Geophysical Research Abstracts
Vol. 16, EGU2014-2632, 2014
EGU General Assembly 2014

Influence of biochar on soil pore structure and denitrification

Peter Maenhout, Steven Sleutel, Nele Ameloot, and Stefaan De Neve

Ghent University, Research Group of Soil Fertility and Nutrient Management, Department of Soil Management, Belgium (peter.maenhout@ugent.be)

Incorporation of biochar into soils has frequently been found to reduce soil emission of the greenhouse gas N2O, formed as an intermediate during microbial denitrification. The exact mechanism that regulates N2O emission reduction after biochar incorporation is still unknown and diverse hypotheses on either chemical, physical or biological controls over soil denitrification exist. The porous structure of biochar may directly and indirectly influence the soil pore structure upon its incorporation. Firstly biochar may increase soil aeration and thereby reduce denitrification which requires an anaerobic atmosphere to continue. In order to investigate this hypothesis we incorporated 4 biochar types in a sandy loam soil and collected undisturbed soil cores after 8 months of field incorporation. We then crushed half of the soil cores and replaced them. We followed N2O emissions from undisturbed and disturbed biochar amended soil cores by GC headspace analysis. From the disturbed soil cores no emission reduction was expected because soil pore structure was severely disrupted. However, both disturbed and undisturbed soil cores showed emission reductions when compared to the soil cores without biochar amendment. This allowed us to reject the hypothesis that biochar would affect soil denitrification through increased soil aeration.

We moved to investigate a second hypothesis, viz. 'Through the retention of water in its finer pores, biochar could create local anaerobic 'denitrification hot spots' in soils. It could be hypothesized that the final further reduction of N2O into N2 is stimulated. We tested this hypothesis by comparing N2+N2O (acetylene inhibition) and N2O emissions from undisturbed soil cores with or without biochar amended, at 70 and 90 % WFPS. At 70% WFPS we expected higher N2 emissions in biochar amended soils compared to the unamended control cores, through the action of anaerobic hot spots in biochar. In contrast, at 90% WFPS anaerobicity would be general in the whole soil matrix and any effect of biochar on the soil pore network structure might be irrelevant under such circumstances. The results of the second experiment, however, clearly demonstrated a general N2 emission reduction from the biochar amended soil cores. This suggests that no stimulation of the last reduction step in denitrification occurred.

In conclusion we reject potential reduction of soil N2O emission by biochar through physical pathways and other mechanisms need to be looked for. We postulate adsorption of labile organic substrates onto the biochar surface to result in inhibition of nitrate reducers driving the first step of the denitrification process.