



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

Rémi Cardinael ^{a,d}, Tiphaine Chevallier ^a, Bernard G. Barthès ^a, Nicolas P.A. Saby ^b, Théophile Parent ^a, Christian Dupraz ^c, Martial Bernoux ^a, Claire Chenu ^d

^a IRD, UMR 210 Eco&Sols, Montpellier SupAgro, 34060 Montpellier, France

^b INRA, US 1106 Infosol, F 45075 Orléans, France

^c INRA, UMR 1230 System, Montpellier SupAgro, 34060 Montpellier, France

^d AgroParisTech, UMR 1402 Ecosys, Avenue Lucien Brétignières, 78850 Thiverval-Grignon, France

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 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 μm), 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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