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Editorial: Plant-soil-microbes: A tripartite interaction for nutrient acquisition and better plant growth

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Editorial on the Research Topic

Plant-soil-microbes: A tripartite interaction for nutrient acquisition and better plant growth

Soil is a living, dynamic matrix that is imperative to terrestrial ecology. Soil minerals serve as both sources and sinks of essential plant nutrients. It is a vital resource not just for agricultural production and food security, but also for soil microorganisms. These soil biota are crucial for decomposition and nutrient cycling processes. Soils impoverished by nutrients lead to crop yield loss and nutritional problems, affecting over two billion people. Being a storehouse of microbial activity, soil fertility and its conservation is sustained by soil microbes. However, the high sensitivity of soil microorganisms to excessive soil contaminants leads to deterioration in soil biodiversity and fertility. Hence, soil contamination is also responsible for reducing crop yields and the deprivation of soil nutrients. Since major microbial activity is confined to aggregates with accumulated plant organic matter and rhizosphere, it can be said, soil diversity and nutrient maintenance is influenced by the presence of plants. Plants can retain adequate nutrient contents despite shifting soil environments through modifications to their root architecture, the development of root-based transport systems, and interactions with beneficial soil microorganisms.

This Research Topic contains four articles on contemporary topics in the area of plant science that extensively covered diverse and extremely important topics including the role of microbes in nutrient acquisition. Taking into consideration of soil health, it has been observed that continuous cropping with a low external nutrient supply leads to declining soil fertility that includes nutrient depletion acidification (lowering of pH), loss of organic matter, and an increase in toxic elements. All these adverse soil aspects markedly account for the low agricultural productivity. One of the articles of the present Research Topic (Koné et al.) assessed soil fertility of different cotton-producing areas for nine years by analyzing and interpreting data such as total nitrogen content (NT), Cation Exchange Capacity (CEC), pH water, base saturation (BS), Sum of Exchangeable Bases (SEB) and suggested that due to vigorous cotton planting the area were in a state of degradation and less favourable for cotton cultivation. However, at some study sites, exchangeable cations

(Ca2+, Mg^{2+} and K^{+}) content and the base saturation increased significantly due to the application of mineral fertilizers manure, compost, and crop residues, as well as the combination of organic amendments with chemical fertilizers. Similarly, another study presented how maize residue management strategies under double-cropping systems alter the response of the soil microbe community (Gao et al.). In the study, researchers studied the physico-chemical properties of soil for the duration of eight years after the application of pulverized harvested maize straw following three treatments (1) all summer maize stalks produced returned to the field (SR), (2) half of the summer maize stalks produced returned to the field (HSR), and (3) all summer maize stalks were removed from the experimental area (control, CK). In his study, though he recorded no change in the maize yield but HSR treatment showed a significant increase in the diversity of microbe species in the soil.

Additionally, other articles discussed the role of plant growth-promoting bacteria in maintaining healthy soil texture and better plant growth. Beneficial microbe traits such as siderophores production, phosphate solubilization, and phytohormone production help in restoring soil nutrients. A study by Prasad et al. from the Research Topic isolated two microbes from the soil identified as genus *Pantoea* and possessed several plant growth-promoting traits including the ability to solubilize phosphate. Further, wheat plants treated with these bacterial isolates increased root and shoot length, and plant dry mass and accumulated higher inorganic phosphate in the plant tissue were observed, suggesting their role in mobilizing soluble P from insoluble P-complexes.

Conversely, nutrient deficiency in the soil reduces plant growth and leads to less uptake of nutrients in the edible portion of plants. One review (Upadhayay et al.) summarizes that the zinc content in edible parts of plants was found to be reduced due to its deficiency in soil and it can be increased through biofortification specifically the microbial biofortification approach.

The studies published in this Research Topic showed continuous farming affects soil health, leading to depletion in crop yield and how plants along with microbes help maintain soil properties for better growth and development of plants. The information reported is required to develop the potential approaches to study tripartite interaction for nutrition acquisition and better plant growth to meet the nutritional demands for crop growth to achieve high and stable crop yield. We believe that this Research Topic shows its commitment to providing a research venue for exchanging perspectives and encouraging new lines of research.

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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