Soil enzyme activities as bio indicators of soil pH and fertility in temperate grassland

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Introduction In recent years, biological indicators are being used to estimate the continued capacity of a given soil to function (*i.e.*, soil health). After all, biological processes are intimately linked with the maintenance of soil structure and fertility, being more sensitive to changes in the soil than conventional physicochemical parameters. Soil enzymes, as mediators and catalysts of vital soil functions, offer great potential as integrative indicators of soil health (Dick *et al.*, 1996). The main aim of the current work was to study the potential of soil enzyme activities as biological (more precisely, biochemical) indicators of soil physicochemical properties as well as of soil fertility in different temperate grasslands.

Materials and methods Two different types of forage production systems were studied, *i.e.*, an intensive crop rotation (cereals in winter/fodder maize in summer) and a temporary meadow for hay, during three consecutive years. The following soil physicochemical parameters were determined (MAPA, 1994): pH, moisture (weight/weight), organic matter content, total N, P Olsen, exchangeable Ca^{2+} and Mg^{2+}, extractable K^{+}, % Al saturation, CEC, and C/N ratio. Finally, plant biomass production (PBP) and soil enzyme activities [*i.e.*, arylsulfatase (S), β-glucosidase (G), acid phosphatase (P), urease (U), and dehydrogenase (DH)] were determined as described by Dick *et al*. (1996).

Results A range of randomly selected plots in the meadow, that represented the whole interval of pH values characteristic of our region, showed a range of DH values that were significantly correlated, following an exponential pattern, with soil pH (Fig. 1). DH has been reported to be related to intracellular processes that occur in viable microbial cells and is usually determined to estimate overall microbiological activity of soil (Dick *et al.*, 1996). A similar but weaker correlation between DH and pH was also observed in soils belonging to the intensive crop rotation plots ($y= 0.24\ e^{0.94\ x}$, R2= 0.77). Most interestingly, DH appeared a good indicator of PBP in the meadow (Fig. 2), again showing a stronger relationship here than in the intensive crop rotation (data not shown). This is an expected result since, according to Skujinš (1978), in unmanaged ecosystems or low-input agricultural systems, such as our meadow, a stronger relationship between soil enzyme activity and PBP might be expected. Finally, S, G, and U showed positive correlations ($p>0.001$) with soil pH and organic matter content. All enzyme activities showed strong correlations among themselves.

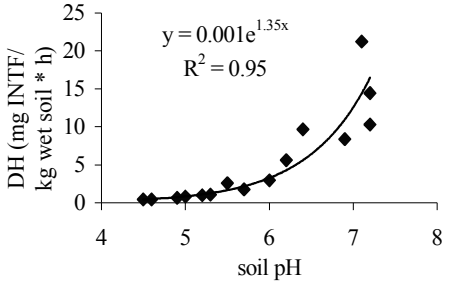

Figure 1 Relationship between pH and DH in meadows

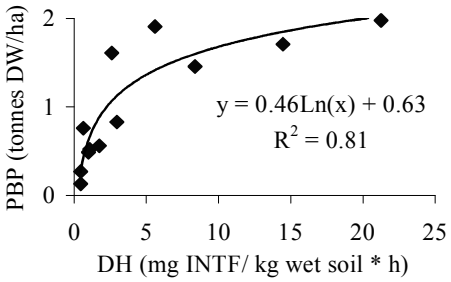

Figure 2 Relationship between DH and PBP in meadows

Conclusions Dehydrogenase activity appears a good indicator of soil pH and plant biomass production, especially in the less perturbed agricultural system studied (*i.e.*, a temporary meadow). Arylsulfatase, β-glucosidase and urease also showed potential as bio-indicators of soil pH and organic matter content.

References:

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