Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Department of soil and environment
Soil Chemistry
Ylva Bellander

PhD Project Abstract

13/06/2024

Towards better risk assessment of cadmium in agricultural soil for sustainable nutrient management

Cadmium is a non-essential element which occurs in all soils, originating from both geogenic and anthropogenic sources. It is toxic to humans even at low levels and bioaccumulates in many human tissues. Because of the long half-life of cadmium in the human body, lifetime exposure is more important than single events with high intake of cadmium. The primary source of cadmium for smoking population is tobacco, while for the non-smoking population, grains and potato are considered major contributors.

Levels of cadmium in agricultural soil has been shown to increase during the 20th century. The main anthropogenic sources in agricultural soil are fertilizers and atmospheric deposition from industries and fossil fuel combustion. Cadmium sources in fertilizers vary with type; in mineral P fertilizer, cadmium originates from the apatite ores where P is mined. Atmospheric deposition as well as use of mineral P fertilizer increased during the 20th century, which is believed to be the cause of the increasing cadmium levels in agricultural soil. Cost of production of mineral fertilizers, as well as the cadmium content, has risen during the last few years due to conflict in Europe. This, along with the knowledge that P is a finite resource and N fertilizers are fossil fuel based to a high degree, has increased the need for more sustainable fertilizer alternatives such as recycled nutrient sources.

The overall aim of this PhD project is to provide the means to determine cadmium-safe application rates (defined as zero-net cadmium accumulation, according to EU regulations) for recycled nutrient sources. This aim will be achieved in four sub-projects. The first sub-project aims to improve knowledge on cadmium chemistry in agricultural soils at naturally occurring concentrations by investigating leaching mechanisms, while the second aims to improve current models for soil-crop transfer of cadmium. This addresses the two factors with the highest uncertainty in cadmium mass balances in agricultural soil, and will improve our understanding of cadmium transport and retention there. In the third sub-project the cadmium content and availability of three recycled nutrient sources (biofuel ash, biogas digestate and beachcast seaweed) will be investigated, aiming to better understand their impact on the cadmium mass balance. Lastly, gained knowledge will be synthezised into a web-based tool, used for calculating Cd-safe application rates of fertilizers.

Ylva.bellander@slu.se