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Microbial Indicators for evaluating soil quality in differently managed soils

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The definition "soil quality" is generally understood as the capacity of soil to function as a vital living system able to fulfill all its function (Doran and Parkin, 1994; Doran and Safley, 1997; Karlen et al., 1997). Microorganisms play a leading role in soil development and preservation, in fact there is a close linkage between the biotic compartment and biogeochemical cycling (Beare aet al., 1995). Since microorganisms respond rapidly to changing environmental conditions (Hargreaves et al., 2003), they are considered as sensible indicators of soil health and this is why they can be usually used for soil status monitoring (Yakovchenko et al., 1996).

In this study we present results and considerations obtained by the research project "Biodiversity and Bioindication in Pavia Province", co-founded by Joint Research Center in Ispra and Pavia Province. The aim of the research is to characterize soil microbial activity of three differently managed soils using microbial eco-physiological indicators to assess soil quality. In particular we analyzed energetic strategies adopted by microbial communities in investigated soils in order to better understand the soil biological fertility status.

This study was carried out in Pavia Province. Three study plots (20m x 20m) have been identified. The first one was a alfalfa (*Medicago sativa*) cultivation characterized by a biodynamic management with no fertilizer or manure application on soil, and no ploughing since 2002. In the second one we had the same situation but the difference was the periodic application of stable cattle sludge (150 kg/year /hectare) and 15N-15P-15K fertilizer. The last one was a maize cultivation characterized by ten years of depurated and stabilized sludge amendment.

Sampling took place on September 2004, January 2005, March 2005, July 2005 and it involved (0-15) cm and (15-30) cm layers considering that microbial biomass decrease

according to available organic matter decreasing as depth increase. Soil samples was air- dried and 2 mm sieved.

Determinations concerned microbial eco-physiological indicators. In particular metabolic quotient (qCO2, Anderson and Domsch, 1990), mineralization quotient (qM, Dommergues, 1960) and microbial quotient (Cmic/Corg, Anderson and Domsch, 1989) were determined by classical measures of total organic carbon (Corg, Springer and Klee, 1954), microbial biomass carbon (Cmic, Vance et al., 1985), respiration of soil (basal, Cbas, and cumulative, Ccum, Isermayer, 1952). In addition a kinetic model describing organic matter decomposition in soil was used to calculate kinetic parameters for each soil (km and C0, Riffaldi et al., 1996).

Since soil is generally substrate limited under natural conditions, community level physiological profile analysis (CLLP, Garland and Mills, 1991) was used to investigate on potential soil microbial activity (growing curve integration, Ig, Guckert et al., 1996) by calculating kinetic parameters (average wells colour development, AWCD0 and kclpp, Lindstrom et al., 1998) and on functional diversity (Shannon-Weaver index, H', Zak et al., 1994) of microbial communities.

All results have been analyzed by variance analysis and principal component analysis to put in evidence possible soil samples significant differences and to better understand which energetic strategy was adopted by microbial communities under different management.