MedCrave Step into the World of Research International Journal of Complementary and Alternative Medicine

Editorial

Rhizospheric microbes: all-rounder players in the soil

Volume 17 Issue 5 - 2024

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Received: October 17, 2024 | **Published:** October 22, 2024

Editorial

Although microbes were not discovered until Anton van Leeuwenhoek observed them in 1683, their role in enhancing plant growth has only been systematically studied in the last two to three decades. Soil, the foundation of healthy agriculture, is home to a diverse range of beneficial microorganisms that play a crucial role in enhancing soil quality and promoting plant health. Maintaining these microorganisms is essential for sustainable agriculture. Rather than importing microbes, native microbial populations can be enhanced in situ, both naturally and through human activities. Forest soils are naturally enriched by plant litter, while agricultural soils are managed by farmers. The rhizosphere, a niche surrounding plant roots, is especially rich in microorganisms, including bacteria that colonize this region. Some of these bacteria, termed rhizobacteria, directly or indirectly benefit plants. Kloepper and Schroth in 1981 introduced the term "plant growth-promoting rhizobacteria" (PGPR) to describe soil bacteria that colonize plant roots, stimulate growth, and reduce plant diseases. PGPRs are well-adapted to diverse environments, with rapid growth rates and metabolic versatility, allowing them to thrive in various ecological niches. The term now specifically refers to bacteria that fulfill at least two of three key criteria: aggressive colonization, growth stimulation, and biocontrol.[1,2]

Plant-microbe interactions occur in the phyllosphere (above-ground parts), endosphere (internal tissues), and rhizosphere (root-associated soil). The rhizosphere, influenced by root exudates and plant secretions, extends a few millimeters from the root surface and is densely populated with bacteria. Actinobacteria, including filamentous species, are also a key component of the rhizosphere microbiome.[3,4] Species such as Azospirillum, Bacillus, and Pseudomonas have been extensively studied for their rhizospheric colonization abilities.[5–7] Recent studies have identified various genera, including Acinetobacter, Alcaligenes, Azospirillum, Azotobacter, Burkholderia, Rhizobium, Serratia, and Xanthomonas, as integral components of rhizospheric biota. When these beneficial microbes are abundant, synthetic pesticides and herbicides become unnecessary. Soil microorganisms act as a natural defense system, preventing plant diseases and promoting plant health.[2] Many studies have shown that a combination of microbial species, rather than single organisms, works synergistically to suppress pathogens and enhance soil health.[8,9]

Conventional agriculture, which relies heavily on chemical inputs such as pesticides, disrupts the balance of soil microbial communities, leading to the destruction of beneficial bacteria and a subsequent decline in soil fertility. In contrast, organic farming practices promote the maintenance of healthy microbial populations, resulting in the cultivation of disease-resistant crops and improved soil conditions. Numerous soil microbes have been identified as essential for enhancing soil fertility, boosting crop production, and controlling plant diseases. These microorganisms play multifaceted roles in the soil, including growth promotion, pathogen suppression, and contributions to environmental sustainability, positioning them as vital components of healthy soil ecosystems hence, they can be considered as all-rounder players in the soil. Despite significant advancements in our understanding of soil microbiology, further exploration of microbial diversity is essential to unlock their full potential for applications in agriculture, environmental sustainability, and human health.

Acknowledgments

None.

Conflicts of interest

The authors declares there is no conflict of interest.

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Citation: Sharma IP. Rhizospheric microbes: all-rounder players in the soil. *Int J Complement Alt Med.* 2024;17(5):237–238. DOI: 10.15406/ijcam.2024.17.00710