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The role of rhizosphere on soil microbial processes under elevated atmospheric CO_2: an experimental approach on poplar trees

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To evaluate the implications of environmental change on soil carbon sequestration it is essential to understand the role played by the roots and the rhizosphere on soil microbial processes. Roots can affect soil microbial activities, and consequently the soil CO_2 effluxes, either by supplying C-rich organic substances (roots exudates) and by altering the soil physical and chemical environment. This can lead to either acceleration or retardation of Soil Organic Matter (SOM) decomposition. The effect of living roots on SOM decomposition was reported as inhibitory due to the competition between roots and microflora for substrates, or as stimulatory due to the priming effect of exudates.

The research work was carried out in the frame of the EUROFACE project. Within a *Populus x euramericana* plantation 6 plots were planted with three different genotypes (*P. alba*, *P. nigra*, *P. x euramericana*). Three of these plots were treated with 550 ppm of atmospheric CO_2 with FACE technology, the other three were kept as controls. Each plot (Control and FACE) was divided in two halves, one of which was treated with nitrogen fertilization.

To separate the root contribution from the total soil respiration we carried out a field experiment in Control and FACE plots by means of a "root exclusion" technique in the year 2003. The soil CO_2 effluxes were measured over a period of 18 months on soils with (*Soil-r*) and without roots (*Soil-h*). At the end of this period, the chemical and biochemical properties as well as the microbial functional diversity were also analysed. MicroResp technique was used in order to evaluate the Community Level Physiological Profile (CLPP).

After 18 months of incubation the organic C was lower in *Soil-h* in comparison to the *Soil-r* of about 36% for microbial biomass C, 31% for labile C and 26% for total organic C. The microbial CLPP was significantly influenced by the presence of roots and the addition of easily decomposable substrates increased the microbial activity in *Soil-r* with respect to *Soil-h*. The ability of microbes to utilise the added substrates and the microbial functional diversity weren't affected by elevated CO_2 in *Soil-h*; differently in *Soil-r* the microbial respiration was significantly increased by elevated CO_2. These results suggest that the activity of microbes was strictly dependent on the roots activity and that microbes were more active in consuming the available C where roots and rhizodepositions were present.