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Effect of climate change on soil carbon dynamics under three wheat based rotation in a Mediterranean semiarid site

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Adoption of intensive and not sustainable farming practices has caused a severe reduction of soil organic C in Mediterranean regions, with major side effects on soil functioning.
The purpose of our research was to simulate the effect of different wheat-based rotations, commonly used in Southern Italy, on soil organic carbon dynamics under climate change. C dynamics simulation was performed with RothC10N, a version of RothC modified to increase the simulation accuracy in dry regions (Farina et al., 2013).
The baseline climate and the two climate change scenarios ensembles (C4IRCA_A1B and CNMI_RACMO A1B), for two time periods each (2011-30 and 2031-50, short and medium term respectively) were obtained using the climate generator LARSWG5 (Semenov and Stratonovitch, 2010) based on 50 years of measured climatic data.
Data for C model validation were obtained by a rotation experiment carried out since 1992 in Foggia (Apulia, Italy) at the experimental farm of the Cereal Research Centre in a clayey vertisol.
Rotations were continuous durum wheat (Triticum durum Desf.) (CW), wheat- fallow (WF) and wheat -irrigated tomato (WT) (Lycopersicon esculentum L.).
Results showed a negative trend of soil C in all rotations and in all climates and periods. Under baseline conditions, compared with the initial C content, after 30 years there was a decrease of 15.6, 19.2 and 31.9 % for CW, WF and WT respectively. Under C4IRCA, in the short term, the two rainfed rotations (CW and WF) lost 0.23 and 0.35 t ha-1y-1 while WT C losses were 0.71 t ha-1y-1; in the medium term CW and WF C losses increased by 46 and 25% respectively while WT losses increased only by 10%. Under CNMI_RACMO trends are similar to those described above but losses are slightly higher (0.43-0.60 and 0.58-0.68 t ha-1y-1 for CW and WF) in the short and medium term periods respectively. Instead no increase of losses was registered for WT rotation.
Therefore, in Mediterranean semiarid areas, the traditional wheat based rotations are unable to preserve the level of C, either under baseline and future predicted conditions. To increase the sustainability of the system, different soil management (i.e. no tillage), higher C inputs (cover crops and more productive systems) are required.