Qualitative and quantitative evaluation of soil organic matter for sustainable soil management

G. MALINA[1], J. KWIATKOWSKA-MALINA[2*]

[1]AGH University of Science & Technology, Mickiewicza 30, 30-059 Krakow, PL (gmalina@agh.edu.pl)

[2]Warsaw University of Technology, Pl. Politechniki 1,
00-661 Warszawa, PL ([*] correspondence: j.kwiatkowska@gik.pw.edu.pl)

Soil is largely a non-renewable and complex natural resource performing many vital functions: biomass production, storage, filtration, transformation of water, carbon and nitrogen. Soil organic matter (SOM) is one of the most important soil quality indicators. It is a building block for the soil structure, improves the infiltration rates and the storage capacity of water, presents a major carbon pool and can act as a source and sink for CO_2 and other greenhouse gases. A decrease of SOM contents is among 8 main threats for soils as indicated in the EU Soil Thematic Strategy. The effective soil management should include its different functions: production, habitat for living organisms, retention capacity. (Micro)biological and abiotic transformations (mineralization and humification) of SOM from diverse sources lead to formation of humic substances (HS), the most spread in nature group of organic compounds. The soil utility value should be evaluated through the SOM qualitative-quantitative analysis of organic carbon and total nitrogen. Organic substances more rich in carbon but poor in nitrogen (e.g. wood, tree coniferous, straw, brown coal) are relatively stable sources of energy and substrates for microorganisms, thus may slower undergo mineralization and humification. Dynamics of SOM transformations is important, especially in the context of stability and efficiency of applied SOM sources. However, no quantitative and qualitative systems exist to-date for reliable evaluation of SOM. The goal of this paper is to review tools and methods for qualitative/ quantitative evaluation of SOM coming from diverse sources for effective soil management. For the qualitative analysis of SOM and humic acids (HAs) novel analytical techniques are applied, e.g.: HPLC, EEM, NMR, EPR, ESR, FTIR, DSC. The quantitative analysis is done through the parameters: humification index (HI), humification degree (HD) and humification rate (HR). Because of lack of reliable data from sufficiently long-term experiments matematical modelling may be applied as a tool for quantitative estimation and prediction of humification of SOM. The parameterization system of SOM quality should be developed to assist more rational and sustainable management of the soil environment.