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Editorial: Microbial services for sustainable agriculture

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Editorial on the Research Topic
Microbial services for sustainable agriculture

Agricultural practices worldwide face many current challenges. Many agricultural lands have been degraded with salinity increase, fertility losses, and hazardous molecules deposition into the soils. Additionally, the world population has increased, and as a consequence, the demand for food production has also increased.

Increasing food production requires using a large number of chemical fertilizers and pesticides contaminating soil, rivers, and groundwater and provoking several diseases in the consumers.

Since the emergence of plants, microorganisms, bacteria, fungi, and viruses have interacted with them, the interactions between plants and microbes are regulated by biotic and abiotic factors such as plant genotypes, soil type, abilities of microbes, soil conditions, and edaphic climate conditions. There are many types of relationships between plants and microbes interactions. The interaction can be naturalist where no one is benefited from the other. The relationship can be symbiotic the example of this relationship is *Bradyrhizobium japonicum* and the leguminous plant. When the *B. japonicum* infects the leguminous, the plant changes its physiology and morphology the attend to the bacteria in all its needs.

On the other hand, the bacteria supply nitrogen to the plant. This relationship is sophisticated and efficient. And the relationship can be harmful as well as plants and phytopathogenic microbes. In this relationship, the phytopathogenic microbes require many nutrients from the plants destroying their cells and tissues and hampering their development.

Depending on the plant species, it can release up to 40% of its photosynthetic metabolites into the soil. This process is named rhizodeposition. With this phenomenon, the plants can fertilize a portion of soil near their roots denominated rhizosphere. The rhizosphere is a portion of soil near the plant root that the plants nutritionally influence. The rhizosphere presents specific characteristics such as high

metabolism and microbial competition. In this place, the microbes can express their abilities to promote plant growth; therefore, plants sustain this system.

The rhizospheric microbes that promote benefits to the plants are denominated plant growth-promoting microbes, and there are direct and indirect ways to promote these benefits.

Microorganisms interacting with plant parts are classified according to their location and can be rhizospheric, epiphytic, and endophytic.

The plant growth-promoting microbes can act directly by increasing soil fertility. Some microbes are phosphorus solubilizing. They release the enzyme phosphatase, phytase, and several organic acids, which mineralize the phosphorus making it available for plants and other microbes. Some microbes denominated diazotrophic can fix the nitrogen from the atmosphere and usually transform it into ammonia, making it available to plants and microbes. Other microbes can produce phytohormones like auxin, gibberellin, and cytokinins. These phytohormones promote root and shoot development, triggering an increase in soil exploration and photosynthesis efficiency.

Some microbes benefit the plants indirectly by producing antimicrobial molecules which act against phytopathogen microbes, decreasing the emergence of diseases; some microbes increase the resistance of the plant to support the diseases it is denominated by induced systemic resistance where the mechanisms of defense in the plant is improved.

These microbes carriers of these characteristics can be used in agricultural practices to face the aforementioned.

Plant growth-promoting microorganisms can be used to reduce the production cost and environmental impact without lowering productivity.

This Research Topic brings seven articles that discuss the use of these microbes as a promising strategy to face the current agricultural problems. This special issue brings together many reviews, and research articles focused on plant growth-promoting microorganisms and their abilities and impact on plant growth and health. Here, we summarize some highlights from the seven articles published in this particular issue.

Ochieno investigated the contribution of soil biota to the outcomes of pathogenic interactions between *Radopholus similis* and *Fusarium oxysporum*.

Escobar Diaz et al. verified the potential of three *Aspergillus* and *Bacillus* species as growth promoters in cotton plants.

Pardo-Diaz et al. evaluated inoculation with two plant growth-promoting bacteria under reduced nitrogen usage.

Reverchon et al. reviewed the existing knowledge on biocontrol approaches against ambrosia beetles and fungi.

Fortt et al. identified the PGPR-mediated mechanisms involved in regulating salt stress.

Lacava et al. addressed research regarding endophytic and rhizospheric microorganisms associated with tropical plants.

Bano et al. reviewed using phytostimulants as an eco-friendly alternative to eliminate disruption.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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