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Editorial: Soil biology for sustainable agriculture and environment

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Editorial on the Research Topic
Soil biology for sustainable agriculture and environment

Soil is a natural ecosystem with functionally and taxonomically diverse biological communities. An intensive agricultural production system has greatly reduced the soil ecosystem services, health, and biology (1). Diverse biological communities ensure the continued capacity of the soil in providing nutrients for crop production, carbon sequestration, organic matter build-up, and environmental quality. Soil is the mirror of landscapes; healthy soil signifies a healthy ecosystem and environment (2). In recent years, soil has garnered scientific and public attention for conservation. However, the effort to quantify functional aspects of soil biology has been challenging and evolving. Agricultural production systems have adopted regenerative practices like cover crops, no-till, residue management, and organic fertilizers to develop a sustainable environment and meet the climate targets. However, the response of soil biotic communities to different managements, land use, and topo-geographical aspects needs a comprehensive understanding for success. The Research Topic *Soil Biology for Sustainable Agriculture and Environment* aimed to provide a collection of articles that focus on the dynamic nature of soil biology in response to different land uses, agronomic practice, and nutrient availability.

Crops play a critical role in maintaining soil microbial diversity by providing carbon substrates, phenolics, and flavonoids as root exudates (3, 4). In a natural ecosystem, aboveground crop—diversity is critical for maintaining the belowground soil microbial diversity (5). Higher root inputs and plant residues increase the soil organic carbon and are responsible for a diverse microbial community composition. However, there is a debate on whether an increase in soil organic carbon increases overall microbial biomass or affects specific groups of microorganisms. The study by Wang et al. observed that an *ex* *situ* addition of dissolved organic carbon increases the biomass of gram-negative bacteria, gram-positive bacteria, fungi, and actinomyces. However, the overall microbial community composition remained unchanged. There were no observed differences in microbial community structure at different soil depths. Dissolved organic carbon was assimilated by specific bacterial groups present in the topsoil. The study emphasized the need for further *in situ* experiments to gain more insight into the effects of dissolved organic carbon on microbial community structure. Liu et al. highlighted the significant impact of land characteristics, especially the topographical position of the slopes (slope aspects), on the distribution of soil organic carbon, total soil nitrogen, and total soil phosphorus. The results showed that northern slopes were more favorable in preserving soil organic carbon, total soil nitrogen, and phosphorus than the southern slopes. Higher temperatures, low water content, and high evapotranspiration on the southern slopes significantly affected the accumulation of soil organic carbon, total soil nitrogen, and total soil phosphorus. Wakelin et al. studied the effects of different plant species and their diversity on rhizodeposition of nutrients, primarily carbon, nitrogen, and phosphorus. They found comparable nutrient deposition in the rhizosphere, irrespective of the plant species. However, there was a trend of higher carbon, nitrogen, and phosphorus build-up in the rhizosphere of nitrogen-fixing species. The study also highlighted the need for further investigations considering different soil types, root exudates, and growth conditions to differentiate the plant-specific dynamics of carbon and nitrogen cycling.

Soil microorganisms influence the decomposition of organic residues and nutrient availability. Agricultural practices use beneficiary properties of soil microorganisms, including nitrogen fixation, macro/micronutrient solubilization, phytohormone production, and biocontrol activities in creating a sustainable cropping system. The article by Upadhayay et al. reviewed zinc-solubilizing bacteria, the nature of their activities, and their significance as bioelicitors for sustainable plant growth and biofortification of agricultural products enriched in zinc. The article by Suman et al. reviewed the importance of different agronomic practices, including crop rotation, intercropping, conservation tillage, green manure, biofertilizer, and agroforestry, in establishing a healthy soil and ecosystem. The review discussed the importance of soil microorganisms, especially plant-growth-promoting activities, in creating sustainable agriculture. Suman et al. also emphasized the importance of function-specific soil microbial research for environmental quality and human health.

We hope that the reader will find helpful references to help them further their understanding of soil biology and conduct challenging research to develop a sustainable agricultural production system.

Author contributions

SD and JR conceived the idea and wrote the draft; SD, JR, SS, and NT reviewed and revised the draft. All authors contributed to the article and approved the submitted version.

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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