

Leaching of Microelement Contaminants: a Long-term Field Study

Tamás Németh* and Imre Kádár

Research Institute for Soil Science and Agricultural Chemistry, H-1022 Budapest,
Herman Ottó út 15., Hungary. E-mail: nemeth@rissac.hu

* Author for correspondence and reprint requests

Z. Naturforsch. **60c**, 260–264 (2005)

A field experiment with microelement loads was set up on loamy textured, calcareous chernozem soil formed on loess. The ploughed layer contained *ca.* 5% CaCO_3 and 3% humus. The soil was well supplied with Ca, Mg, Mn and Cu, moderately supplied with N and K, and weakly supplied with P and Zn. The water table is at the depth of 15 m, the water balance of the area is negative, and the site is drought sensitive. Salts of the 13 examined microelements were applied at 4 doses in the spring of 1991.

Treatments were arranged in a split-plot design, in a total of 104 plots with two replications. Loading rates were 0, 90, 270 and 810 kg/ha per element in the form of AlCl_3 , NaAsO_2 , BaCl_2 , CdSO_4 , K_2CrO_4 , CuSO_4 , HgCl_2 , $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}$, NiSO_4 , $\text{Pb}(\text{NO}_3)_2$, Na_2SeO_3 , SrSO_4 , ZnSO_4 . Soil profiles of the control and the 810 kg/ha treated plots were sampled in the 3rd, 6th and 10th year of the trial. The mixed samples, consisting of 5 cores/plot were taken in 30 cm steps to 60 cm (year 1993), 90 cm (year 1996), and 290 cm (year 2000). Ammonium acetate + EDTA-soluble element content was determined. The main conclusions of the study are:

1. In soils contaminated with 810 kg/ha load rates As, Hg, Ni, Cu, Pb, Ba and Sr displayed no significant vertical movement. There is little uptake and translocation in plants of these elements: their concentration in the above-ground plant parts usually remains below 5–10 mg/kg dry mass with the exception of Ba and Sr showing a somewhat higher accumulation. Under our conditions the above elements did not behave as dangerous contaminants to the soil, groundwater, or plants.
2. Moderate leaching of Zn and Cd was detected when applied at higher doses. Their accumulation was also moderate in the above-ground plants parts. Zn is not a dangerous pollutant for soil, plants or groundwater at our site. Cd, however, is a very dangerous element because of its high toxicity to mammals, soil life and crops.
3. Cr, Se, and Mo (in the form of chromate, selenate and molybdenate anions) exhibited great mobility in the soil and partly in the soil-plant system. Cr was hardly detectable in the above-ground parts of plants. Still, its rapid leaching can jeopardize groundwater quality. Se was strongly accumulated in all plant organs and was highly toxic for all crops. Mo, too, showed 2–3 orders of magnitude greater accumulation in plant parts, resulting in products unfit for animal or human consumption. Under our experimental conditions Cr(VI), Se, Mo can be classified as dangerous contaminants, since the anion forms remained stable for a long time in this well-aerated calcareous environment.

Key words: Microelements, Leaching, Soil Pollution, Long-term Experiment