POTENTIAL CONTRIBUTION OF NATURAL PLANT OF THE INTERCANOPPY OF FRUITY CROPS ON CARBON SEQUESTRATION

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1. Introducction

Natural plant vegetation of the intercanoppy area of fruity crops such as olive oil groves might be a soundness strategy to sequester organic carbon in the soil and to increase soil fertility and reduce soil erosion. There is no information on the potential for carbon sequestration of this practice, however. The objective of this study was to provide information on the variability of annual production of aboveground organic carbon of natural vegetation of the inter-canopy of olive oil farms and their potential for carbon sequestration. In addition, we test if the relationship between organic carbon input and soil organic carbon (SOC) follows a saturation or lineal model in the range of values found in olive oil groves.

2. Material and methods

Eleven commercial olive oil farms in which natural plants were allowed to growth each year during the last eight years were selected. Natural plants were mechanically cleared during March and residues left on the soil surface in all farms. Five of these farms were paired with a nearby (≈ tens of meters) comparable olive oil farms (in terms of climatology, orientation, slope, soil properties and farming characteristics such as tree density and age), except for no natural plant have been allowed to grow (several passes of a chain mover and pre-emergence herbicides) for the last 20 years. Thus, differences between these five pairs of olive oil farming were attributed primarily to the long-term presence of natural plants. Aboveground plant biomass in 50x50 cm 5-replicated frames was collected immediately before clearing, and total carbon analysed (CNH auto-analyser). SOC, analysed by the dichromate digestion method (Anderson and Ingram, 1993), and the non-protected and physically, chemically and biochemically protected SOC, following the three-step physical and chemical fractionation procedure of Stewards et al. (2009), were determined in the top 5 and 5-15 cm of soil samples taken in the inter-canopy area of both types of olive oil groves.

3. Results and discussion

Annual aboveground carbon production ranged between 125 to 1056 kg C ha^{-1} (Fig. 1) averaging 560 kg C ha^{-1}. Although this value is lower than that of other studies on crops residues, was similar to that of Álvaro-Fuentes (2009) for residues of barley in a semiarid site of north Spain, and to the carbon sequestration potential outlined by several researchers under different scenarios of application crop residues. However, the extent that the input of plant-derived carbon increases the SOC stock will ultimately depend on decomposition rate of which, in turn, depends on many factors.

SOC in the plant-covered farms were significantly higher than that of the comparable uncovered, and this was true for the 0 - 5 and 5 – 15 cm depths. Between 9.0 to 16.1 more tons of organic carbon per hectare was storage in the top 15 cm of soil in the covered olive oil groves.

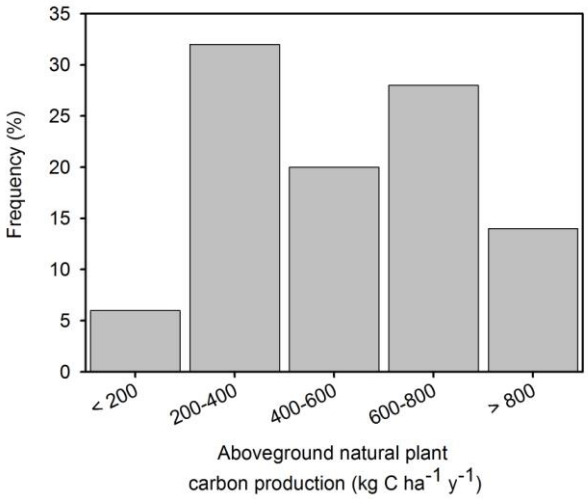

Fig. 1. Variability of aboveground natural plant carbon production of natural-plant covered olive oil groves. Data for 2010.

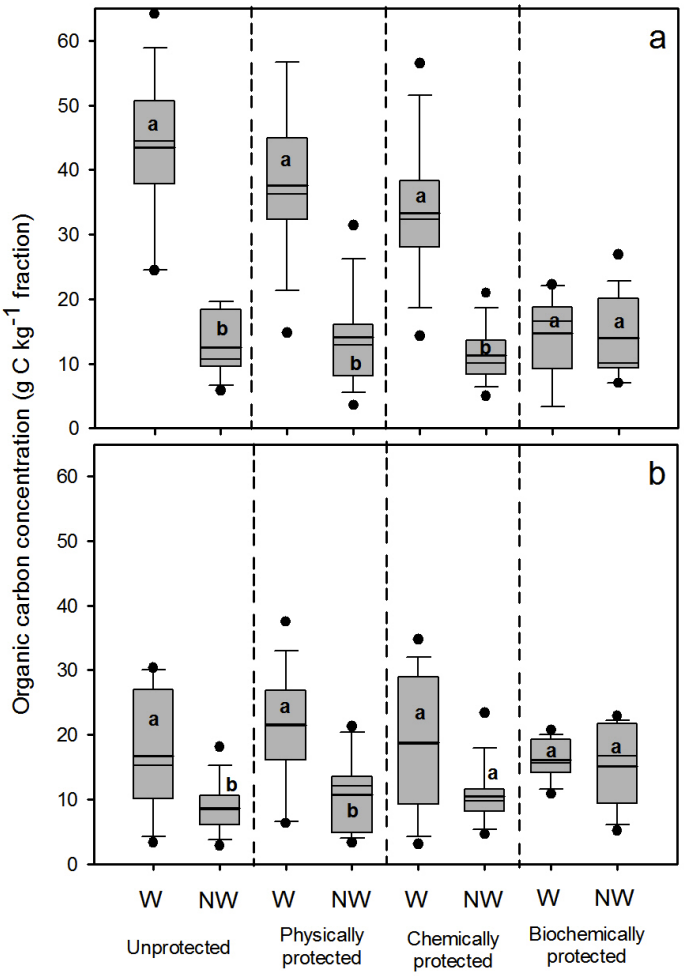

Fig. 2. SOC concentration of non-protected, physically, chemically and biochemically protected pools in the 0 - 5 (a) and 5 -15 (b) cm of soils in natural-plant covered (W) and comparable non-covered (NW) olive oil farms. Different subscript letters mean significant differences (P<0.05).

Unprotected SOC was almost five times higher in the covered plots. This was not surprise, as recently derived, partially decomposed plant residues that are not closely associated with soil minerals constitute this pool. The physically (OC in the micro-aggregates) and chemically (silt+clay associated) protected SOC were also the fractions that accounted for the higher SOC in the natural plant covered farms. Thus, the presence of natural plant in the inter-canopy of olive oil farms increased the pools of SOC fractions linked to long-term carbon sequestration (e.g. physically and chemically protected SOC). The biochemically protected SOC did not differ between comparable farms.

Concentration of organic carbon in the unprotected and, chemically and physically protected SOC pools were linearly related to SOC concentration (data not presented) indicating a linear relationship between carbon input and SOC.

4. Conclusión

The presence of natural plant in the inter-canopy of olive oil farms is an excellent strategy for carbon sequestration, still to be deeply explored. This strategy can be of regional significance taking into account the almost 1.5 millions of hectares of olive oil farms in Andalucía. Non-protected but also the chemically and physically protected SOC pools were the fractions which increased after 8 years of natural plant, and relationship between carbon input and SOC was linear, indicating no carbon saturation.

Referencias

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