Geophysical Research Abstracts
Vol. 21, EGU2019-3073, 2019
EGU General Assembly 2019
© Author(s) 2019. CC Attribution 4.0 license.

Modelling of resilient cropping systems for future climate: A case study for Southern Finland.

Marco Acutis (1), Elena Valkama (2), Ansa Palojärvi (3), and Laura Alakukku (4)

(1) University of Milano, Department of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, United States (marco.acutis@unimi.it), (2) Natural Resources Institute Finland (Luke), Turku, Finland , (3) Natural Resources Institute Finland (Luke), Turku, Finland , (4) Department of Agricultural Sciences, University of Helsinki, Helsinki, Finland

Conservation agriculture (CA) is considered as a more resilient system than conventional one, offering the possibility to increase carbon sequestration in soil and biodiversity, and to reduce erosion, fuel consumption and pesticide use, however, with possible yield reduction. CA is a farming system based on (1) minimum soil disturbance, (2) permanent soil cover with crop residues and/or cover crops, and (3) crops diversification through rotation and intercropping. CA occupies only 5% of total agricultural area in Europe, and about 10% of no-till area in Finland.

We performed a comparative assessment of yield and soil organic carbon (SOC) at 0-30 cm depth under actual and future climate scenarios in Jokioinen, Southern Finland (60°48´N, 23°29´E) over 20 years for CA and conventional cropping systems by using the ARMOSA model that simulates the cropping systems at a daily time-step. We used daily measured data of mean air temperature, rain and radiation from 1998 to 2017. For future weather data, we used the 2030 climate change scenario from JRC-Agri4cast, which predicts temperature increase by 0.8° C and annual precipitation decrease by 20%. For model validation, we used soil and yield data from the long-term experiment (2000-2017) located in Jokioinen involving no-tillage and mouldboard ploughed tillage treatments for spring barley (*Hordeum vulgare*) monoculture. Dry bulk density and SOC content were measured with 4-years intervals, and barley yields were measured annually. The soil used for the simulation was Vertic Luvic Stagnosol, with silty clay texture and a 2.3% of organic carbon in the 0-30 cm surface layer. We simulated 3 cropping systems:

a) Conventional (Conv): mouldboard ploughing, barley monoculture, removed residues;

b) NT: no-tillage, barley monoculture, retained residues;

c) CA: no-tillage, crop rotation (barley - oat - oilseed rape - spring wheat), Italian ryegrass (*Lolium multiflorum*) as a cover crop undersown in spring, and retained residues.

Validation of the model showed a Modelling Efficiency of 0.46 and 0.54 for yield and SOC, respectively. Simulations showed that under actual climate, NT and CA systems caused the loss of barley yield by 15 and 27%, respectively, compared to Conv; however, under future climate scenario, the yield loss reduced and amounted only 1 and 13%, respectively, compared to Conv. Moreover, compared to actual climate, barley yield increased in Conv (4%), as well as in NT (21%) and CA (24%).

Under actual climate, Conv system lost SOC drastically (1058 kg $ha^{-1}y^{-1}$), while NT and CA systems showed a SOC increase of 434 kg $ha^{-1}y^{-1}$ and 917 kg $ha^{-1}y^{-1}$, respectively, meeting the objective of the 4 per mille initiative. Under future climate scenario, all the systems have worst performance in terms of SOC sequestration respect to the actual scenario, and only CA showed a positive value of SOC sequestration (325 kg $ha^{-1}y^{-1}$).

Despite some yield increase in a future, climate change seems to be a challenge in Southern Finland, due to forecasted SOC reduction. In this contest, CA based systems performing better under future climate scenario than under actual one, may offer a relevant option for a climate change resilient cropping systems.