



## Which agroforestry tree species meet the challenges of climate change mitigation and soil fertility restoration in the Highlands of Madagascar?

K. Which Agroforestry for Annual Crops?

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Within agroforestry systems, trees greatly contribute to soil carbon sequestration. An important diversity of tree species can be used when designing agroforestry systems. While the effect of tree presence on soil carbon stocks is widely recognized, we still know little of how this contribution varies according to tree species. In the present study, we aimed at quantifying the soil carbon stocks derived from three main tree species: *Eucalyptus robusta*, *Coffea arabica*, and *Citrus dementina*, used in rainfed rice-based agroforestry in the Highlands of Madagascar. A full factorial mesocosm experiment was realized, with seedlings of the tree species planted in a Ferralsol. Natural  $\delta^{13}C$  abundance in soil was measured to assess tree-derived carbon. Six months after planting, *Eucalyptus robusta* was the species exhibiting the highest tree-derived carbon (5.52 MgC ha<sup>-1</sup>). The tree-derived carbon from the two other tree species was 1.02 MgC ha<sup>-1</sup> and 0.53 MgC ha<sup>-1</sup> respectively for *Citrus dementina* and *Coffea Arabica*. The difference in soil C sequestration among tree species was highly explained by differential root biomass. Tree root biomass was significantly correlated with soil  $\delta^{13}C$  ( $R^2=0.65$ ,  $p\text{-value}<0.001$ ). Our experiment assay highlighted the differential contributions of tree species to soil carbon sequestration at the earlier stage of the agroforestry setting. The capacity of each tree soil carbon sequestration constituted one criterion for evaluating the tree species potential to address agronomic and ecological objectives of agroforestry adoption.