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Editorial: 'Save Soil' by managing soil nutrient losses, agronomic practices and crop-microbial interaction: World Soil Day 2022

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Editorial on the Research Topic
'Save Soil' by managing soil nutrient losses, agronomic practices and crop-microbial interaction: World Soil Day 2022

Soil and its variable forms are the primary source of all terrestrial life and the soil is considered to be living for its dynamic nature (Pattnaik et al., 2023). Soil is a fundamental source for all living organisms and impacts non-living factors (water, air, minerals, etc.), making it an invaluable and finite resource (Kaur et al., 2023). The importance of soil expands from agronomy through to industrialization; thus, it is crucial to understand the impact of human activity on soil quality (Singhal et al., 2023). To address several global issues related to pollution, food security, and health, the United Nations promotes the Sustainable Development Goals (SDGs) with targets to "save soil" by minimizing nutrient loss and pollution load from the soil. Due to increasing anthropogenic pollution load, many soil pollution control measures are failing, therefore, new technologies and eco-friendly solutions are needed to balance and restore soil health (Majumdar et al., 2021, 2023). Soil-crop interactions are essential considering the crop yield and productivity under different soil statuses (Upadhyay and Majumdar, 2022; Sarkar et al., 2023). These processes, including nutrient release or soil detoxification, are mediated by soil-inhabiting microbes. The intrinsic role of soil parameters, including the different classes of soil, control soil microbiota which in turn modulate soil nutrient contents and make these bioavailable. Different crops, especially cereals, are constantly interacting with these soil microbes, thus the relationship between soil, crops, and microbes is complex (Majumdar et al., 2022).

This Research Topic has been enriched with some of the crucial aspects of soil quality management, crop plant intensification and microbial community involvement in soil-crop betterment. Diverse academicians around the world have shared their current research findings within this Research Topic. Primarily, three categories have been highlighted by the articles accepted under this Research Topic—soil amendments and quality management, crop productivity and nutrient dynamics, and soil microbial diversity with intricate involvements. In a study, it has been demonstrated that a combination of conventional fertilizers and nano-fertilizers can increase the bioavailability of N, Cu, and

Zn along with microbial biomass C and soil dehydrogenase enzyme activity (Upadhyay et al.). The application of nutrients from fertilizer mixes at the right time and right ratio is an essential contributing factor for better soil quality maintenance and the proposed method can increase soil NPK content and plant uptake (Kumar et al.). As a potential soil amendment modulator and nutrient management tool, an optical sensor-based application in-season estimate of yield (INSEY) and grain yield (GY) has been developed which will help to estimate the nitrogen and other soil nutritive parameters (Mitra et al.). Another integrated nutrient management (INM) practice has been reported for the measurement of active and passive soil organic content and nutrient enrichment which proved to be efficient in microbial metabolisms and soil enzymatic activities (Bamboriya et al.). Management of soil organic content has been tested with the tea plantation approach where proposed practice along with the conventional management strategy have been compared and a higher microbial community associated with *N*-metabolism and mycorrhizal fungi are noted (Huang et al.). In recent times, tillage practice has become a center of focus for many research groups to understand different aspects of agronomic situations that may arise when variable tillage practices are implemented. For sustainable soil management, conservation tillage practices supplemented with organic fertilizers are suggested for the long-term benefit of wheat-soybean productivity and quality enhancement (Meena et al.). For the rice-lentil cropping system, a minimal tillage practice with implemented INM has been proven to be efficient in field trials (Bhattacharya et al.) whereas zero tillage and short-duration varieties of lentils are found more growth-oriented and nutrient-conserving compared to the conventional tillage practice (Mukherjee et al.). During a 29-year long-term field trial of a rice-wheat cyclic cropping system, variable rates of NPK has been used along with or without Zn supplementation, at a fixed ratio. This improved the soil enzymatic activities along with greater microbial diversity and organic matter release making the crop productivity higher (Bhatt et al.). For some crops like soybeans, the conventional method of cultivation might be deteriorating which can be compensated for implementing system of crop intensification (SCI) approach. This boosts higher yield and soil nutrition balance where root nodules associated with soybeans are larger, resulting in a bulk plant growth and root density with greater NPK uptake (Singh et al.). Microbial communities are one of the primary modulators of soil nutrient dynamics and these microbial communities might get influenced with changing plant species. This theory has been proved by considering a soil microbial community analysis where apple orchard associated fields are inter-planted with leguminous forage red clover and natural mixed herbs, resulting in an increase of species richness, metabolic activities, soil fertility and land use efficiency (Jiao et al.). The conservation practices for soil quality with proper crop intensifications and associated microbial interventions are well-portrayed in these articles.

While there is no limit to research in soil quality management in urban, rural and agro-climatic areas, the focus should be more engaged toward sustainable development goals (SDGs) promoted by the United Nations (Lal et al., 2021). This Research Topic certainly elucidated some promising research themes that trigger some more future aspects of environmental sustainability and "Save Soil" motto including eco-friendly amendments and seed-priming techniques, water-saving irrigation approaches, molecular assessments of microbial involvement in plant growth promotion, and the fate of natural soil contaminants. It is believed these future research sections will be explored in due time.

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AM: Conceptualization, Project administration, Writing – original draft, Writing – review & editing. DM: Project administration, Validation, Writing – review & editing. SS: Project administration, Validation, Writing – review & editing.

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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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