Geophysical Research Abstracts
Vol. 18, EGU2016-7689, 2016
EGU General Assembly 2016

Positive feedback of crop residue incorporation on dissolved organic carbon contents under anaerobic conditions in temperate rice paddy soils

Daniel Said-Pullicino, Marcella Sodano, Chiara Bertora, Cristina Lerda, Dario Sacco, and Luisella Celi

Rice Agro-ecosystem and Environmental Research Group, Dept. of Agricultural, Forest and Food Sciences, University of Torino, Grugliasco, Italy (daniel.saidpullicino@unito.it).

Rice paddy soils are generally characterized by large concentrations and fluxes of DOC in comparison to other ecosystems. Our recent studies have shown that the combination of relatively high pore-water DOC concentrations under anoxic soil conditions (>10-20 mg C l^{-1}) and important percolation fluxes of water during field flooding may contribute significant organic C inputs into the subsoil (18-51 g C m^{-2}) over the cropping season. Crop residues incorporated into the soil after harvest represent the main input of organic C into paddy soils, returning about 200-300 g C m^{-2} y^{-1} in single-cropped rice paddies. The anaerobic decomposition of these residues may supply important amounts of DOC to soil pore waters. Moreover, the supply of electron donors with the input of residue-derived labile OM may further increase DOC contents by stimulating the microbially-catalyzed reductive dissolution of Fe and Mn oxyhydroxides under anoxic conditions, and release of DOC previously stabilized on the mineral matrix (i.e. positive feedback). This could have important implications on organic C inputs into the subsoil as well as substrate availability for methane production.

We therefore hypothesized that crop residue management practices that influence the amount of labile organic matter present in the soil at the time of field flooding may strongly influence soil solution DOC concentrations as well as the positive feedback on the release of soil-derived DOC. We tested this hypothesis at field-scale by evaluating variations in the contents and quality of DOC above and beneath the plough pan over the cropping season as a function of crop residue management practices involving: tillage and crop residue incorporation in spring (SPR), tillage and crop residue incorporation in spring, dry seeding and 1 month delayed flooding (DRY), tillage and crop residue incorporation in autumn (AUT), and straw removal after harvest and tillage in spring (REM). Moreover, we linked changes in DOC concentrations to the reductive dissolution of Fe and Mn oxyhydroxides and methane emissions.

Results evidenced that highest DOC concentrations in the topsoil (up to 40 mg C l^{-1}) were obtained when crop residues were incorporated in proximity of field flooding (i.e. SPR), while lowest contents (up to 20 mg C l^{-1}) were observed with post-harvest removal of rice straw (i.e. REM). The former also resulted in an important increase in DOC concentrations below the plough pan suggesting an important transfer of organic C into the subsoil with respect to the other treatments. Incorporation of crop residues in spring also enhance the reductive dissolution of Fe and Mn oxyhydroxides evidenced by a rapid release of reduced Fe and Mn in the soil solution and transport along the soil profile. This was also linked to an increase in the aromatic character of the DOC suggesting an important contribution of soil-derived organic C to the DOC pool. Methane emissions were moreover strongly linked to DOC concentrations in the topsoil, however we do not have direct evidence of a positive feedback of residue incorporation on soil-derived methane production.