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EPIC calibration and validation to predict crop yields and soil organic carbon dynamics among different management practices.

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Mathematical models are valuable tools to estimate agronomic and environmental effects of different management practices. Their use could be of interest for the evaluation of long term benefits associated with agri-environmental measures financed by European Common Agricultural Policy (CAP) through the regional Rural Development Programmes (RDP). In this study we focus on the simulation performances of the widely used agri-environmental model EPIC (Environmental Policy Integrated Climate Model). We tested the model ability in simulating crop yields, soil organic carbon (SOC) levels, soil volumetric water content (VWC) and water table depth in 44 plots from three farms located in the low-lying Veneto plain (North Eastern Italy). In each farm, three different management practices were used: conventional agriculture (CV), conservation agriculture (CA) and conventional agriculture with the use of cover crops (CC). The model was tested in the 2010-2017 period, with the first four years used as calibration period and the last as validation period. We also compared the performance of two subroutines for simulating SOC: PHOENIX and CENTURY.

Differences among tillage practices were detected in the original data, with CA causing a reduction in yield, in particular for corn and soybean, but also a rise in SOC levels in the most superficial layers with respect to CC and CV managements.

First results showed that EPIC performance in reproducing crop yields and SOC content was satisfying (r^2 = 0.59 and NSE(Nash – Sutcliffe Efficiency) = 0.61, for crop yields and r^2 = 0.78 and NSE = 0.76 for SOC), while it was less accurate for VWC and water table dynamic (r^2 < 0.5 and NSE < 0.0).

An improvement in the simulation of soil hydrology was obtained using a modified version of the model which incorporates the Richards equation. Another adaptation was the use of Johnsongrass (Sorghum halepense) to simulate weed infestation in CA managed plots which allowed to improve yields simulations.

This study demonstrated that EPIC can be a valid tool to predict patterns of environmental parameters under different management scenarios and therefore, once validated to local conditions, it could be used to support public administrations or farmers' decisions.