Organic carbon decomposition rates with depth under an agroforestry system in a calcareous soil

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Introduction

- Agroforestry systems increase soil organic carbon (SOC) stocks (Cardinael et al., 2015, 2017, 2018a,b), but little is known concerning the potential decomposition rate of SOC at different depths.
- SOC dynamics have poorly been studied under Mediterranean climate due to the presence of soil inorganic carbon (SIC) in soils (Chevallier et al. 2016).

Objectives of the study

- Assess SOC mineralisation potential as a function of soil depth in an agroforestry plot compared to an agricultural control plot.
- Estimate the contribution of SIC to CO2 emissions at different depths.

Materials and methods

- Soil cores sampled in agricultural control plot, in agroforestry tree rows and alleys
- Measures of SOC and SIC contents (Micro-GC) and their respective $\delta^{13}C_{SOC}$ and $\delta^{13}C_{SIC}$ (IRMS – Micro-Gaz)
  - [SIC] and $\delta^{13}C_{SIC}$: orthophosphoric acid dissolution
  - [SOC] and $\delta^{13}C_{SOC}$: 550°C treated soil
- Soil incubation (duration 44 days):
  - 4 replicates per location: Control; Tree row; Alleys
  - 4 depths: 0-10; 10-30; 70-100 and 160-180 cm (n=48).
  - 40 g soil placed in 500 ml jars
  - Moisture pF 2.5 – 20°C, microbial biomass measured at the end
- Measures of the amount and the $\delta^{13}C$ of the CO2 emitted from soils

$$\delta^{13}C_{CO2} = f_{SIC} \times \delta^{13}C_{SIC} + (1-f_{SIC}) \times \delta^{13}C_{SOC}$$

where $f_{SIC}$ is the contribution of SIC to CO2 emissions.

Results

- Soil heterotrophic respiration was only higher under tree rows at 0-10 cm. CO2 emissions decreased dramatically with soil depth.
- In topsoil layers, most CO2 derived from SOC. In deep soil layers, most CO2 derived from SIC.

Conclusions

Subsoil organic carbon seems to be as prone to decomposition as surface organic carbon. SIC contribution to CO2 emissions needs to be considered for studies on SOC dynamics in calcareous soils.

References