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Use of enzymes involved in the carbon cycle as indicators of the intensity of soil management in grassland soils from Galicia (NW Spain)

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The intensity of grassland management is known to alter soil microbial communities (Lovell et al, 1995), although its influence on the activities of enzymes involved in the carbon cycle remain unknown. In Galicia (NW Spain), intensively exploited grasslands coexist with low management grasslands. In the present study, the activities of the main hydrolytic enzymes involved in the carbon cycle (CM-cellulase, β-glucosidase and invertase) were compared in grasslands subject to these management systems, with the purpose of investigating how the intensity of grassland management affects soil quality and whether it is possible to use these enzymes as indicators of the degradation suffered by soils as a result of management practices.

A total of 64 grasslands were sampled, 29 of which were grasslands subject to low management regimes (permanent, semi-natural or natural pastures with few, if any, fertilizers applied), and 35 of which were grasslands subject to intensive management regimes (high rate of fertilizer application and annual or biannual reseeding and ploughing). Sampling took place during the spring of 2005. The upper 10 cm of the soils were sampled for analysis of total carbon, total nitrogen, microbial biomass carbon and three hydrolytic enzymes involved in the carbon cycle: CM-cellulase, β-glucosidase and invertase. ANOVA of the results was applied to assess the effects of management on soil enzymatic activity.

Organic matter and microbial biomass contents were higher in the low management grasslands than in the intensively managed sites, although the differences were not sta-

tistically significant. Furthermore, invertase activity was significantly higher ($p \leq 0.05$) in the low management sites than in the intensively managed sites. The activities of β-glucosidase and cellulase were also higher in the low management systems, although in this case the differences were not statistically significant. When the enzymatic activities were expressed per unit of microbial biomass carbon, they were higher in the intensively managed plots ($p \leq 0.01$ for invertase and β-glucosidase activities and $p \leq 0.05$ for CM-cellulase activity). The results revealed that all enzymes involved in the carbon cycle have been affected by management practices, thus suggesting that all may be used for assessing the effects of management on soil quality. The best indicators for assessing differences in grassland management intensity/regime were the ratios invertase/microbial biomass carbon and β-glucosidase/microbial biomass carbon.

References

Lovell R.D., Jarvis S.C., Bardgett R.D. (1995). Microbial biomass and activity in long term grassland: effects of management changes. *Soil Biology &Biochemistry* 27, 969-975.