Imperial College London

Natural Environment Research Council

2024_80_UKCEH_GA: From lab to land: Advancing synergetic green technologies for the remediation of contaminated land.

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Geogenic processes and industrial activities such as mining and fossil fuel production have led to the release of metal contaminants into the environment. The accumulation of persistent metal contaminants like cadmium and lead, in concentrations harmful to ecosystems and human health, is now a critical global environmental concern in the 21st century. The Environment Agency estimates that about 300,000 hectares of land in the UK are contaminated, with metal contaminants constituting a significant portion[1]. Over 250 new sites in the UK are categorized as being contaminated annually, due to metal deposition.

While there are mechanical and chemical remediation methods, they are expensive, destructive, and unsustainable. In contrast, plants are natural miners of metals, and the capacity of some plants to remediate metal contaminants has been extensively studied[2]. For instance, a combination of bacterial inoculation with a phytochelatins synthesizing legume and a metal hyperaccumulator, in a synergetic legume-assisted-microbial phytoremediation system, achieved a remediation efficiency of 75%, the highest ever reported in a zinc-contaminated environment[3].

However, many of these success stories are from laboratory studies or pot experiments conducted in controlled environments[3-5]. **Without a rigorous assessment of these successful lab-based remediation techniques in actual field conditions where they are subjected to the complexities of real-world biological, edaphic, and climatic factors, the advancement of green remediation technologies would stagnate, and the related social and economic benefits would remain unrealized.**

This project aims to:

1. Evaluate the efficacy of three synergistic green remediation strategies, previously identified as successful in laboratory studies, at three distinct metal-contaminated sites in the UK, characterized by varying biogeochemical properties.

2. Uncover the bio-geochemical mechanisms that underpin metal sequestration in real-field conditions.

3. Explore sustainable approaches for the repurposing and recycling of the biomass produced by the remediation process.

This project is multidisciplinary and brings together an interdisciplinary team of scientists. The successful student will receive training across ecotoxicology, landscape agronomy, geochemistry, bioengineering, microscopy, and spectroscopy, and be among the pioneering PhD researchers at the newly established UK Centre for Multimodal Correlative Microscopy and Spectroscopy (CoreMiS) at the UKCEH.

[1]Ashworth et al. 2005. ISBN Number 184432480X. [2]Kafle et al. 2022. Environ. Adv. 8, 100203. [3]Adediran et al. 2016. Int. J. Phytorem. 18 (7), 720-729. [4]Adediran et al. 2016. New Phytol. 209 (1), 280-293. [5]Adediran et al. 2015. J. Hazard. Mater. 283 (0), 490-499.