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Root distributions and traits in a tropical agroforestry parkland dominated by Faidherbia albida: potential impacts on soil C and nutrients stocks? —

A. Transitioning to Healthy Soils

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In agroforestry systems, the associated plants can induce an heterogeneity of the entries of C originating from roots according to the distance to the tree and depth. The aims of this study were (i) to analyse the root strategies for both perennial (Faidherbia albida) and annual (pearl millet) species, (ii) to quantify the root C inputs to the soil and (iii) to link the root systems to soil properties. The experimental set-up was synthesized in Fig. 1. Crop aerial biomass was higher under the trees than further away, whereas the crop root biomass was equivalent and concentrated at 0-10 cm of depth. On the contrary, Faidherbia roots were concentrated in soil layers below 100 cm, at both locations (under and further away from the trees). Root traits such as length and diameter followed exponential decay with increasing depth. Faidherbia roots had higher C and N content than pearl millet and for both species, root N content increased with increasing depth. The topsoil was richer in C and N under than further away from the trees, but it was not true below the depth of 10 cm. The higher soil C and N contents under the trees might mainly be due to the tree aerial litter inputs rather than to the root inputs as (i) no difference in the root systems was noteworthy according to the location and as (ii) differences in soil quality occurred only in topsoil. Tree roots occupied deeper soil layers than the crop, probably as a response to the long period of cohabitation in this site. Faidherbia would compensate the lack of nutrients in deep soil layers by extending its investment area. The complementarity of the perennial and annual root systems ensured an efficient use of soil resources and significant carbon inputs below 100 cm of depth.