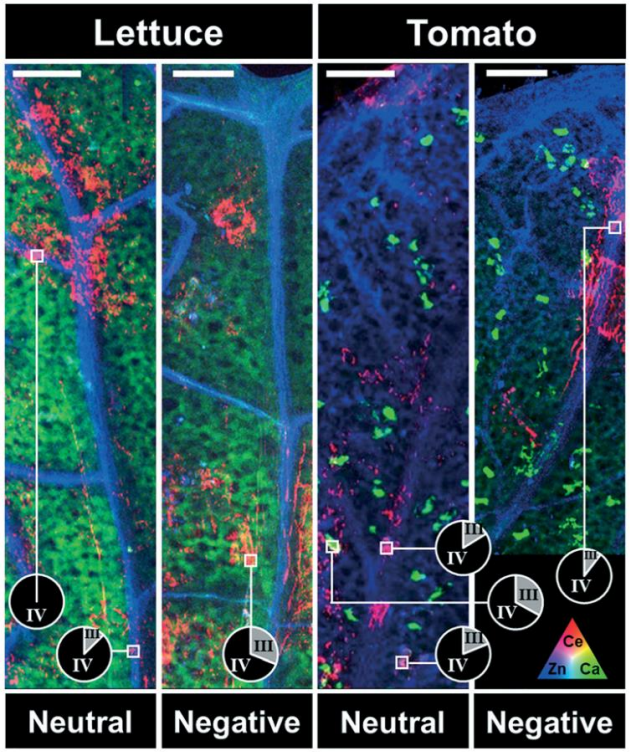
Targeted Nanoparticle Delivery of Nutrients to Plants



Tri-color X-ray fluorescence images of dicot leaves showing Ce (red), Zn (blue), and Ca (green) for lettuce and tomato after 48 hours of hydroponic exposure to cerium oxide nanoparticles (NPs) with different surface charges. White boxes show where micro X-ray spectroscopy was used to determine Ce oxidation state, which differed depending upon the charge of the NPs.

Work was performed in part at Brookhaven National Laboratory

Scientific Achievement

The surface charge of nanoparticles was found to significantly affect transport into plant vascular and leaf tissue.

Significance and Impact

Tailoring the surface charge of nanoparticles may provide targeted delivery of nutrients in plants.

Research Details

- Plants were exposed hydroponically to positively-charged, negatively-charged, and neutral 4 nm CeO_2 nanoparticles.
- X-ray fluorescence microscopy and spectroscopy at NSLS-II beamlines XFM and SRX showed that NPs with negative charge associated with vasculature, but positive charged NPs associate with mesophyll tissue.
- Up to 30% reduction of Ce(IV) to Ce(III) was observed for neutral and negative NP treatments.

E. Spielman-Sun, A. Avellan, G.D. Bland, R.V. Tappero, A.S. Acerbo, J.M. Unrine, J.P. Giraldo, G.V. Lowry. *Environ. Sci. Nano*, **6**, 2508-19 (2019).