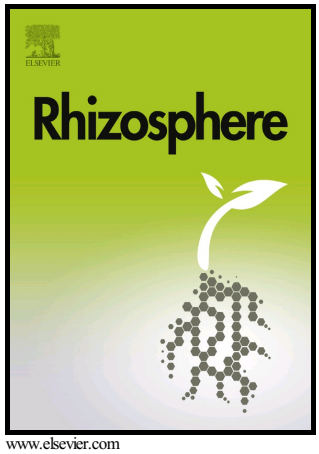

Impact of root system architecture on rhizosphere and root microbiome

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Impact of root system architecture on rhizosphere and root microbiome

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Abstract

The root system influences plant fitness, health, and productivity via its phenotypic traits (phenes) such as root length, biomass, density, volume, and surface area. Although these traits differentially impact the release of 20 to 80% of total photosynthates as root exudates, their role in influencing microbial communities in the rhizosphere and root environments is not clear. The root phenes or architecture significantly alter soil biophysical and edaphic properties such as aggregation, structure, pH, moisture, temperature, and nutrient stoichiometry (C:N, C:P, and N:P ratios, etc.). Meantime, the exteriors and interiors of various root types demonstrate a tremendous phenotypic plasticity in their cellular structure, anatomy, cell types, shapes, metabolisms and biochemical profiles. These heterogeneities in the rhizosphere and endosphere create micro-environments and ecological niches for diverse microbial species to foster beneficial rhizospheric interactions. Results from the root systems of some agricultural, forest and model plants suggest that root phenes selectively filter and recruit different microbial communities. However, microbial colonization of root and rhizosphere environments may also occur through vertical transmission. We suggest that plant breeders should nevertheless consider root phenome and biota while developing new cultivars. Linking root phenome to microbiome (or its functional traits) and crop management practices may enhance our understanding of rhizospheric interactions, and their role in developing climate-resilient rhizosphere ecosystems.

keywords

Agriculture; climate change; crop variety; metabolome; microbiome; plant breeding; root phenotype; root system architecture; root phenes =