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Shade tree species impacts on soil nutrient availability and food web in conventional and organic coffee agroforestry

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Conventional, intensively managed coffee monocultures are environmentally damaging. The use of shade trees and organic management are welcome options to reduce coffee physiological stress, reduce synthetic inputs and restore soil biological balance. However, whether the effects of shade trees on soil functioning would be similar for different coffee management practices should be investigated. Here, we measured soil total C and N, inorganic N, Olsen P, pH, biomass produced in bioassay, nematode and microarthropod communities under three shade types (unshaded coffee, shaded with *Terminalia amazonia*, and shaded with *Erythrina poeppigiana*) combined with two management practices (organic and conventional) in a 17-year old experimental coffee plantation in Turrialba (Costa Rica).

Under conventional management, soil nutrient availability and fauna densities were higher under shade, regardless of the shade tree species (Fig 1). Under organic management, only *Erythrina*, a heavily pruned, N₂-fixing species, had increased soil nutrient availability and fauna density, while *Terminalia* shade had a null or negative impact. Soil N availability was linked to bacteria-feeding nematodes while soil P availability was more linked to detritivorous microarthropods. Higher fertility was recorded in soil with balanced foodwebs. This study highlights the importance of the choice of shade tree species for soil fertility in low input systems, more so than in fertilized systems.

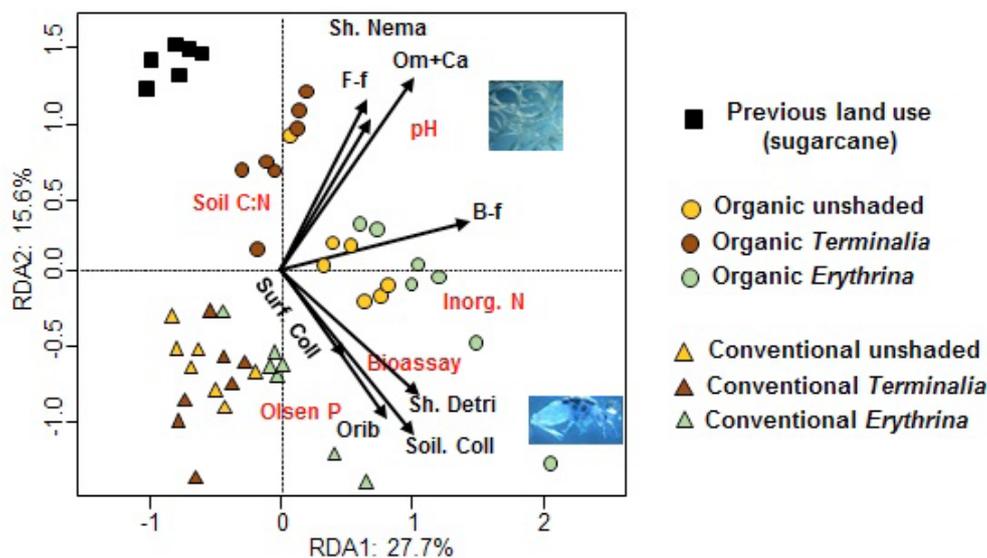


Fig 1. Redundancy analysis of soil biogeochemical parameters (in red) constrained by nematode and microarthropod communities (in black). Nema: nematodes; Detri: oribatid mites and collembola; Sh: Shannon Index; B-f: bacterial-feeding nematodes; F-f: fungal-feeding nematodes; Om + Ca: omnivorous and carnivorous nematodes; Surf. Coll: “surface-living” collembola; Soil. Coll: “soil-living” collembola; Orib: oribatid mites.

Keywords: Management practices, Shade type, Soil fertility, Soil food web, coffee.