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Long term bioimmobilization and bioremediation at an AMD contaminated site in Eastern Thuringia

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The residual contamination with heavy metals and the low pH affects the re-establishing of vegetation in acid mine drainage (AMD) polluted areas.
Here, microbially assisted bioremediation and bioimmobilization strategies were tested with respect to altering element uptake into plant biomass, leading to planting regimes and microbial communities that maximize reduction of the ecotoxicological risk and input into food webs and water ways.

The experimental site is a since the mid-nineties remediated site, disturbed by several decades of extensive uranium leaching (Eastern Thuringia, Germany). On the ground this former heap, the effect of 5cm topsoil or municipal compost addition on the plant availability of metals was investigated for several years. The soil was inoculated with mycorrhizal fungi and streptomycetes with plant growth promoting properties. The inoculated microorganisms proofed to be tolerant to increased levels of heavy metals and salt.
A soil characterization including sequential extraction was performed in the amended as well as in an untreated control plot to investigate possible shifts in metal availability/mobility as an effect of the amendments added. The bioavailable heavy metal fraction was lowered by metal binding to the organic fraction. The inoculation with microorganisms aided the treatment of the soil.
Biomass productivity of disseminate plants was enhanced continuous over the years. Diversity and evenness of the natural plant community were increased and plant growth was increased with inoculation. A shift in the microbial community could be observed. Seasonal investigation of the soil microorganisms showed enhanced cell numbers and higher activity.
Also these effects are stable over several years and repeated harvesting of the above ground biomass.
Thus, microbial aided revitalisation of disturbed soils, as well as addition of soil amendments were used to combine metal immobilisation and enhanced biomass production. The outdoor tests were also simulated under controlled conditions in greenhouse experiments and thereby approved former results.

Future trials will test whether with bacteria and fungal mycelia enhanced phytoextraction by remobilization from the organic fraction and uptake into plant biomass under controlled conditions can be devised to promote future possible land-use and might be preferable for AMD treatment in nutrient-poor sites.