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Effects of amendments on the mobility, bioaccessibility, and phytoavailability of As, Cd, Pb, and Zn in contaminated urban kitchen garden soils

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Abstract (379 words)

Urban gardening is a growing trend that responds to the need for nature in cities, a growing movement towards healthy and sustainable eating and food production, and difficult economic and societal contexts. Both private and community gardens in these areas are often on urban wastelands, along roads, highways, or railways, near industrial sites, and have even sometimes earned the term "guerrilla gardens" for their lack of agronomic regulation. In France, many urban gardens are associated with varying levels of inorganic contaminants hailing from anthropogenic activity or geogenic metal(loid) presence.

Moderately metal(loid)- contaminated urban kitchen garden soils can benefit from gentle remediation options including the use of soil amendments, which are able to improve soil function and agronomic quality while decreasing environmental and human health risk. This study first analyses the effects of common doses of a various commercialized soil amendments on the mobility of metalloid(s) in contaminated urban kitchen garden soils. Fourteen different amendments and amendment mixes were tested on three kitchen garden soils with diverse sources of anthropogenic or geogenous contamination and varying physico-chemical characteristics. Amendments from four differing categories were tested, including i) organic amendments like composts, ii) natural fertilizers such as bone meal, crushed horn, and organic poultry manure fertilizer, iii) calcareous amendments including two different limes, and iv) natural siliceous and alumino-silicate amendments, including diatomaceous earth and zeolite. Amendments at varying common doses were evaluated via chemical extractions on their ability to reduce the mobility of metallic elements after multiple weeks of maturation at a constant humidity and temperature. The most pertinent of these amendments were then chosen to be tested in conjunction with a vegetal model grown upon the amended soils in greenhouse conditions.

Changes in physico-chemical soil characteristics, mobility and bioaccessibility of metal(loid)s in the soil, and phytoavailability in the lettuce were then tested. Mobility and bioaccessible metal(loid)s were evaluated with 0.05 M EDTA buffered at a pH of 7, an ammonium nitrate extraction, a 4-phase sequential extraction, and a UBM bioaccessibility test. Phytoavailability was determined using pseudo-total soil and plant metal(loid) contents. The study results show that it is possible to reduce both extractable and phytoavailable metal(oid)s with amendment addition. However, variable effects are seen according to the contaminated soil tested, and differences arise in the presence of a plant model.