

## **Relationship between initial soil microbial diversity and the quality of exogenous organic matter: Effect on carbon stability of Soil Organic Matter**

Fida Mrad\*, Nadia Bennegadi-Laurent, Marie-Paule Norini, Isabelle Trinsoutrot-Gattin, Karine Laval and Richard Gattin

Unité AgriTerr, Esitpa, 3 rue du Tronquet, CS 40118, 76134 Mont Saint Aignan, FRANCE

\* Corresponding author

Tel.:+033 (0)2 32 82 91 76

E-mail address: fmrad@esitpa.fr

### **Abstract**

In a context of global climate change, carbon management is an important point. Therefore, the strategy of sequestration of stable carbon in agricultural soils is the preferred option to offset emissions of greenhouse gases. In addition, from an agronomic point of view, changing agricultural practices by Exogenous Organic Matter (EOM) inputs, allows to significantly increase the organic carbon storage in soils.

The objectives of our work were to understand: i) the respective relationship between the chemical composition of Organic Waste Products (OWP) and the diversity of soil microbial communities, and ii) the effect of those communities on the degradation of organic matter.

This study concentrated mainly on four organic waste products: green waste compost, green waste-sludge compost, sewage sludge and cattle manure mature. The degradation of these OWP was studied by incubation at 20°C for 6 months, in two agricultural soils that have different microbial diversity status (Permanent Grassland PG, Arable Cropping AC). The OWP were made at constant carbon (4g carbon/kg dry soil).

The physicochemical characterization of the organic matter of OWP and the soils was conducted to determine the total carbon and total nitrogen. Furthermore, thermal analysis has been proposed in order to assess their level of stability. Soil functional activity was measured through i) enzymatic activities including cellulase, xylanase, lipase, and alkaline phosphatase and ii) potential metabolic activity of heterotrophic bacteria with Biolog™ ecoplate well system (average well color development (AWCD) and Richness (R)). In parallel, the dynamic of carbon mineralization was followed.

Thermogravimetric analysis showed different levels of stability between OWP. Indeed, the weight losses between 200 and 760°C was higher in order of importance, for the sewage sludge, green waste-sludge compost, cattle manure and green waste compost. These weight losses occurred mainly in two steps. At 210–320°C range, the peak observed was attributed to the combustion of carbohydrates, which were more important for sewage sludge (41%), even though the thermal degradation of the aromatic structures occurred at 400–679°C for green waste compost (16%). Moreover, the combination of these two results seemed to indicate that organic matter is slightly more transformed in the first case than in the second. These results are in agreement with those obtained on the Van Soest biochemical fractionation of OWP, and with Organic Matter Stability Index (OMSI).

Preliminary results during the first 21 days of incubation indicated changes in microbial functions depending on the time of incubation, the nature of OWP and the initial status of microbial diversity of soils. Indeed, the monitoring of the measured variables often indicated significant changes at 8 and 14 days of incubation. Moreover, the microbial community from PG soil was more active than from AC one, if we consider the functional activities or the carbon mineralization. Finally, adding OWP favored carbon mineralization in both soils. However, the effects on microbial functions were more nuanced. In fact, in PG soils, the EOM input did not change functional activities. In contrast, in AC modality, the metabolic activity was generally higher when OWP were added. However, the enzymatic activities were not stimulated by inputs. Green waste-sludge compost was hardly degraded by cultivable bacteria. We found that the metabolic activity (R, AWCD) was low and equivalent to the AC soil. The same result was observed with the dynamic of carbon mineralization.

In summary, the first results of this study show that depending on the composition of the microbial communities of both soils and composition of the OWP, microbial activities seem to respond differently and more significantly for the AC soil and for stable OWP. To complete our study, it is necessary to conduct additional measurements on microbial community such as abundance (total DNA, carbon biomass) and diversity (bacterial and fungal DNAs) up to 6 months of soil incubation.