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# Editorial: Plant-growth promoting microbes: A Green approach to enhance crop productivity

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**Editorial on the Research Topic**
Plant-growth promoting microbes: A green approach to enhance crop productivity

The growing human population has drastically reduced agricultural land per capita during the last few decades. As the horizontal expansion of crop production is limited, alternative measures need to be employed to maximize crop growth to ensure global food security (Singh et al., 2020). Although initially viewed as a panacea for agriculture, the continual use of synthetic fertilizers and pesticides has resulted in a loss in soil quality in many world regions. In addition, nutrient use efficiency remains low for many added nutrients (e.g., N, S, P) (Baweja et al., 2020). Thus, an integrated approach to agriculture with a reduced reliance on agrochemicals is essential to sustain civilization and agroecosystem health. Plant-associated and growth-promoting microorganisms (PGPMs) reside in the close vicinity of plants (rhizosphere, phyllosphere) and are naturally selected communities through evolution. The targeted application of plant-associated beneficial microbes in crop production systems could help support more environmentally-friendly crop production systems by reducing atmospheric pollution (e.g., greenhouse gas emissions), improving water quality (e.g., from reduced N and P losses), enhancing crop quality, promoting soil health and creating more biodiverse agricultural systems (Banik, 2021). This can only be achieved, however, if we understand the basis of plant-microbe interactions. Ultimately, advances in agronomic approaches, selection of suitable crop cultivars, and personalized microbiomes will enable us to enhance biotic and abiotic stress tolerance to build resilience in cropping systems.

Plant-associated beneficial microbes can promote crop production, induce defense response, and promote growth under stress conditions. These microbes produce a wide range of bioactive compounds and plant growth regulators to elicit physiochemical changes and biochemical processes under environmental stress. These fundamental processes involve oxidative defense pathways, signal transduction cascades, secondary metabolite production, and altered nutrient uptake alongside maintaining the integrity of photosystems (Garbeva and Weisskopf, 2020). Additionally, plants regulate the composition and activity of their associated bacterial community (Bag et al., 2022). Microbes of the rhizomicrobiome play key roles in nutrient acquisition and assimilation, improved soil texture, secreting, and modulating extracellular molecules such as hormones, secondary metabolites, antibiotics, and various signal compounds, all leading to the enhancement of plant growth. Plant growth-promoting rhizobacteria (PGPR) are isolated from the rhizosphere and exert substantial benefits to plants in terms of enhanced nutrient availability and hormone production. Further, PGPR improved root development and plant enzymatic activity. These beneficial impacts of PGPR have been verified in several plant species. Plant growth-promoting rhizobacteria are also reported to increase plant tolerance against salinity, drought, and heavy metals. Plants inoculated with different PGPR strains manifested minimal oxidative injury alongside a better antioxidant system. Besides, plants inoculated with PGPR strains also had a higher photosynthetic activity with lesser damage to photosystems. PGPR strains enhanced the phytoremediation ability of plants. PGPR strains induce substantial physiological and biochemical alterations in host plants and thereby diminish the intensity of damage due to abiotic stresses. For instance, ACC deaminase-producing bacteria can be used for bio-augmentation and seed priming to enhance crop stress tolerance and yield potential. In this context, 1-aminocyclopropane-1-carboxylate is released in root exudates, where it is converted into ammonia and α-ketobutyrate, producing ethylene with a marked effect on plant growth and function under stress (Ali et al., 2021).

Thus focusing on the importance of the underlying physicochemical processes induced by plant growth-promoting microbes (PGPMs), a total of five manuscripts have been accepted for publication in this issue to improve our understanding of the mechanisms and functions of microbes in agriculturally important crops. In an *in silico* study Bhanja et al., line Quinine from Phosphate-Solubilizing Microbes encoding genes displayed higher content of GCs at different positions, gene adaptability, and codon usage bias. Another article by Gohil et al., showed that *Bacillus* sp. Strain PG-8, isolated from fermented cow products enhanced the growth of *Arachis hypogea*. Two review articles by Mandal et al., and Inbaraj demonstrated recent updates on plant-associated beneficial microbes mediated alleviation of abiotic stress. Another review article by Pattnaik et al., demonstrated the roles of agriculturally important microorganisms in the uptake of essential soil nutrients.

In recent years, microbial-assisted reclamation of agricultural contamination is getting popular to enhance crop productivity. The application of most of these microbial-based technologies is very limited as several malfunctions occur during field application. However, more research should be carried out to minimize all the lacuna for utilization of microbes under field conditions.

## Author contributions

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

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## Conflict of interest

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