Greenhouse gases: A new group of soil micro-organisms can contribute to their elimination

August 28 2014

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Nitrous oxide (N2O) is a potent greenhouse gas that is also responsible for destroying the ozone layer. INRA research scientists in Dijon have shown that the ability of soils to eliminate N2O can mainly be explained by the diversity and abundance of a new group of micro-organisms that are capable of transforming it into atmospheric nitrogen (N2). These results, published in *Nature Climate Change* in September 2014, underline the importance of microbial diversity to the functioning of soils and the services they deliver.

Nitrous oxide (N2O) is one of the principal greenhouse gases, alongside carbon dioxide (CO2) and methane (CH4); it is also responsible for destruction of the ozone layer. Terrestrial ecosystems contribute to about 70% of N2O emissions, at least 45% being linked to the nitrogen-containing products found in agricultural soils (fertilisers, slurry, manure, crop residues, etc.). "In order to lower emissions of N2O and develop more environmentally-friendly agriculture, it is important to understand the processes involved not only in its production but in its elimination", explain the scientists. This elimination can be achieved by micro-organisms living in the soil that are able to reduce N2O into nitrogen (N2), the gas that makes up around four-fifths of the air we breathe and which has no impact on the environment.

INRA scientists, working in collaboration with Swedish and Irish colleagues, have analysed 47 soil samples collected throughout Europe and demonstrated very considerable differences between these soils in terms of their capacities to eliminate N2O. Unlike other greenhouse gases such as carbon dioxide (CO2) or methane (CH4), the ability of soils to eliminate N2O and thus act as a sink for this greenhouse gas has been very little studied hitherto.

Their work has shown that this variability is linked to a new group of N2O-consuming micro-organisms. These organisms had been identified by the same research teams in 2013, but had never previously been taken into account in studies aiming at understanding N2O emissions. "We have discovered that it is both the diversity and the abundance of this new group of N2O-consuming micro-organisms that are important to the ability of soils to eliminate N2O", explains Laurent Philippot, an INRA researcher in Dijon.

This study has also helped to clarify the influence of the physicochemical properties of soils on the development of these micro-organisms. Thanks to a metagenomic approach and the analysis of several hundreds of thousands of DNA sequences, the scientists were also able to identify several groups of micro-organisms that could act as bioindicators for the capacity of European soils to transform N2O into N2. The team is currently working on identifying farming practices that could stimulate this new group of N2O-consuming micro-organisms, in order to ensure sustainable agricultural production.

All these findings underline the importance of the biodiversity of soil micro-organisms to the functioning of soils and the services they deliver.

More information: Jones C.M., Spor A., Brennan F.P, Breuil M.C., Bru D., Lemanceau P ., Griffiths B., Hallin S., Philippot L. 2014. "Recently identified microbial guild mediates soil N2O sink capacity."

Nature Climate Change Volume: 4,Pages:801–805Year published:(2014)DOI:DOI: 10.1038/nclimate2301