



Long-term impact of land management in soil biological processes can be assessed by fingerprint of dissolved organic carbon and peroxidase activity in topsoil and subsoil

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The dissolved organic carbon (DOC) is a highly dynamic pool, directly related to biological functions and to the stabilization of organic carbon (OC) through interaction with the mineral phase. Therefore, the characterization of the main components of DOC can be linked to the metabolic status of soil and the turnover of OC and provides a sensitive approach to evaluate the impact of land use on OC turnover in soils. Accordingly, the objective of this study was to derive relationships between DOC characteristics and biochemical activity in soils under contrasting land management. The soil solution was isolated from topsoil and subsoil for three soils (Vertisol, Ferralsol, Acrisol, World Reference Base 2014) collected from undisturbed areas and from a location(s) immediately adjacent which has a long history of agricultural, pasture or afforestation use (>20 years) by centrifugation at 4000 rpm (20 min, 25 °C). The fingerprint of DOC was obtained to identify OC functionalities by spectrofluorometric analyses and Excitation-Emission matrices (EEM) were obtained for all samples. The excitation wavelengths were increased from 250 to 400 nm in 5-nm steps for each excitation wavelength, and emission was detected from 250 to 500 nm in 0.5-nm steps and. Humification index (HIX), freshness index (FrI), fluorescence index (FI) and redox index (RI) were derived from the EEMs. Extracellular laccase activity was examined by monitoring the oxidation of 2,2'-azinobis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS) at 420 nm.

The EEMs revealed a depletion of the humic-like component (250<ex<400, em 380-550) in the topsoil for soils under pasture or cropping compared to adjacent soils under native vegetation. For soil under pasture, the subsoil appeared enriched in the humic-like component compared to the subsoil under native vegetation. A component assigned to aromatic proteins was identified in the subsoil of the cropping area. The HIX consistently decreased for cropping areas compared to soil under native vegetation across the different soils. However, HIX decreased for the Ferralsol under pasture compared to areas under native vegetation, but increased for the Acrisol under pasture. Generally, HIX is substantially related to land use, with the highest HIX values determined for soils under native vegetation.

Laccase activity was generally higher for topsoils collected from undisturbed areas for the three soils examined and a significant decrease in the enzyme activity was determined for soils collected from the corresponding adjacent crop land. The rate of ABTS oxidation varied for the different soils following the order Vertisol>Acrisol>Ferralsol and was always higher for the topsoils compared to the corresponding subsoils.

Overall, results indicate that land management has a strong impact on soil biological activity. Importantly, such impact is directly linked to changes in the composition of soil OC, particularly the transformation of OC inputs into oxidized products that can contribute to OC build up in soil. For the first time, we have utilized DOC fingerprinting and extracellular laccase activity as complementary techniques to examine changes in OC speciation in soil solutions. This approach provides a suitable link between variations in biological functions and OC dynamics.