Soil enzyme activities as driven by contrasting agro-ecologies and management practices in grasslands across Europe

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Introduction: Interactions between soil enzyme activities involved in nitrogen (N) cycling, management and agro-ecological distinctions are vital for understanding the stability and sustainable productivity of grassland systems. What remains unclear, however, is if grassland management per se is a stronger regulator of soil N cycling enzymes than agro-ecological distinctions, as driven by the amount and type of nutrient resources applied. The objective of our study was to determine the extent to which management and agro-ecological distinctions regulate N-cycling enzymes in grassland systems across selected countries in Europe.

Materials and methods: Fluorometric quantification of Leucine-aminopeptidase (LEU) activity was analysed under contrasting managements (intensive, less intensive, extensive) across a Pan European agro-ecological gradient: Germany (DE), Switzerland (AZ), Sweden (SE), Portugal mainland (PT) and Azores (AZ). In each country, 12 sites were randomly selected from each management and from two agro-ecologies (favourable and less favourable growth conditions). Measurements were done in triplicate using 7-amino-4-methyl coumarin (AMC) substrate and the activities were expressed as nanomoles of AMC g^{-1} dry soil h^{-1}. The data were analysed using a linear mixed effect model and Spearman correlation in R (R core team, 2018).

Table 1. Country effects on LEU activity. Means with a common letter are not different at 5% level (Duncan MRT).[1]

Country	Leucine aminopeptidase activity	
	(nm g^{-1} dry soil h^{-1})	SEM
PT	135 [a]	74
AZ	410 [ab]	83
SE	647 [b]	112
DE	1,076 [c]	73
CH	1,420 [d]	73

[1] SEM= Standard error of means.

Results: Country showed significant effect on LEU activity (P<0.001) (Table 1), but not management and agro-ecological regions (P>0.05, results not shown). PT had the lowest LEU activity compared to all countries except AZ. In contrast, LEU activity revealed significant correlations with pH (R^2=0.47, P<0.001=***), organic matter (R^2=0.62***), total soil N (R^2=0.58***) and total soil C (R^2=0.67***).

Conclusion: Our results suggest that LEU activity responds strongly to site-specific soil chemical properties, probably masking effects of management intensity and agro-ecology within each country.

R Development Core Team (2018) R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.