

Endophytes and Its Role in Plant Growth Promotion

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ARTICLE ID: 75

Abstract

The agricultural sustainability concept considers higher food production combating biotic and abiotic stresses, socio-economic well-being, and environmental conservation. However, the extensive application of chemical fertilizers to improve soil nutrients and plant nutrition has resulted in various ecological and environmental problems. Endophytes serve as a sustainable source of novel bioactive compounds and an environmentally friendly substitute for plant growth promotion (PGP). Endophytes colonize plants without causing any negative effects on them. They share a symbiotic relationship with their host and exert beneficial effects on them. The beneficial endophytes help in plant growth and soil health development, either directly or indirectly such as by soil mineralization, production of bioactive molecules, induced systemic resistance, phytohormone synthesis, and resilience to drought stress. Hence, endophytes appear to have a significant role in enhancing plant growth and protecting them from both abiotic and biotic factors and thus enables sustainable agriculture.

Introduction

Intensifying agriculture with the purpose of satisfying global food demand can help accomplish the desired sustainable development goals and food security. Increasing population needs to be fed by increasing the production and productivity of agricultural produce, and novel strategies are required (Adeleke et al., 2022). Endophytes are gaining importance because of their role in plant growth stimulation, protection against biotic and abiotic stresses and pests via modulation of growth hormone signalling, higher seed yield and plant growth hormones. The endophytes have an advantage over rhizospheric colonizers, once they are established within the tissues of the host plant, are no longer subject to the variations of changing soil conditions which may inhibit the functioning and proliferation of rhizospheric bacteria (Chaturvedi et al., 2016). Endophytes represent microorganisms that reside within plant tissues,

without typically causing adverse effects to the plants, for a substantial part of their life cycle, and are primarily known for their beneficial role to their host plant. These are the microbes that colonize living, internal tissues of plants without causing any immediate, overt negative effects (Jain and Pundir, 2017). Microorganisms like bacteria, fungi, and actinobacteria inhabit intra and intercellular plant tissues. Endophytes are capable to colonize leaves, petioles, stems, twigs, bark, root, fruit, flower, and seeds. These microorganisms represent positive plant–microbe interaction

Endophytes promote plant growth via two mechanisms referred to as direct plant growth promotion (DPGP) and indirect plant growth promotion (IPGP). In the DPGP mechanism, endophyte fungi and bacteria own the competency to perform enhancement of plant growth by production and regulation of phytohormone (indole-3-acetic acid, cytokines, gibberellins), improvement of antioxidant activity and augmentation of nutrient movement or procurement (Dwibedi et al., 2022). Direct promotion occurs either by increased acquisition of essential nutrients which involve nitrogen, phosphorus and iron or by modulation of hormone levels synthesizing auxin, cytokinin or gibberellins. Some endophytes can lower levels of the phytohormone ethylene by synthesizing an enzyme, 1-aminocyclopropane-1-carboxylate (ACC) deaminase that cleaves the compound ACC, the immediate pre-cursor of ethylene in all higher plants. IPGP occurs by inhibition by production of antagonistic substances against bacterial or fungal pathogens (Chaturvedi et al., 2016).

References

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