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Neutron imaging to study root responses to Ni heterogeneity in soil

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Technical difficulties in non-destructive observation of root growth and development in soil limits our understanding of the interactions between soil and roots. Neutron Radiography (NR) has increasingly proved to be an efficient tool to image living roots in situ. NR quantifies the water distribution in plant-soil systems. Hydrogen has a higher neutron cross-section than most other biological components and it is present at the highest concentrations in biological tissues. Plant roots have a higher water-content than the ambient soil and can thus be resolved. We compared root responses of Ni hyperaccumulator plant Berkheya coddii and non-accumulator plant Cicer arietinum to Ni heterogeneity in soil. We grew the plants in growth containers filled with control soil, homogeneously contaminated, and heterogeneously contaminated soil with Ni. The plants were grown for 5 weeks and neutron radiographs were taken 3 times over the course of the experiment. Neutron imaging reveals root growth and development in response to trace elements in soil. Using image analysis algorithm we calculated the root volumes in the contaminated and uncontaminated segments in neutron images. We observed no significant difference in the root allocation in the contaminated and uncontaminated segments of the growth container for Berkheya coddii. However for Cicer arietinum, the root development was greatly hindered in the contaminated segments. Our results suggests that, unlike some other hyperaccumulator plants such as Thlaspi caerulescens, Berkheya coddii does not forage towards the Ni-rich patches in soil.