Critical loads for metals in agricultural lands: investigations in South West France

Thomas Bur, Anne Probst, Laure Gandois, Charles Gers, Yves Crouau, Sophie Leguédois, Jean-Luc Probst

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BUR, T., PROBST, A., GANDOIS, L., GERS C., CROUAU Y., LEGUEDOIS, S, PROBST J-L.

Ecolab, CNRS, INP, University Toulouse III, UMR 5245 Av. de l'agrobiopole 31326 Castanet Tolosan, France.

Corresponding author email: anne.probst@ensat.fr

Critical Loads (CL) were first initiated to protect pristine forested ecosystems from sulfur, nitrogen and heavy metal atmospheric inputs. It is now extended to other semi-natural conditions to regulate all sources of Anthropic Metal Elements (AME) to avoid a non reversible degradation of a considered ecosystem.
Agricultural lands receive AME via agricultural practices and atmospheric deposition. In comparison with forest ecosystems, agricultural lands are subject to important human interactions: soil tillage, action on vegetal cover (pasture, crops…), human-induced soil erosion, application of chemical fertilizer, sewage sludges, manure or pesticides, food resources in relation with human health,…
Thus, inputs and outputs fluxes of metal elements must be carefully assessed for agricultural land to model realistic CL and their exceedances. However, attention must be paid to keep the CL model simple enough to allow CL calculations at regional and national scales. Nevertheless there is a wide variety of agricultural situations and, as a consequence, the main processes leading to chemical accumulation and biotoxicity should be varying. CL models for agrosystems should integrate, in pedotransfer functions, factors such as soil type, geomorphologic conditions, and farming in order to take into account, as much as possible, each agricultural situation. The determination of critical limits using soil arthropods as indicators of contamination and toxicity still need investigations since the use of bio-chemical models designed for forested soils might not be adapted.
Investigations are ongoing in this aim to improve and adapt CL modelling and their exceedance for agricultural lands in the South West of France. The diversity of soils and agricultural practices over the Midi-Pyrénées region where agricultural lands represent 56% of the total area, are considered.
A detailed scheme of metal elements fluxes is presented. The diversity of Collembola communities in the agricultural soils of the area has been investigated. The relationships between Collembola communities and soil characteristics as well as the Collembola capacity to concentrate metal elements are shown. The relationships between metal availability in agricultural soils and bioaccumulation are discussed. Finally, ecotoxicological tests are planned on Collembola species in agricultural soil to determine critical limits for metals based on soil parameters.