EGU21-6372
https://doi.org/10.5194/egusphere-egu21-6372
EGU General Assembly 2021

Soil carbon sequestration through crops rotation in a Mediterranean Cambisols: measurement and modelling

Enrico Balugani, Martina Maines, Denis Zannoni, Alessandro Buscaroli, and Diego Marazza
Bologna University, Bologna University, CIRSA, Italy (enrico.balugani2@unibo.it)

Soil carbon sequestration (SCS) has been identified by the IPCC as one of the most promising and cheap methodology to reduce atmospheric CO_2. Moreover, an increase in soil organic carbon (SOC) levels improves soil quality by increasing soil structure (and, hence, resistance to erosion) and promoting soil ecosystems services like water retention, productivity, and biodiversity. Various agricultural techniques are available to increase SOC; among them, crop rotation can improve SOC through soil coverage, changes in water regimes, increase in both carbon inputs, and increase in soil aggregates formation.

SOC dynamic models, such as RothC, have been suggested by the IPCC as a way to evaluate the SCS potentials of different soils. Such models could also be used to evaluate the sequestration potential of different agricultural practices. Moreover RothC allows to estimate the time within which the SOC variation, due to a certain agronomic management, can be considered significant as measurable above a threshold value.

In this study, we evaluated the SOC changes for different crop rotations through direct measurements and RothC modelling, with the objective of: (a) estimating their SCS potential, and (b) propose a robust monitoring methodology for SCS practices. We performed the study in an agricultural field close to Ravenna (Italy) characterized by Cambisols and humid subtropical climate. Soil carbon content was assessed before the setup of the crop rotation, and after 3 years of rotation. A RothC model was calibrated with field data, and used to estimate SOC dynamics to 50 years, in order to assess long-term SCS. The model results were also used to assess the best methodology to estimate the SOC variation significance.

The measured SOC was similar to the equilibrium SOC predicted by the RothC model, on average, for the crop rotations. The measurements showed that the SOC, already low at the beginning of the experiment, further decreased due to the crop rotation practice. Of those tested, the best for SCS involves the following crops: corn, soybeans, wheat on tilled soil, and soybeans; while the worst is with corn, wheat on tilled soil, and wheat on untilled soil. However, the SOC variations predicted by RothC for the various rotations were too small to be observable in the field during experimentation. This could be due both to the uncertainty associated with SOC sampling and analysis, and to the short duration of the experiment. The moving average computations on the simulation values allowed us to assess the time required to measure the long-term trend of SOC variation as significant with respect to the environmental background, instrumental error, and SOC

periodic fluctuations. That time was estimated to range from 8 to 50 years, changing depending on the rotation type. Periodic fluctuations in SOC should be carefully considered in a monitoring protocol to assess SCS.