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Does agricultural practices impact the quantity and the forms of organic carbon stored in cultivated soils of the Senegal groundnut basin? A Rock-Eval approach

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Soil organic carbon (SOC) is a key element in the functioning of agrosystems. It ensures soil quality and productivity of cultivated systems in the Sahelian region. This study uses Rock-Eval pyrolysis to examine how cultural practices impact SOC quantity and quality of cultivated sandy soils in the Senegal groundnut basin. Such thermal analysis method provides cost-effective information on SOC thermal stability that has been shown to be qualitatively related to SOC biogeochemical stability. Soils were sampled within 2 villages agricultural plots representative of local agricultural systems and for local preserved areas. Total SOC concentrations ranged from 1.8 to 18.5 $g.kg^{-1}$ soil (mean ± standard deviation: 5.6 ± 0.4 $g.kg^{-1}$ soil) in the surface layer (0-10 cm) and from 1.5 to 11.3 $g.kg^{-1}$ soil (mean ± standard deviation: 3.3 ± 0.2 $g.kg^{-1}$ soil) in 10-30 cm deep layer. SOC of cultivated soils significantly (p-value < 0.0001) decreased according to treatments in the following order: +organic wastes > +manure > +millet residues > no input. Our results show that the quantity and the quality of SOC are linked to each other and both depend on land-use and agricultural practices, especially the nature of organic inputs. This correlation is very strong in the tree plantation (R^2 = 0.98) and in the protected shrubby savanna (R^2 = 0.97). It remains important for cultivated soils receiving organic wastes (R^2 = 0.82), manure (R^2 > 0.75), or millet residues (R^2 = 0.91) but it's no more significant in no-input situations. The Rock-Eval based indexes were depicted in a I/R diagram that illustrate the level of SOC stabilization and plotted against comparable results from literature. The Senegalese sandy soils have thermal signatures showing an inversion of the I and the R indexes compared to data from the literature and highlighting SOC stabilization as a function of soil depth. Indeed, the studied soils were characterized by a more abundant refractory pool (A5 which ranged from 7.7 to 21.3 % in 0-10 cm layer and from 12.5 to 24.3 % in 10-30 cm, respectively) compared to other tropical soils. The SOC in these sandy soils while positively affected by organic inputs is dominated by labile forms that mineralize quickly which is excellent for the needs of productivity of these agrosystems but not for mitigation of climate change.

Keywords: Soil organic carbon; Organic inputs; Thermal analysis; Agrosystems; West Africa