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Is the thermal stability of soil organic matter related to its biogeochemical stability in cultivated Arenosols of the groundnut basin of Senegal?

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Soil carbon (C), now more than ever, attracts the interest of the scienti c community for its importance in combating climate change and achieving food security. As a result, its key role in agricultural soil fertility and in anthropogenic greenhouse gas emissions mitigation is high on international agendas. A key issue regarding the linkage between food security and carbon storage concerns the mineralization or the stability of soil organic matter (SOM). Rock-Eval® analysis was used to examine the thermal stability of SOM and these results were presented in details at the EGU General Assembly in 2020 (EGU2020-11229). Several indicators are used to further appreciate the quantity and quality of SOM: particle size fractionation (POM-C), determination of permanganate oxidizable carbon (POX-C) and carbon mineralization kinetics (Min-C). The results of both approaches are crossed and presented here. Soils were sampled from two soil layers (0-10 et 10-30 cm) in agricultural plots representative organic inputs practices in local agricultural systems (No input, +Millet residues, +Manure and +Organic wastes). Total soil organic carbon (SOC) concentrations ranged from 1.8 to 18.5 g $C.kg^{-1}$ soil (mean ± standard deviation: 5.6 ± 0.4 g $C.kg^{-1}$ soil) in the surface layer (0-10 cm) and from 1.5 to 11.3 g $C.kg^{-1}$ soil (mean ± standard deviation: 3.3 ± 0.2 g $C.kg^{-1}$ soil) in 10-30 cm deep layer. The soil organic matter in these Arenosols while positively affected by organic inputs is dominated by thermally labile forms. The POM-C fractions represent respectively 45 % and 24 % of the COS in the 0-10 cm and 10-30 cm soil layers respectively. Permanganate oxidizable carbon (POX-C) and mineralizable C (Min-C) averaged 254 ± 14 mg $C.kg^{-1}$ soil and 10.7 ± 1.2 mg $C\text{-}CO_2$ kg^{-1} soil in the 0-10 cm layer. Our results show that in different situations, the labile pools POM-C, POX-C and Min-C are linked to the active thermal pools A1 (highly labile pool), A2 (labile pool), A3 (resistant pool) and even A4 (refractory pool). The A3 and A4 pools, which are known to be relatively stable in more clayey soils, are in fact quickly mineralized in the sandy soils of this region. This intense mineralization of SOM promotes the recycling of nutrients which is excellent for productivity of these agrosystems, but not for mitigation of climate change in the long term.

keywords: Sahel ; Arenosols ; Thermal stability ; Biogeochemical stability ; Rock-Eval analysis, POM-C ; POX-C ; Min-C.

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