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Dynamics of soil organic carbon fractions in olive groves in Andalusia (Southern Spain) in soils with contrasted parent material and under different management practices

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Spain has 2.5 million hectares of olive groves, 60 % of which are situated in Andalusia (Southern Spain). The most common agricultural management consist of a conventional or reduced tillage combined with herbicides to eliminate weeds. This might lead to some ecological problems (e.g. erosion, soil nutrient and organic carbon losses). The recommended management consist of a plant cover of spontaneous herbaceous plant in the inter row of olive oil orchards which are usually mowed early in spring.

In this study, we assessed the influence of: i) two soil managements: non-covered and weed-covered, and ii) soil parent material (carbonated and siliceous), on soil organic carbon (SOC) fractions. In addition, we assessed the existence of a saturation limit for the different SOC fractions by including calcareous and siliceous soils under natural vegetation.

Weed-covered soils accumulated more total SOC than soils under the non-covered management and this was independent on the parent material type. Same was true for most of the SOC fractions. However, the relative proportion of the SOC fractions was not affected by the presence of weeds, but it was due to the parent material type; carbonated soils had more unprotected and physically protected SOC, whereas the siliceous soils were relatively enriched in biochemically protected pool.

Otherwise, table 1 shows that the chemically protected SOC pool was best fit to a saturation function, especially in the siliceous plots. The other fractions were best fit to a linear function. Therefore, these results suggest that chemically protected pools are the only protected fractions which can be saturated considering the SOC in the natural vegetation soils as the SOC limit. Considering SOC levels in the weed-covered and non-covered managements of all protected fractions and their respective limits of total SOC, saturation deficits in the non-covered and weed-covered plots were 75% and 60% of total SOC, respectively.

Table 1. Significance of the linear and saturation models between total SOC and SOC of each isolated fraction for the whole set of plots and for plots of similar mineralogy. Physically protected fraction is comprised of three sub-fractions: iPOM, chemically and biochemically protected within microaggregates. "-" stands for non-analysed fractions.

Fraction/Sub-fraction	Whole set of plots		Siliceous		Carbonated	
	Linear	Saturation	Linear	Saturation	Linear	Saturation
Unprotected	0.87	0.76	-	-	-	-
Physically protected	0.82	0.86	-	-	-	-
iPOM	0.75	0.73	-	-	-	-
Chemically protected within microaggregates	0.26	0.49	0.72	0.79	0.63	0.65
Biochemically protected within microaggregates	0.75	0.66	0.87	0.82	0.73	0.66
Chemically protected	0.41	0.62	0.69	0.79	0.78	0.71
Biochemically protected	0.76	0.69	0.89	0.90	0.72	0.62

These results suggest that there is a high potential for SOC sequestration in Andalusian olive grove soils. Nevertheless, it is very important to analyse in detail the influence of the soil mineralogy properties on SOC accumulation.

The management clearly affects the total amount of SOC and its fractions, whereas the parent material type mainly affects the proportion of these.