

# Bacteria-induced changes in zinc speciation counteract its toxicity despite increased bioavailability to plants

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## Introduction and Context

Models like the Free Ion Activity Model or the Biotic Ligand Model for predicting the toxicity of trace metals are based on an understanding of factors that control bioavailability, of which speciation is key [1]. One application of such models is in assessing metal toxicity to plants growing on metal contaminated soils. Inoculation of soil/seeds with some bacteria can improve plant growth but the mechanisms behind this phenomenon are contentious [2]. Hence, we monitored growth of *Brassica juncea* in the presence of *Pseudomonas brassicacearum*, *Rhizobium leguminosarum* or both strains under zinc stress, and combined synchrotron-based micro-XRF imaging with XANES analysis to shed light on mechanisms behind the apparent metal tolerance.

## Results and Discussion

Improved plant growth occurred when seeds were inoculated with either bacteria relative to controls, despite higher zinc concentration in the plant tissues of bacteria-inoculated plants, as revealed by bulk analysis and by synchrotron-based micro-XRF imaging of roots.

Linear combination fitting of XANES data showed significant differences in zinc speciation between controls and bacteria treatments, while the speciation also depended on the organic matter content of the growth medium. Furthermore, the locus of the zinc depends on whether the bacterium is endophytic or rhizospheric. Our results caution against using bioavailability alone as an indicator of adverse outcomes.

[1] Buffle, J. et al (2007). *Environ. Sci. Technol.*, **41**, 7609–7620. [2] Adediran G.A. et al (2015). *J. Hazard. Mater.* **283**, 490–499.