

Perspectives and drawbacks of nanoremediation in the soil-plant system: From isotopes to the field

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The contamination of soil with metal(loid)s is a global problem worldwide. Due to their non-degradability and persistence in the environment, the remediation of soils is thus limited to their extraction or stabilization. Engineered nanomaterials, including nano zero-valent iron (nZVI), have gained much attention in the last two decades in the field of pollutant remediation for a wide range of organic and inorganic compounds. Their high reactivity, large specific surface area, and abundant sorption sites are potentially suited to their application to groundwaters and to contaminated soils as stabilizing amendments. In the case of soils, the majority of the studies are conducted at a laboratory scale, while field-scale evidence and investigations of their interactions in the soil-plant systems remains scarce. Additionally, there is still a limited number of studies describing possible toxicological issues and the economic viability in general [1]. In order to critically assess its feasibility, there is a need to understand in detail the mechanisms involved in contaminant stabilization using advanced solid-state and isotope analyses and especially test its efficiency directly in the field [2,3].

[1] Komarek (2024), *npj Materials Sustainability* 2, 8.

[2] Mitzia, Vitkova, Ratie, Choteborsky, Vantelon, Neaman & Komarek (2023), *Environmental Science: Nano* 10, 2861-2879.

[3] Lewandowska, Vankova, Beesley, Cajthaml, Wickramasinghe, Vojar, Tsang, Ndungu & Komarek (2024), *Science of the Total Environment* 927, 171892.