Role of microbial diversity in mitigating the emissions of the greenhouse gas n2o in relation to agricultural practices

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Assessing soil biodiversity and role in ecosystem services

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Palais des Congrès, Dijon, France

2-5 DECEMBER 2014

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December 2-5, 2014, Dijon, France

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SOIL BIODIVERSITY

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GLOBAL
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INITIATIVE

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Dijon – France

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Role of microbial diversity in mitigating the emissions of the greenhouse gas n2o in relation to agricultural practices

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Agriculture is the main source of terrestrial N_2O emissions. This gas is the main depleting substance of the ozone layer and contributes to about 6% of total global warming. The unique known biological process able to convert N_2O is its reduction to N_2 by organisms possessing the *nosZ* gene, which encodes the nitrous oxide reductase. A recent publication (Jones *et al*., Nature Climate Change, in press) showed that the abundance and the diversity of a recently discovered clade of *nosZ*_carrying microorganisms are important players of soil N_2O sink capacities. Therefore, enhancing the comprehension of the role of the abundance and the diversity of microbial populations in N_2O emissions and looking for agricultural practices that could favour microbial populations able to reduce N_2O into N_2 is key in determining N_2O emissions mitigation strategies.

In this study, two experimental sites comprising nine management strategies that differ in crop rotation, tillage depth, fertilization, straw incorporation and cover crop were chosen. To characterize the activity of soil microbial communities, potential denitrification rates and N_2O/N_2O+N_2 emission ratios were measured. The abundance of the different microbial guilds involved in N-cycling was quantified by real-time PCR, and the diversity of the *nosZ* gene was determined by 454 pyrosequencing.

Our results suggest that the agricultural practices we tested were not sufficient to modify deeply the abundance and the diversity of denitrifying microbial communities related to the N_2O emissions. However, the diversity and the abundance of these guilds were strongly dependent on the experimental site and responded to soil physico-chemical parameters (e.g.: pH, loam). We also confirmed the link between the diversity of *nosZ* microorganisms and the soil N_2O sink capacity (Fig.1), which emphasize the importance of microbial diversity for ecosystem functioning.

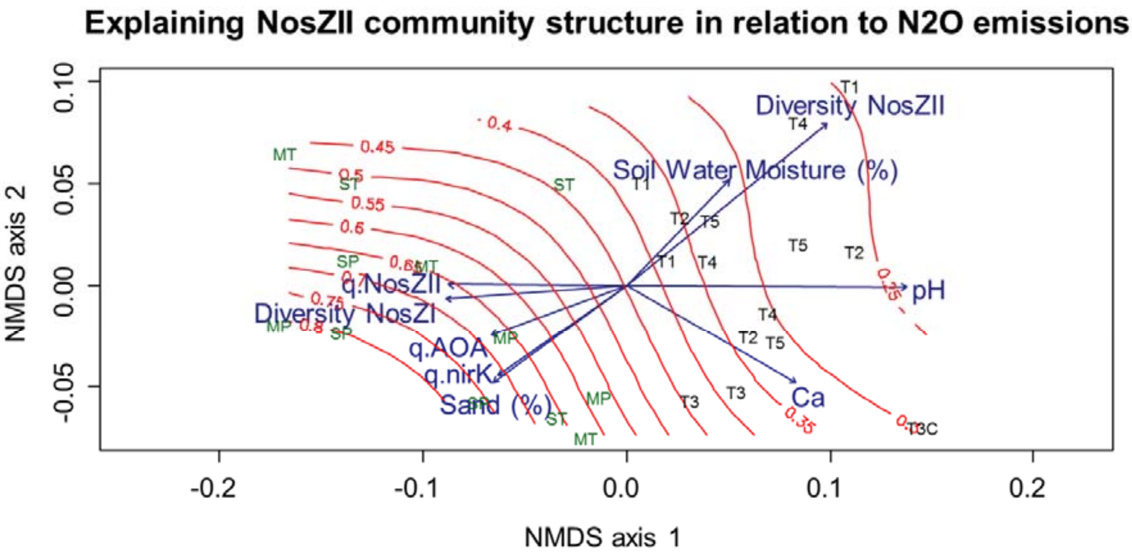

Fig1. NMDS ordination of weighted unifrac distance matrix (stress: 0.1094) at two sites (green and black). Red curves represent N2O emissions ratio gradient (higher ratio indicates higher N2O emissions). Significant explanatory variables represented as vectors in blue (p<0,1): diversity of NosZII (simpson diversity index for NosZII), diversity of NosZI (simpson diversity index for NosZI), Ca (calcium g/kg of soil), q.AOA, q.nirK and q.NosZII represent the quantification of ammonia oxidizing archaea, nitrite reductase bacteria nirK, and nitrous oxide reductase NosZII respectively by nbc/g soil. Sand and soil water moisture are expressed in percentage.

Keywords: N2O emissions, Denitrification, Agroecology, Functional Diversity