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ECOLOGICAL SIGNIFICANCE OF SOIL MICROBIAL FUNCTIONAL DIVERSITY ACROSS EUROPE

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ABSTRACT

Soil microorganisms are abundant and their functions essential for the soil bio-geochemical processes, quality and ecosystem services such as water infiltration, organic matter turnover, and carbon sequestration. Measuring soil respiration has for many years been the basis of estimating soil microbial activity and today several microtiter-based multi-endpoint techniques are used for determining soil microbial functional diversity: Substrate induced respiration on specific substrates (MicroResp), Community Level Physiological Profiling (CLPP) with growth on specific carbon substrates using ECO-Biolog plates, and soil enzymatic activity assayed by Extracellular Enzyme Activity (EEA) based on fluorogenic-labelled substrates. Only CLPP is currently used in classification and assessment schemes of soil monitoring and only EEA is ISO standardized. Hence, the data obtained are significant input to further standardization of the techniques.

We contrasted these techniques in a European transect of 81 soils covering five Biogeographical Zones and three land-uses in order to test the sensitivity, ease and cost of performance, and ecological significance of the methods. The techniques vary in how close they are to in situ functions; dependency on growth during incubation; and whether only bacteria are responding. All techniques were able to separate the soils according to land-use, soil texture and organic matter, and pH. The MicroResp technique was the most labour intensive in terms of time spent in the laboratory and for data calculation, while CLPP based on ECO-Biolog plates required the shortest labour time.

Based on experimental results, microbiological reasoning and ecological theory, we perform a qualitative comparison between the multi-endpoint methods of determining soil microbial functional diversity, and suggest standardized practical application and data assessment. The discrimination potential of the techniques will be discussed in relation to the ability to determine soil biodiversity and quality and the ecological significance thereof.



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