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Influences of repeated application of organic waste products on soil organic carbon content and stability assessed using Rock-Eval 6® thermal analysis

Amicie Delahaie[1], Pierre Barré[1], Lauric Cécillon[1,2], François Baudin[3], Camille Resseguier[4], Thierry Morvan[5], Denis Montenach[6], Florence Savignac[3], Aurélia Michaud[4], Florent Levavasseur[4], and Sabine Houot[4]

[1]Laboratoire de Géologie, Ecole Normale Supérieure de Paris, 75005 Paris, France
[2]Normandie Univ, UNIROUEN, INRAE, ECODIV, 76000 Rouen, France
[3]ISTeP - Institut des Sciences de la Terre Paris, Sorbonne Université, 75005 Paris, France
[4]Université Paris-Saclay, INRAE, AgroParisTech, UMR ECOSYS, 78850 Thiverval-Grignon, France
[5]INRAE, Agrocampus, UMR SAS, 35042 Rennes, France
[6]INRAE, Centre Grand Est-Colmar, 68000 Colmar, France

The term Organic Waste Products (OWPs) encompasses a wide range of byproducts such as manure, sewage sludge or green waste compost. The use of OWPs impacts soil quality and functioning, agricultural yields, carbon (C) sequestration, biogeochemical cycles of nutrients like nitrogen (N) or phosphorus, and organic matter (OM) dynamics. These impacts likely depend on the considered OWP.

Taking advantage of 3 mid to long-term experimental trials (6 to 20 years) located in the Northern part of France (Paris region; Brittany; Alsace), we investigated the impact of 16 different OWPs on C content and stability. To do so, surface soil samples from replicated plots amended with the different OWPs used either alone or in addition with mineral N fertilization and appropriated control treatments were analyzed using Rock-Eval 6® thermal analyses. Samples taken up at the onset of the experiment and after 6, 18 and 20 years for the 3 sites respectively were analyzed. It resulted in the analyses of 248 different samples whose Rock-Eval 6® (RE6) signature can be used as a proxy for soil organic carbon (SOC) biogeochemical stability. In particular, we determined 2 RE6 parameters that were related to SOC biogeochemical stability in previous studies (e.g. Barré et al., 2016): HI (the amount of hydrogen-rich effluents formed during the pyrolysis phase of RE6; $mgCH.g^{-1}$ SOC), and T50 CO_2 oxidation (the temperature at which 50% of the residual organic C was oxidized to CO_2 during the RE6 oxidation phase; °C). We also computed the amount of centennially stable SOC from RE6 parameters using the model developed in Cécillon et al. (2018).

Our results showed that no clear effect of OWPs addition can be established for the youngest site (6 years). On the contrary, OWPs amendments had a clear effect on SOC quantity and quality at

the sites having experienced 18 and 20 years of OWPs addition. For these sites, OWPs amendments increased SOC content, decreased SOC thermal stability (T50 CO_2 oxidation) and increased the Rock-Eval 6® Hydrogen Index (HI) compared to control plots. OWPs amendments tended to increase slightly the amount of centennially stable SOC at the sites having experienced 20 years of repeated OWPs application. Our results suggest that if OWPs addition does increase SOC content, at least in the long run, the majority of this additional SOC is labile and may be quickly lost if OWPs additions are stopped.

References:

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