Soil health in temperate agroforestry systems: What effects of tree rows and tree species?

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Introducing tree rows within temperate crop fields is considered as a lever to intensify ecosystems services; such systems are defined as alley cropping agroforestry. The potential benefit of these systems for enhancing soil's functions is rarely studied. Here, we investigate soil health heterogeneity in temperate alley cropping agroforestry systems according to two factors: the position relative to the tree row (at the tree row; at 0.5 m from the tree row in the crop alley; at 6.5m from the tree row in the middle of the crop alley), and tree species with contrasted functional traits that might influence local microclimate (*Pyrus communis*, *Fraxinus* sp. and *Acer monspessulanum*). The study was performed in one of the few mature and species-diverse agroforestry systems in Europe (Domaine de Restinclières, Southern France; 25-year-old trees). Soil health was assessed using two integrative methods: Biofunctool®, that evaluates the three essential soil functions (i) structure maintenance (ii) carbon transformation and (iii) nutrient cycling; and MicroResp^{TM}, that enables to analyse the activity of soil's microbial catabolic profiles. The position relative to the tree row explained most of the soil health differences. The highest soil health scores were found in the tree row, whilst both positions in the crop alley had similar soil health scores. Tree species impacted soil carbon dynamics and microbial catabolic profiles only. This study confirmed the clear effect of the position relative to the trees observed in other recent studies while it highlighted the role of trees in helping to engineer ecosystems. Higher impact is even expected when considering other specific species as nitrogen fixing trees. Thus, this study underlines the importance of considering spatial organization and tree species choice to optimize soil ecosystem services within temperate agroforestry plots.