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Spatial colonization of microbial cells on the rhizoplane.

Xavier Raynaud (1), Thilo Eickhorst (2), Naoise Nunan (1), Christina Kaiser (3), Dagmar Woebken (4), and Hannes Schmidt (4)

(1) Institute of Ecology Environmental Science, Sorbonne Université, UPMC-Paris6, CNRS, Paris, France, (2) Soil Microbial Ecology, University of Bremen, Leobener Str., UFT, 28359 Bremen, Germany, (3) University of Vienna, Department of Microbiology and Ecosystem Science, Terrestrial Ecosystem Research, Althanstrasse 14, 1090 Vienna, Austria, (4) University of Vienna, Department of Microbiology and Ecosystem Science, Division of Microbial Ecology, Althanstrasse 14, 1090 Vienna, Austria

The rhizoplane is the region where the root surface is in contact with soil and corresponds to the inner limit of the rhizosphere. At the rhizoplane level, plants exchange elements with the surrounding soil and the rhizoplane can therefore be considered as the region that drives nutrient movement and transformation in the rhizosphere. The rhizoplane differs in many respects from the bulk soil due to the far larger supply of substrates derived from the roots, with far greater microbial cell densities and reduced levels of diversity (Philippot et al., 2013). This is likely to result in completely different interaction profiles among microorganisms which may affect rhizosphere biogeochemistry. While the diversity of microorganisms associated with the rhizosphere and on the rhizoplane is getting increasing attention, knowledge on the spatial organisation of this diversity is still scarce.
We therefore aimed at investigating the spatial arrangement of microbial rhizoplane colonization to increase our understanding of potential interaction dynamics within soil-microbe-plant interfaces.
To study the spatial distribution of microbial cells on roots we cultivated rice plants in water-logged paddy soil. Root samples were taken three months after germination. After removing adhering rhizosphere soil the root samples were chemically fixed and prepared for CARD-FISH (Schmidt & Eickhorst, 2014). For hybridization, the oligonucleotide probes EUB I-III (Daims et al., 1999) were applied to cover the majority of bacteria colonizing the rhizoplane. Root segments were then subjected to confocal laser scanning microscopy where triplicate image stacks of 10 μm thickness (0.5 μm layer distance) were acquired per region of interest (ROI). ROIs were defined as distances from the root tip (0, 5, 10, 15 mm) and corresponded to the root tip, elongation zone, and zone of maturation. Image stacks were processed using ImageJ software to extract microbial cells spatial coordinates, as well as other features of the root (e.g. root cell walls).
For all the images analysed, we found that microbial cell distributions were not distributed randomly and strongly associated to root cell walls. The spatial organization of root cell walls could be used to simulate microbial cell distribution that have similar spatial properties compared to the microscopic data. Root cell walls thus appear as a strong determinant for microbial cell colonization of the rhizoplane.