



Influence of land use on soil organic matter

H. Rogeon (1), L. Lemée (1), A. CHABBI (2), and A. AMBLES (1)

(1) Université de Poitiers, CNRS, SRSN, UMR 6514, 86022 Poitiers, Cedex, France (laurent.lemee@univ-poitiers.fr), (2) Institut National de la Recherche Agronomique - INRA-UEFE Les Verrines - 86 600 Lusignan, France

Soil organic matter (SOM) is actually of great environmental interest as the amount of organic matter stored in soils represents one of the largest reservoirs of organic carbon on the global scale [1]. Indeed, soil carbon storage capacity represents 1500 to 2000 Gt for the first meter depth, which is twice the concentration of atmospheric CO₂ [2]. Furthermore, human activities, such as deforestation (which represents a flux of 1.3 Gt C/year), contribute to the increase in atmospheric CO₂ concentration for about one percent a year [3]. Therefore, carbon dioxide sequestration in plant and carbon storage in soil and biomass could be considered as a complementary solution against climate change.

The stock of carbon in soils is greatly influenced by land use (ca 70 Gt for a forest soil or a grassland against 40 Gt for an arable land). Furthermore the molecular composition of SOM should be also influenced by vegetation. In this context, four horizons taken between 0-120 cm from the same profile of a soil under grassland and forest located in the vicinity of Poitiers (INRA Lusignan, ORE Prairie) were compared. For the surface horizon, the study is improved with the results from the cultivated soil from INRA Versailles.

Soil organic matter was characterized using IR spectroscopy, elemental analysis and thermal analysis. Granulometric fractionation into sand (50–2000 µm), silt (2–50 µm) and clay (<2 µm) was conducted. The organic matter associated with the mineral fractions was thus characterized using thermochemolysis coupled with gas chromatography and mass spectrometry (Py-GC/MS).

The total lipidic fractions were extracted with CH₂Cl₂/MeOH using an accelerated solvent extraction (ASE). In the three soils, lipids are concentrated into the superficial horizon (0-30 cm) which indicates a low mobilisation. Lipids from the superficial horizon are more abundant for the arable soil (1010 ppm) than for the two other (400 ppm).

Lipids from the forest and the grassland were fractionated and derivatised (methylation and acetylation) prior to GC-MS analysis. They are mainly of plant origin from surface to 50 cm horizons (long odd chained hydrocarbons, long even chained alcohols and fatty acids) whereas they clearly have a different origin in the deepest horizons. The fatty acids fraction is of particular interest since it is possible to distinguish bacterial from plant inputs. The isotopic carbon ratio composition (delta 13C) of a whole soil gives information about the photosynthesis process. Therefore, this technique could be used to differentiate bacterial from plant inputs into the fatty acid fraction. Indeed the obtained delta 13C values of fatty acids from bacterial and plant origins are different. It is particularly interesting to notice that branched compounds (bacterial input) present higher values than linear compounds.

Humic substances were obtained from IHSS (International Humic Substances Society) protocol. Contrarily to lipids, humin is less present in the arable soil (60% of the sample) than in the other soils (90%). In the case of the forest and the grassland, the increase in this refractory pool of OM with depth indicates that SOM become more resistant to biodegradation in deepest horizons. Furthermore, humic acids and humin were characterized by thermochemolysis using TMAH as alkylating agent. The major pyrolysis products of humic acids and humin are short chained (<C20) fatty acids. The bacterial input revealed by the presence of branched iso, anteiso compounds is more important in the two surface horizons than at depth.

References

- [1] Schlesinger, W. H., (1995), Soils and Global Change, pp 9-26
- [2] Lal, R., et al., (2004), Soil carbon sequestration to mitigate climate change, Geoderma 123, 1-22.
- [3] IPCC, 2001. Summary for policymakers. In: Watson, R., (Ed.), Climate Change 2001: The Scientific Basis.

Cambridge University Press, Cambridge, 1-20.