Carbon sequestration potential in the soil under two cropping systems and different irrigation systems.

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Introduction

- Approximately more than 40% of the earth's surface is currently threatened by soil degradation, a process in which the loss of soil organic carbon (SOC) has a relevant role, and which is accelerated by climate change.
- In soils dedicated to agricultural activities, quality and productivity can be improved by increasing the SOC changing the management practices that are used.
- The problem of SOC decrease especially affects the Mediterranean basin. These SOC losses are influenced by traditional, non-conservative agronomic practices that favour the decomposition of organic remains and erosive processes.
- Regarding irrigation, this practice increases soil productivity, which is associated with more soil C, due to the greater amount of generated biomass. On the other hand, irrigation also reduces the amount of C available for the roots and affects the dynamics of SOC by improving growth conditions and microbial activity, thus promoting soil respiration and therefore loss of SOC due to CO2 emissions.

Material and Methods

Experimental sites

The selected farm is located in Córdoba in the Southern Spanish region of Andalusia: 37º 51' 48" N; 4º 47' 29¨W and the studies were conducted in three agricultural seasons 2016, 2017 and 2018. The corn (*Zea mays* L.) under irrigation was the crop implanted during the whole study.

The factors considered in the study have been soil management system (No Till (NT) and Tillage (T)) and irrigation dose (full dose on crop demand: 100 % and deficient dose, up to 75 %).

Experimental design

As experimental design a split-plot was chosen with three replicates, being the main factors the soil management system (NT, T), and the sub-subplot factor the irrigation (100, 75%). Each experimental unit (subplot) has a dimension of 5×10 m^2 and nine subplots were established per irrigation dose and soil management system.

Results

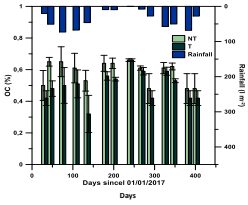

Figure 1. Evolution of the SOC contents in the two management systems contemplated in the project (NT and T).

As can be seen in figure 1, the temporal evolution of the soil SOC content represents a series of maximums and minimums caused by the activity of microorganisms that attack the organic remains, and that is all influenced by soil humidity and temperature. Regardless of the sampling date, SOC contents in no-till are higher than those of the tilled soils. The non-alteration of the soil, which favors the decomposition of the plant remains, and the maintenance of the stubble on the soil surface may be some of the reasons of those differences.

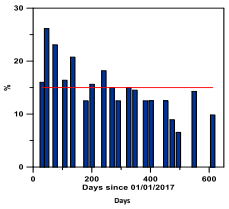

Figure 2. SOC contents gained in soils managed under No-till compared to traditionally tilled soils throughout the entire study.

In the represented period, the soil managed by NT has presented, for the first 0.05 m of depth, an average of 15% more SOC than the soil managed by traditional tillage techniques.

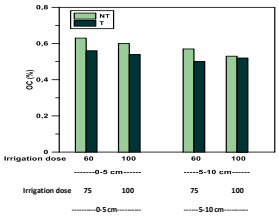

Figure 3. Average SOC contents (%) for the studied depths, depending on the irrigation dose.

Figure 3 shows the average SOC content in the plots managed by both systems, no-tillage and traditional tillage differentiated according to the irrigation regime, deficit irrigation at 75% (R 75) and irrigation on demand 100% (R 100), for different depths.

It can be seen that irrigation, regardless of the used management system, has had an influence on the soil carbon content.

Within the same management system, interesting differences have been observed when comparing the two irrigations used. Thus, it can be noticed that in the first layers of NT soils 5% more OC has been fixed in those 75% irrigated. That has not been observed in traditionally tilled soils in which the OC content has been maintained in both irrigation systems.

Discussion

- Comparing the two variables analyzed in these tests, soil management and irrigation, it has been noticed that the first one has most influenced the dynamics of carbon sequestration. On average, soils managed by conservation agriculture techniques have shown 13% and 7.8% more SOC than traditionally managed soils at 0-5 and 5-10 cm depths, respectively.
- The conservation agriculture techniques are more efficient in sequestering soil carbon in situations of water stress. Regarding deeper layers, the NT plot has sequestered 3% more SOC in the soils 75% irrigated, while in the soils completely irrigated it has not increased and, what is more, the SOC sequestration decreases by 6% in the case of deficit irrigation. In other words, to achieve an increase in carbon sequestration, greater water amount is necessary.

Acknowledgement

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