The rhizosphere: a playground and battlefield for soilborne pathogens and beneficial microorganisms

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Editors

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Rhizosphere: Achievements and Challenges

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Rhizosphere: Achievements and Challenges

Described by Hiltner over a century ago (1904), the rhizosphere is defined as the fraction of soil influenced by plant root activities. This dynamic, complex interface where soil, plant roots and microbes interact is a major hotspot of microbial activity, where numerous subtle molecular processes, as well as multiple feedback events take place. Rhizosphere investigations at the microscopic scale have driven spectacular academic advances in the fields of soil sciences or plant-microbe interactions. They bear promises in terms of environmentally-friendly procedures such as bioremediation or ecological engineering. The long recognized role of rhizosphere processes in plant nutrition and health, and more generally in plant adaptation to stress conditions, is now becoming central for designing sustainable management practices of agricultural and forest ecosystems. The rhizosphere, however, must also be considered and investigated at a much larger scale than its own, especially as a location where important steps of both carbon and nitrogen cycles occur, with obvious links with global changes. Major advances in understanding the rhizosphere have been achieved over the last two decades. Combined expertise in plant biology, microbial ecology and soil sciences and design of research strategies including the latest innovative methods in these fields opens exciting prospects for the future.

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Cover caption:

Background photograph: Fababean (*Vicia faba* L.) grown in the long-term P-fertilizer field trial at Aûzeville (INRA Toulouse), exhibiting roots with N_2-fixing nodules, abundant roots hairs and adhering soil, i.e. key players and features in the rhizosphere of legumes (photograph by P. Hinsinger).

Left insert photograph: *In situ* detection of *gfp*-tagged *Pseudomonas* sp. DSMZ 13134 cells on root surface of barley (*Hordeum vulgare* L.) using the CLSM (confocal laser scanning microscope LSM510, Carl Zeiss, Jena, Germany). Two-day old seedlings were inoculated with a bacterial suspension (10^8 cells per seedling). Plants were grown for two weeks in agricultural soil in pots in a greenhouse before analysis of the root colonization. Autofluorescent soil particles can be seen in the upper right corner (courtesy of K. Buddrus-Schiemann, Helmholtz Zentrum München, Neuherberg, Germany).

Right insert photograph: *In situ* detection of bacterial cells on the root surface of potato (*Solanum tuberosum* L.) grown under field conditions four weeks after planting. Fluorescence *in situ* hybridization (FISH) was performed using the oligonucleotide probe EUB-338-mix labeled with Fluos. Bacterial cells appear with the CLSM as green fluorescent signals and a clay particle can be seen as redish autofluorescence (courtesy of K. Buddrus-Schiemann, Helmholtz Zentrum München, Neuherberg, Germany).

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