Geophysical Research Abstracts
Vol. 16, EGU2014-6978-2, 2014
EGU General Assembly 2014

Dynamics of aggregate stability and soil organic C distribution as affected by climatic aggressiveness: a mesocosm approach

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In the framework of a research project aimed at evaluating the adaptation scenarios of the Italian agriculture to the current climate change, a mesocosm experiment under controlled conditions was set up for studying the dynamics of soil aggregate stability and organic C in different size fractions.

Three alluvial loamy soils (BOV - Typic Haplustalfs coarse-loamy; CAS - Typic Haplustalfs fine-loamy; MED - Typic Hapludalfs fine-loamy) along a climatic gradient (from dryer to moister pedoclimatic conditions) in the river Po valley (northern Italy), under crop rotation for animal husbandry from more than 40 years, were selected.

The Ap horizons (0-30cm) were taken and placed in 9 climatic chambers under controlled temperature and rainfall. Each soil was subjected to three different climate scenarios in terms of erosivity index obtained by combining Modified Fournier and Bagnouls-Gaussen indexes: i) typical (TYP), the median year of each site related to the 1961-1990 reference period; ii) maximum aggressive year (MAX) observed in the same period, and iii) the simulated climate (SIM), obtained by projections of climate change precipitation and temperature for the period 2021-2050 as provided by the IPCC-A1B emission scenario. In the climatic chambers the year climate was reduced to six months.

The soils were analyzed for particle size distribution, aggregate stability by wet and dry sieving, and organic C content at the beginning and at the end of the trial.

The soils showed different behaviour in terms of aggregate stability and dynamics of organic C in the diverse size fractions. The soils significantly differed in terms of initial mean weight diameter (MWD) (CAS>MED>BOV). A general reduction of MWD in all sites was observed at the end of the experiment, with the increase of the smallest aggregate fractions (0.250-0.05 mm). In particular, BOV showed the maximum decrease of the aggregate stability and MED the lowest. C distribution in aggregate fractions significantly changed at the end of the trial, depending of soil types. In CAS and MED a decrease of C content was observed in fractions larger than 0.250 mm, while an accumulation occurred only in CAS microaggregates. BOV showed a singular pattern, with an increase of organic C in all fractions. In this site an improvement of aggregation, involving the coarser fractions, seems to have been favoured during the experiment.

Overall, the imposed climate did not affect significantly these trends, except in CAS, where TYP and SIM climates showed an increase of macroaggregates and their C concentration.

Soil pedoclimatic characteristics showed to be the main factors affecting C and aggregates dynamics in this mesocosm experiment.