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Dynamic of soil organic carbon pools in cacao-based agroforestry systems of Divo (Côte d'Ivoire)

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Abstract

Soil is a major carbon pool at the global scale. It can also act as a carbon sink or source, based on their properties, climate and management methods. Adopting sustainable agricultural practices such as agroforestry could help to increase the soil's organic matter content and carbon sequestration and even countering, anthropogenic greenhouse gas emissions. The choice of tree species to be associated with cacao trees seems to be essential to the efficiency and sustainability of this system soil carbon storage. Potassium permanganate oxidizable carbon (POxC) and basal soil respiration (SituResp) are indicators of organic carbon dynamics that could be influenced by organic matter fluxes in cacao system. This raises the question of the long-term impact of cacao-associated tree systems on soil organic carbon dynamics, especially when specific tree species as legume trees are involved. The study was carried out in a four-block randomized experimental design in Divo (Ivory Coast, West Africa). It involved cacao-*Albizia lebbeck* (Cacao-Alb) and cacao-*Acacia mangium* (Cacao-Aca) intercrops, and unshaded cacao plots (Control). After 20 years of intercropping, we assessed the impact of associated shade tree legume (ATL), *A. lebbeck* and *A. mangium* in cacao stand on soil organic matter dynamic (at 10 cm depth) at various distances from ATL (D1: 0-1.75m; D2: 3.25-5m and D3: 7-9m).

The results indicated a higher SOC stock and PoxC content under Cacao-Alb compared to Cacao-Aca and Control treatments. However, Cacao-Alb recorded a trend of SOC mineralization, especially farther away from the ATL trunk. Cacao-Aca, recorded the lowest SOC stock, with a significant decrease as compared to Control and a higher POxC. The results under *A. mangium* could be attributed to both a lower carbon input due to the quality of its litter and an increased mineralization, particularly farther away from the ATL trunk. Unlike the Cacao-ATL plots, the Control plots tended to accumulate carbon. However, SOC mineralization was more prominent in Cacao-Aca plots than in Cacao-Alb plots. These contrasted results between the two ATL species, could be explained by the litter quality reflected by lower C/N and C/P ratios produced by *A. lebbeck*.

Keywords: Cacao agrofrestry systems; Tree legume; *Acacia mangium*; *Albizia lebbeck*; soil organic carbon; POxC-SituResp® indicator.