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EDITORIAL

State-of-the-art in characterisation of the soil-plant metallome

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Technological advances are driving exciting new research for the measurement and visualisation of the metallome in the soil-plant continuum. The metallome is defined as the totality of metal and metalloid chemical species within cells or tissues (Williams 2001; Szpunar 2004) and consequently, metallomics is the study of the metallome and its interactions and functional connections with genes, proteins, metabolites, and other biomolecules within organisms (Mounicou et al. 2009). These methods include approaches using diffusive gradients in thin-films (DGT) devices, laser-induced breakdown spectroscopy (LIBS), synchrotron-based X-ray fluorescence (XRF) and X-ray Absorption Near Edge Structure (XANES), and molecular methods including whole genome sequencing (WGS) and transcriptomics. This Special Issue showcases some of the research that exemplifies novel methodologies for gaining insights in the metallome in soils and plants. Andrews et al. (2023) tested the suitability of LIBS to obtain rapid in situ elemental distribution in plant and soil samples utilising only small sample volumes and minimal sample preparation which could be advantageous for high-throughput phenotyping. Liu et al. (2023) demonstrated the utility of a combination of DGT devices with mass spectrometry imaging for in situ synchronous imaging of root exudates and rare earth elements at the root-soil interface in a hyperaccumulator plant species. This approach could equally be used for many other species, for example to assess phosphorus mobilisation around cluster roots. Degryse et al. (2023) performed spatially resolved XRF and XANES to assess whether zinc availability could be improved by post-granulation acid treatment in cogranulated phosphate fertilisers. Risse et al. (2023) used an experimental setup in which soil pore water was sampled to monitor changes in soil solution ionome, pH, and dissolved organic carbon (to show root-induced nickel mobilisation in the rhizosphere of a hyperaccumulator plant species). Goryluk-Salmonowicz et al. 2023 isolated endophytic bacteria from tissues of *Armeria maritima* and characterised using whole genome sequencing and *Pseudomonas* spp. endophytes were shown to be resistant to antibiotics and metal ions and harboured potential resistance genes. Zhao et al. (2023) assessed the molecular basis of iron deficiency responses in *Chenopodium quinoa* (quinoa)

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using a comprehensive approach involving physiobiochemical and transcriptome analysis. In summary, the increase of non-invasive and non-destructive methods in particular has enabled to gain a wealth of knowledge on the mechanisms of nutrient and trace element behaviour in the rhizosphere and the processes that lead to metal/metalloid uptake in plants. We anticipate that technological advances in this field will continue to enable cutting-edge research that will be reported in *Plant and Soil*.

Declarations

Competing interest No competing interests are declared.

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