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Editorial

Soil Biology and Plant Biology Integrate into the Global Environment for Human Beings Sustainable Development under Current Changing Climate Change

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1. Plants and Soil Are the Base Stone for Human Beings Survival

Soil biology is the combination of soil science and biology, which mainly intestates all the process from its occurrence, development, maturation, degradation to pollution and composition. All the interactions of soil factors with biological factors and their shaping colorful and diverse life patterns and mechanisms are also the key content. Soil biology has played increasing roles in agricultural sustainable development, food safety and eco-civilization construction in the globe [1–7]. Soil is the first protecting barrier and survival sustainability, during the process of which plants play the core role driving the cycle of the world by basing upon soil ecosystem. Soil environment is involved in all the process of living organisms and supports life cycle of plants. Plant-soil interaction has become the hot topic of the globe, which is the reporting focus for Journal of Soil Biology (JSB). Plants have developed into an array of complicated mechanisms to cope with various stresses, which only can provide sustainable and cycled materials [8–11]. So, in an ever-changing world, Soil biology and plant biology are of the utmost importance for securing humankind's future well-being. In the invitation of Journal of Soil Biology as the editor-in-chief, this short perspective simply summarizes current background, overview on the main roles of soil biology and plant biology, and concentrates on the emerging important challenges for soil biology under the new-era science branches integrating chance.

Soil is also the hub linking with atmosphere, hydrosphere, lithosphere and biosphere, the material base of terrestrial ecosystem existence, evolution and development, main venue for global element biogeochemical cycle, natural history body protecting human survival by supporting all the living process in the terrestrial ecosystem. Currently, facing a lot of challenges such as global deficient soil resources, worsening environmental pollution, ecosystem degradation, frequent natural disasters and climate change, how to coordinate and play the productive function and environmental protecting function has been important target of soil biology [1–4]. Plants are sessile living body and exposed to stressful environments. Currently, plant biology is combined into agricultural science and soil science from molecular level to ecosystem scale, which utilizes the recent advances in RS technology, molecular biology, biotechnology, synthetic biology and multi-omics to solve issues in model plant systems and agricultural crops for eco-restoration and sustainable productivity at various scales, which sustainably drives the natural recycling and promotes fusing with other sciences branches and making for the gap among them (Figure) [12].

2. Overview on Developments and Roles of Plant Biology and Soil Biology

The most important missions for plant biology is to shape the future and solve the world's most challenging issues by tackling sustainability, climate change and environmental protection, food and water safety and provision, as well as global health maintenance and improvement by performing the optimal plastics of plant functions. For the recent past 4 decades, plants have been e investigated in gene-expression regulation, immunity communication, signal transduction and recognition and gene editing, epigenome, and its interactions with soil-microbial genome, but plant-soil interacting process, especially salt-affected soil and coastal zone and polluted soil have been less targeted. The above land area will take about 50% cover in China arable land, and 30% coastline area of China, respectively [5–9,12–17]. Based on plant measures (as the first productivity or environmental indicators), how to monitor the plant(vegetation)-environment interacting process, how to improve soil-affected soils, how to conduct eco-marine aquaculture and how to ecologically protect and restore soil environment and coastal zone for the sustainable development will be the challenge on the globe for a long time. All the traditional and modern practical measures for agriculture and eco-environmental construction and remediation are how to better manage and regulate plant-environment corresponding relationship, and all their actions and interactions are made true under SPAC system, which aims at managing and regulating plant-environment interactions for sustainable productivity with good ecology [17–22].

3. Challenges and Perspectives

Agricultural productivity in the twenty-first century faces significant challenges due to population growth, decreasing availability of arable land, and rapidly changing environmental conditions. Achieving sustainable increases in crop yields with limited land resources has therefore become a global priority. The plant rhizosphere, which harbors a diverse and dynamic microbial community, has garnered considerable attention for its substantial influence on plant growth, development, and stress adaptation. The rhizospheric microbiome, often described as the “second genome” of plants, consists of bacteria, fungi, actinomycetes, and other microorganisms that interact closely with plant roots and contribute to plant health and productivity [23–27]. They are considered responsible for nutrient cycling, phytohormone production, and protection against biotic and abiotic stresses, thereby providing a sustainable alternative to conventional agriculture that relies on chemical inputs [27–31].

Soil and plants are one-interacting unified body. Agriculture is one of the main driving factors leading to biodiversity decline, but the extension and scope of agricultural activities will increase the challenge to decipher agricultural-soil microbe assembling [28–33]. So, it is urgent to need bringing out dynamic driving factors of agricultural biodiversity on larger space scales by RS technology [34–36]. With a better understanding of the soil microbiome and its interactions with plants, designing synthetic bacterial community may complement current agricultural practices to enhance plant performance on marginal soils for sustainable productivity, which is also a great challenge [37–39]. Utilizing the potential benefits of plant-associated microbes represents another sustainable approach to increasing crop productivity. Plant-promoting bacteria (PPB) provide multiple benefits to plants. However, the biogeography and community structure remain largely unknown [40,41], which is one potential challenge for future.

