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Cd toxicity in Ash amended to plantations; the dilemma of different answers at different levels of description.

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Wood ash contains much heavy metal and may therefore be considered toxic to the soil system and its organisms. We evaluated this at several levels of description from simple toxicity tests to field tests with ash application in an acid plantation of Norway spruce.
In pot studies ash stimulate plant growth, equally because of the pH increase and the nutrients added. The pH increase stimulates decomposition activity. Soil carbon availability is not permanently increased with ash amendment, however, which may suggest that decomposition increase is coupled to primary production increase.
Plantation organisms changed markedly with ash. Moss cover change, enchytraeid worms decrease, and the bacterial food chain increase without a reduction in fungal activity. The bacterial communities also change. Ash did not affect ectomycorrhiza, probably because it remains in the upper cm after surface application.
Wood ash increase plantation soil Cd, and so did Cd in grass although at a very low level, Cd in lichens and Cd in the small biomass of earthworms. The toxicity of Cd is regulated by metal binding to soil being several orders of magnitude lower than in pure liquid. Ash is toxic towards microarthropods in farmland soil, not in plantation soil being an effect of pH not of heavy metals. Cd toxicity was reduced when applied with ash, and available Cd and plant uptake even decrease with increased ash to soil. Tolerance of bacteria to Cd does not increase with ash also suggesting low availability of Cd in ash. Other more abundant cations like Zn regulate Cd uptake. Mycorrhiza reduce Cd uptake in several plants. In barley Cd gradually decrease from root via stem to seeds.
In conclusion for ash amounts up to 10 t/ha, we do not find metal toxicity of ash or evidence for bioaccumulation of metals in soil organisms. Neither CO_2 output nor exchange of N2O and CH4 in the plantation was changed with ash, and nitrogen leaching did not increase.
So, even though marked changes occur in the soil biota following ash amendment, no adverse effects within the system were observed and polluting outputs from the system were not increased. By addressing the in part contrasting results at description levels between simple toxicity tests, pot studies with organisms, ash and heavy metals under control, and field studies we got a system understanding of the ash effects on soil organisms and processes.