

Signal to survive: endophyte-driven strategies for abiotic stress tolerance

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6.1 Introduction

As sessile organisms, plants are constantly subjected to biotic and abiotic stresses that affect their growth and development, but to a lesser extent, their yield. Among the abiotic stressors, drought, salinity, heat, cold, waterlogging, and heavy metals are significant causes of yield losses worldwide, as they impair plants' physiological processes (Anand et al., 2023; Morales-Vargas et al., 2024). This catastrophe, exacerbated by climate change, which leads to more frequent and severe extreme weather events, enlarges the area of saline soils and increases the frequency of droughts (Verma et al., 2021a; Morales-Vargas et al., 2024). As the global population is expected to reach nearly 10 billion people by 2050, one of the major issues the world will face is how to feed the rising population; thus the need to make crops more resilient to stress and increase their yield becomes imperative (van Dijk et al., 2021).

Conventional approaches, such as crop rotation and breeding, and advanced technologies, including marker-assisted breeding and transgenic plants, have paved the way to a partial solution to the problem. However, in most cases, they face limitations such as cost, time, environmental safety, and public acceptance. In the meantime, endophytes, the microorganisms that get involved in the symbiosis with plants and live inside their tissues without causing any harm, have become the plant's new, powerful, green, and sustainable allies, offering a straightforward solution to the problem of abiotic stress tolerance to a great extent (Anand et al., 2023; Ameen et al., 2024; Morales-Vargas et al., 2024). Microorganisms, including bacteria and