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Multi-variate approaches to measuring soil microbial activity: concepts and applications in national-scale monitoring schemes

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Soil microbial communities are characterised by their extreme complexity and the diversity of functions that they carry out. Such functions underpin many of the key ecosystem services provide by soils and it follows that appropriate characterisation and measurement of microbial activity is a pertinent indicator of soil quality. However, due to such inherent complexity, and an ecological imperative for multi-functionality, individual variables are difficult to interpret in terms of the functional capacity of soil communities in toto. In a formally structured assessment of a set of 183 candidate biological indicators of soil quality that showed high potential for deployment in nationalscale soil monitoring schemes, two multi-variate microbial activity measures ranked highly in the top ten such indicators. These were multiple substrate-induced respiration (MSIR) and multi-enzyme profiling using fluorescently labelled substrates. Issues relating to the potential application of these techniques in soil monitoring programmes were studied, including: definition of standard operating procedures, inter-laboratory consistency in measurement and determination of their sensitivity to detect change against the background of inherent spatial and temporal variability. The interlab trials showed that relative and absolute measurements were consistent between laboratories for the enzyme profiling technique, but absolute values for MSIR varied significantly. A wide variety of temporal variation was seen with respect to the constituents of the

multi-component profiles for both techniques, but consistency in multi-variate statistical summary data was apparent. These data are being used to inform the prescription of a trans-UK monitoring scheme.