Title: RHIZOtest – the first standardized laboratory bioassay designed to assess the environmental bioavailability of trace elements to plants in soils

Co-authors: BRAVIN Matthieu N.[1], LEMAL Laure[2,3], CHEVASSUS-ROSSET Claire[2], MONTES Mélanie[2], ARNAL Didier[4], HINSINGER Philippe[4] and DOELSCH Emmanuel[2]

Affiliations:
[1] CIRAD, UPR Recyclage et risque, Réunion, France
[2] CIRAD, UPR Recyclage et risque, Montpellier, France
[3] RHIZLAB, Montpellier, France
[4] INRA, UMR Eco&Sols, Montpellier, France

E-mail: matthieu.bravin@cirad.fr

Abstract: A lot of laboratory bioassays were developed to assess the toxicity of trace elements on plants and among which some are widely used and even standardized at an international level. Surprisingly, there was no laboratory bioassay developed to assess the environmental bioavailability of trace elements to plants, that is to say the uptake of trace elements in plants. Considering the ecotoxicological relevance of the environmental bioavailability endpoint, we developed and tested a dedicated laboratory bioassay, the RHIZOtest, to allow its recognition and standardization it at an international level.

The RHIZOtest is a plant-based test initially developed in the 1990s and used as a research tool to investigate the role of root-induced chemical processes as a driver of trace element dynamic in the rhizosphere and bioavailability to plants. The RHIZOtest is notably characterized the small size of the system and by a physical separation between plant roots and soil that enables to collect easily and quickly both compartments separately. These characteristics led to evaluate its performance as a risk assessment tool.

We first assessed the robustness, the repeatability and the reproductibility of the RHIZOtest via an international ring-test. The RHIZOtest was hence validated for the measurement of the environmental bioavailability of arsenic, cadmium, cobalt, chromium, copper, lead, nickel, and zinc to three target plant species (tomato, cabbage, and fescue). We secondly assessed the ability of the RHIZOtest to distinguish the environmental bioavailability of trace elements for different plant species. Using a scoring approach, we were able to classify 10 plant species as a function of the bioavailability endpoint. Finally, we assessed the ability of the RHIZOtest to distinguish the environmental bioavailability of trace elements for plants grown in different soils. We thus exposed tomato, cabbage, and fescue to 55 soil samples exhibiting very constrasted physical-chemical properties.

Armed with this knowledge, a draft describing the RHIZOtest tool and methodology was submitted to the international organization for standardization (ISO) and was validated as new standard, the NF EN ISO 16198, in February 2015. The development of the RHIZOtest is going on with its application to other contaminants such as nanoparticles and trace organic contaminants.

Keywords: Metal, Phytoavailability, Phytotoxicity

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