Soil and water resource are the basis for food safety, healthy ecosystem and human well-being [1–11,42]. China is an agricultural country with 20% population on the globe and low arable land resource. For the past 30 years, our limited land with 9%-area on the globe has been developed with heavy load for industrialization and urbanization, the urgent trendy of which has been strengthened by soil degradation, environmental pollution, water-soil loss and underground water mining. Facing such great challenge, plant science will play more and more roles and have a longer road to go on.

Soil salinization worldwide influences agroforest by restraining output and functions of farmerland and forest ecosystems. Soil microbiota plays vital roles in plant growth and resistance to stress, but how plants interact with root microbiomes to fight adverse environments remains elusive. Recently, authors have put a good way to this global issue. During the feedbacking process of plant-soil interactions, plants and rhizosphere microbiota affect soil nutrients, microbiological community, but also leave behind water-soluble metabolites and volatile organic compounds in soil, which can impact root growth, nutrients uptake, anti-disease property and microbiota assembly and drive positive feedbacking or negative feedbacking [34]. Plant-soil interactions is also the key process to drive natural ecosystem and agricultural productivity. The food safety of the world is facing new challenge with climate change and the lead combined stress. Establishing whole genome-phenotyome-environmentalome-AI-breeding system is urgent [43].

Soil stresses affect crop yields and also present global agricultural challenges. Soil compaction triggers reduction in root length and radial expansion driven by the plant hormone ethylene. Ethylene controls cell wall biosynthesis to promote root radial expansion. The updated study has demonstrated how soil compaction stress, via ethylene, upregulates *auxin response factor 1* in the root cortex, which represses cellulose synthase (CESA) genes. CESA repression drives radial expansion of root cortical cells by modifying the thickness of their cell walls, which results in a thicker epidermis and thinner cortex. This research links ethylene signaling with root cell wall remodelling, and reveals how dynamic regulation of cellulose synthesis controls root growth in compacted soil. The other new study first time brings out that plants regulate rhizosphere spatial distribution and balance of microbiological organisms by the local amino acids release, which provides a new green idea for sustainable agricultural development [43,44].

Soils provide the most fundamental surviving environment for plants, which can drive the life cycle and natural cycle [45]. Studying soils must understand the nature of living organisms: Cells are the hardware carrier of life, biomolecules are the base materials of life, enzymes are the core switch to regulate and control all biochemical reactions of life, and Soils are the base stone and protecting barrier of life existence, maintaining and management. So, our JSB will focus on the study of combination of soil and plants for contributing to global sustainable human beings development [Figure 1]. So, Understanding plant-soil-microbiological body ecosystem and exploring their linkage is also the key to master the healthy status of soils, which is one of the challenges for soil biology.

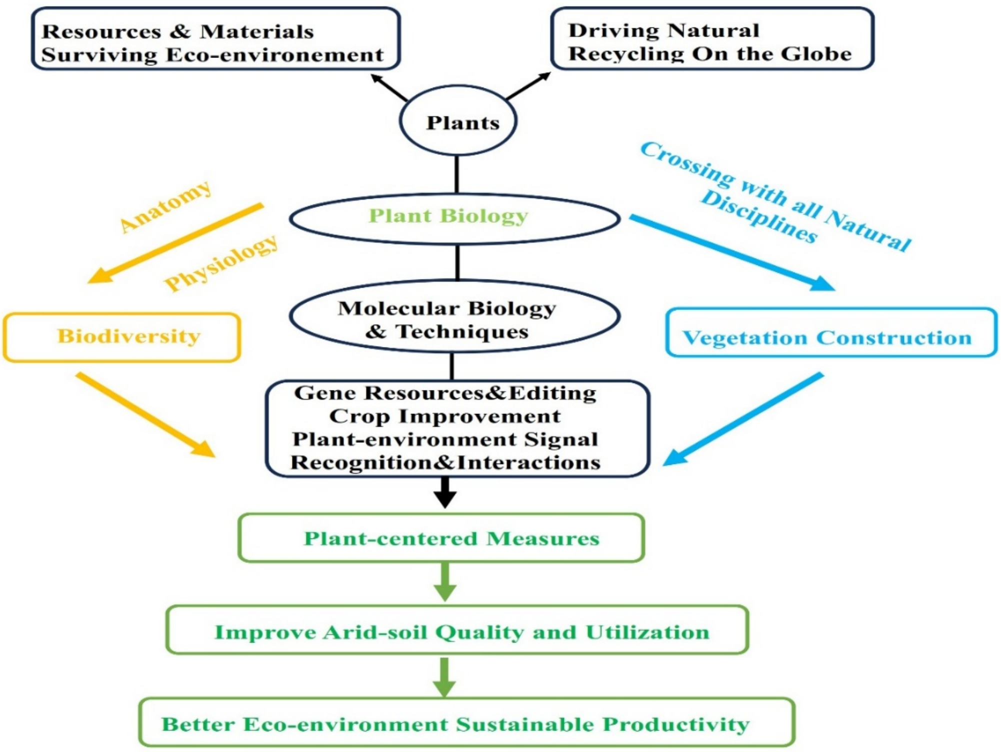

Figure 1. Central roles of Plant Biology in the total environment.

Conflicts of Interest

The authors declare no conflict of interest.

Use of AI and AI-Assisted Technologies

No AI tools were utilized for this paper

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