPR) and plant growth-promoting fungi (PGPF), which have emerged as promising biological solutions, focusing on innovative strategies that enhance resilience and ensure food security. They inhabit the soil and thrive in the rhizosphere, where they enhance plant growth and productivity through various direct and indirect mechanisms such as the production of phytohormones, siderophores, and solubilization of minerals. It allows better water and nutrient uptake, promoting root development, and inducing systemic resistance to environmental stresses. These microbes can modulate plant physiological processes, such as antioxidant enzyme activity which mitigates oxidative stress caused by reactive oxygen species (ROS) during abiotic stress. This enhancement helps protect plant cells from damage and maintains metabolic functions. osmotic adjustment, by promoting the synthesis of compatible solutes like proline and soluble sugars. These compounds help maintain cell turgor and stabilize proteins and membranes, enabling plants to withstand water deficits (drought), salinity, and extreme temperatures. Recent studies highlight the role of specific PGPR strains in enhancing drought tolerance by improving soil moisture retention and promoting root biomass expansion, while PGPF has been shown to enhance nutrient bioavailability, particularly in saline soils. PGPR synthesizes various phytohormones, such as auxins, cytokinins, and gibberellins, which promote cell division and elongation, thereby enhancing plant growth and resilience. These hormones also help regulate plant responses to stress by modulating stomatal closure and improving water use efficiency. The application of PGPR represents a sustainable and eco-friendly approach to enhancing crop resilience against abiotic stresses.
Keywords: Climate Change, Abiotic Stress, Crop Resilience, PGPR, PGPF, ROS, phytohormones.

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