



## Impact of alley cropping agroforestry on stocks, forms and spatial distribution of soil organic carbon — A case study in a Mediterranean context

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### Abstract :

Agroforestry systems, i.e., agroecosystems combining trees with farming practices, are of particular interest as they combine the potential to increase biomass and soil carbon (C) storage while maintaining an agricultural production. However, most present knowledge on the impact of agroforestry systems on soil organic carbon (SOC) storage comes from tropical systems. This study was conducted in southern France, in an 18-year-old agroforestry plot, where hybrid walnuts (*Juglans regia* × *nigra* L.) are intercropped with durum wheat (*Triticum turgidum* L. subsp. *durum*), and in an adjacent agricultural control plot, where durum wheat is the sole crop. We quantified SOC stocks to 2.0 m depth and their spatial variability in relation to the distance to the trees and to the tree rows. The distribution of additional SOC storage in different soil particle-size fractions was also characterized. SOC accumulation rates between the agroforestry and the agricultural plots were  $248 \pm 31 \text{ kg C ha}^{-1} \text{ yr}^{-1}$  for an equivalent soil mass (ESM) of  $4000 \text{ Mg ha}^{-1}$  (to 26–29 cm depth) and  $350 \pm 41 \text{ kg C ha}^{-1} \text{ yr}^{-1}$  for an ESM of  $15,700 \text{ Mg ha}^{-1}$  (to 93–98 cm depth). SOC stocks were higher in the tree rows where herbaceous vegetation grew and where the soil was not tilled, but no effect of the distance to the trees (0 to 10 m) on SOC stocks was observed. Most of the additional SOC storage was found in coarse organic fractions (50–200 and 200–2000  $\mu\text{m}$ ), which may be rather labile fractions. All together our study demonstrated the potential of alley cropping agroforestry systems under Mediterranean conditions to store SOC, and questioned the stability of this storage.

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### Keywords:

Soil mapping; Soil organic carbon storage; Soil organic carbon saturation; Deep soil organic carbon stocks; Visible and near infrared spectroscopy; Particle-size fractionation

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