Benefits of Conservation Agriculture on soil carbon sequestration

CONTEXT

Importance of soil organic carbon in agroecosystems

The soil organic matter (SOM) is a key parameter of soil functioning since it is positively related with a large number of soil processes and functions (chemical, physical and biological). In this sense, the **soil organic carbon (SOC), as the main component of SOM, has been identified as a main indicator of soil health** and, indeed, in croplands, it is recommended the **increase in SOC levels in order to enhance crop yields, reduce soil degradation and favour soil biology diversity and activity** (Lal, 2018). Among the different crop management practices suggested to increase SOC levels, the adoption of **conservation agriculture (CA) may have a positive effect s**ince the reduction of tillage intensity and the intensification of cropping systems might stimulate the reduction of SOC losses and the increase of carbon inputs (Paustian *et al*. 2016).

Furthermore, in Mediterranean conditions, it is foreseen that global warming will not only result in an increase in air temperatures but also a reduction in annual precipitation (Cramer *et al*. 2018). These changes in climate will affect soil processes and microbial activity with the concomitant impact on SOC dynamics and turnover. For this reason, in **the project CAMA, it was key to assess the real impact of CA on SOC changes** not only under present climate but also under future climate conditions.

Fig. 1. Soil organic carbon is a key indicator of soil health.

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WORK DONE AND RESULTS OF CAMA

Effectiveness of CA to increase SOC levels

In the different long-term experiments across the Mediterranean basin considered in the CAMA project, it was observed that the **reduction of tillage intensity** and, in particular, no-tillage (NT) **increased SOC levels** but only in the **top soil layer**. For example, in Fig. 1 it is presented the SOC stock values in the long-term located in Spain, where after 13 years of NT, it was observed a SOC increase of almost 40% in the 0-5 cm soil layer. This fact is key since **the majority of soil processes and functions occur in the first soil centimeters** where these high levels of SOC support different ecosystems services.

Table 1. Soil organic carbon (SOC) stock (Mg C ha-1) for different tillage systems: conventional tillage (CT) and no-tillage (NT) in the 0-5, 5-10, 10-25 and 25-50 cm soil layers in Spain. For a given soil layer, different letter indicates significant differences between tillage systems (P<0.05). Values between parentheses are standard deviation.

Soil layer (cm)	SOC stock	
	CT	NT
0-5	7.65 (1.80)b	10.46 (4.53)a
5-10	8.07 (1.48)	8.02 (1.67)
10-25	20.08 (3.80)	19.36 (4.42)
25-50	26.25 (6.17)	25.96 (8.25)

Future trends of SOC changes under climate change

In the CAMA project, a simulation exercise allowed us to study the future trend of SOC dynamics under climate change conditions in the Mediterranean basin. In all the study sites, the two climate change scenarios (with different increases in air temperature and decreases in precipitation) predicted a **reduction of SOC levels compared with the climate baseline scenario** (Fig. 1).

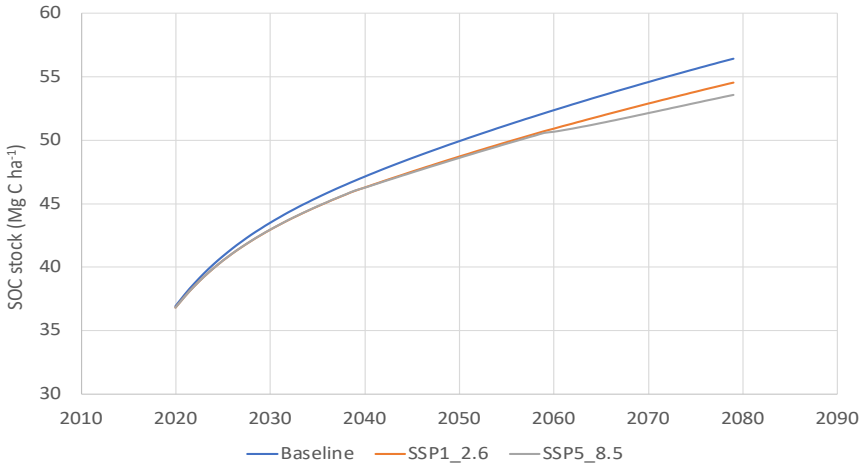

Fig. 1. Simulated temporal SOC stock change over a 40 year simulation (2020-2080) in Kef (Tunisia) under three climate scenarios (baseline, SSP1-2.6 and SSP5-8.5) for two different tillage systems: no-tillage (upper graph) and conventional tillage (below graph).

CAMA PROJECT FACTSHEET

CAMA Conservation Agriculture in the Mediterranean Area

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CONCLUSIONS AND RECOMMENDATIONS

According to the results obtained in the CAMA project, the **adoption of the no-tillage system is an adequate strategy to increase SOC in the soil surface layer** and under present and climate change conditions in rainfed Mediterranean agroecosystems.

The following **should be promoted**:

- The **elimination of tillage implements specially soil inversion** implements such as mouldboard plough.
- The facilitation of a **crop residue layer which covers the entire soil surface all year around.**

References

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