EGU2020-11949
https://doi.org/10.5194/egusphere-egu2020-11949
EGU General Assembly 2020

Iron-reducing bacteria play a key role in lignin degradation by electron transferring from soil organic matter

Carolina Merino[1,2,3], Francisco Matus[1,2,3], Yakov Kuzyakov[4], Ignacio Jofré[2], and Francisco Najera[2]
[1](carolina.merino@ufrontera.cl) Center of Plant, Soil Interaction and Natural Resources Biotechnology Scientific and Technological Bioresource Nucleus (BIOREN), Temuco, Chile
[2]Laboratory of Conservation and Dynamic of Volcanic Soils, Temuco, Chile.
[3]Network for Extreme Environmental Research (NEXER) Universidad de La Frontera, Temuco, Chile
[4]Institute of Environmental Sciences, Kazan Federal University, Kazan; RUDN Moscow, Russia.

Electron acceptors (NO_3^-, SO_4^{2-}, Fe^{3+}, Mn^{4+}) play a crucial function in the oxidation of soil recalcitrant organic compounds. Soils that present large amount of total Fe (8-57 g kg^{-1}soil) and organic (C) (10-110 g kg^{-1}soil), iron-reducing bacteria (IRB) may play a importan role. In the present study we hypothesized that IRB which reduce Fe(III)(oxyhydr)oxide of low solubility to soluble Fe(II), can contribute substantially to the degradation of lignin from soil organic matter (SOM). The aim of this study was to isolate IRB and evaluate their importance in lignin degradation. IRB were obtained from topsoils of different climates (humid temperate, cold temperate, subpolar), vegetation type (steppe, rainforest) and parent materials (granitic, volcanic, fluvio-glacial, basaltic-Antartic and metamorphic). The potential of IRB to reduce Fe(III) was assessed with lactate substrate as source of carbon (C) and anthraquinone-2,6-disulfonate (AQDS) as electron acceptor. The contribution of IRB to lignin degradation was assessed in an anaerobic microcosms experiment for 36 h. The CO_2 efflux from sterilized and reinoculated soil with IRB was compared with sterilized (abiotic), non-sterilized (biotic) and induced Fenton reaction. Lignin degradation by IRB was examined by: 1) bacterial growth containing alkali lignin and alkali lignin disappearance during incubation, 2) Lignin peroxidase and manganese peroxidase activities originated from IRB, 3) cells abundance estimated from ATP synthase from bacteria growing in alkali lignin and 4) lignin degradation monitored by fluorescence disappearance intensity. The major microbial group for Fe(III) reduction, as essayed by PLFA and nested-PCR and sequencing different species were Geobactericeae-strains (G. metallireducens and G. lovleyi) in all studied. The CO_2 respiration in reinoculated soils was 140% higher than the CO_2 release by abiotic and Fenton reaction and, 40% lower than biotic treated soil. The Fe(II) extractable in HCl in soil derived from basaltic-Antarctic parent material showed 362 % more Fe(II) solubilisation than that of biotic treatment. Fluorescence intensity decreased during lignin degradation and it was closely correlated with CO_2 release in the same sample. We conclude that IRB community such as Geobacter spp. Uses intensively Fe(III) as an electron acceptor to oxidize lignin compounds, and this process is especially active in Fe rich soils.