Response of microbial physiology to change in land uses: a bioenergetics approach

Abstract

Some land uses are known to affect the activity of soil microorganisms that, in turn, affect the dynamics of soil organic matter. However, it remains unclear how the soil organic matter and microbial activity respond to changes in inputs related to variations in inter and intra-specific plant traits. The aim of my PhD project is to investigate how microbial physiology constrains soil organic C dynamics under different land-uses using a bioenergetics approach. I will test whether land use affects the energetic yield of active microorganisms and their microbial carbon use efficiency. I will use a short Rotation Coppice Willow (*Salix*) field experiment as a model system. The principle hypothesis is that land-use can be exploited to manage microbial physiological states by affecting the intensity and allocation of metabolic fluxes (summarized by the microbial carbon use efficiency and the microbial growth rate) and therefore soil organic carbon dynamics in soils. The bioenergetics approach that I will use to address these research questions consists (i) in characterizing the soil organic matter, (ii) measuring the CO2 emission and the microbial heat dissipation that result from microbial activity and (iii) identifying the active metabolic pathways in soil. This will be achieved by a combination of chemical and thermal techniques using: (i) ultra-high resolution mass spectrometry, (ii) nuclear magnetic resonance spectroscopy, (iii) fourier transform mid-infrared spectroscopy, (iv) thermogravimetry and bomb calorimetry, (v) gas chromatography mass spectrometry, (vi) isothermal microcalorimetry and (vii) isotopomers.

One of the outcomes of my PhD will be a better understanding of how management practices can be used to alter soil organic carbon dynamics. In the longer term, the envisaged mechanistic understanding will result in better advice to practitioners and stakeholders regarding to the optimization of C sequestration in various situations.