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Steering Soil Functions with Tailor-made Soil Amendments

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Motivation

Healthy soil supports important functions like nutrient cycling, carbon storage, water retention, and disease suppression through soil microbes[1]. However, intensive farming and long-term use of synthetic fertilizers have caused soil degradation and nutrient imbalance. Converting agricultural residues such as manure and crop waste into soil amendments through biological treatment helps improve soil health and recycle nutrients in a sustainable, circular way. Recent research shows that biological treatments such as anaerobic digestion, composting, and fermentation can produce soil amendments that change their chemical properties, physical structure, and microbial composition. These properties influence soil microbes and their activity, which ultimately affects important soil functions.

Technological challenge

Despite advances in soil amendments, one size does not fit all; a knowledge gap exists in the systematic design of tailor-made soil amendments that maximize targeted soil functioning. Understanding the role of biochemicals present in the soil amendments in improving the functioning of agricultural soil is important. It remains unclear how exactly an amendment-driven shift in soil microbiome translates to functional improvement in soil. The linkage between microbial changes and soil functions over time and across scales is not well understood. This limits our ability to implement effective pretreatment for valorization and amendment strategies for sustainable agriculture.

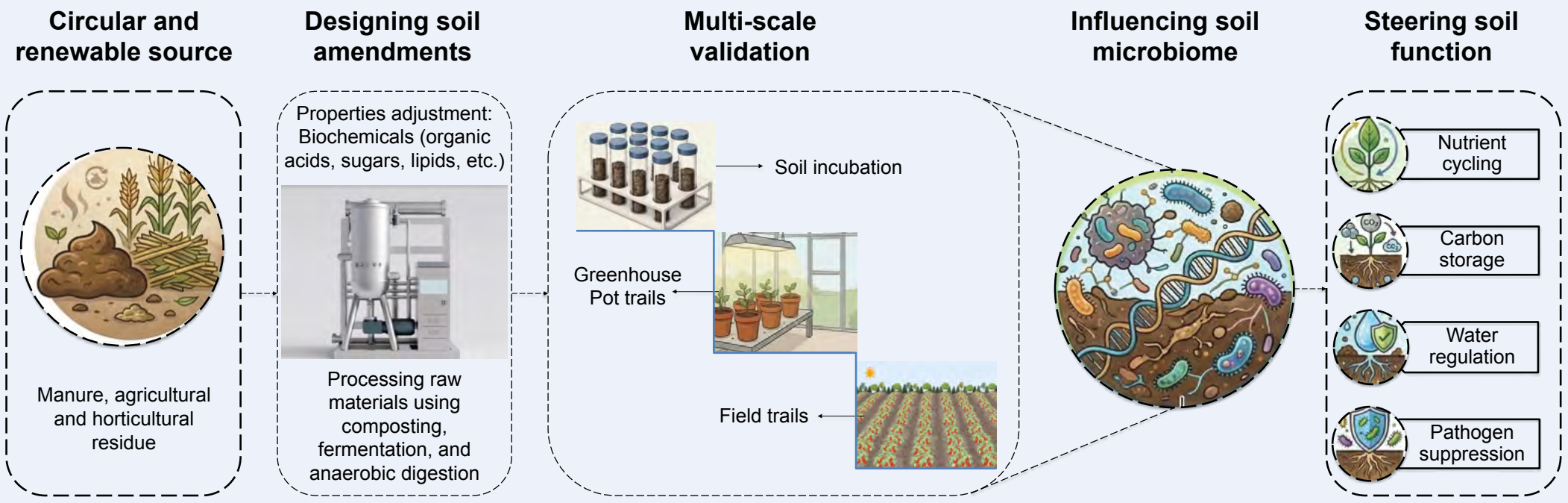

Fig 1. Research overview and approach

Research goals

To steer soil function, we aim:

1. To develop tailored soil amendments from agricultural and horticultural residues, such as manure, crop waste, and greenhouse residues, using biological treatment technologies to create amendments with different beneficial properties.
2. To investigate how the biochemical properties of these amendments influence soil microbiomes and key soil functions, particularly nutrient cycling, carbon storage, water retention, and pathogen suppression, to understand better the amendments- soil microbiome-soil function interaction.
3. To evaluate the suitability of tailored soil amendments for sustainable agriculture by assessing their potential to improve soil quality, resource efficiency, and resilient crop production under laboratory, greenhouse, and field conditions.

References

[1] Hartmann, M., & Six, J., Nature Reviews Earth & Environment 4(1) (2022) 4-18.

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