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Effect of compost amendment on zinc speciation in soil and edible plants (*Eruca vesicaria Cavalieri*): Evaluation with conventional and advanced techniques.

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Metals are very common contaminants in soil. Long-term depositions of metals in soil can lead to accumulation, transport and biotoxicity/zootoxicity phenomena caused by mobility and bioavailability of significant fractions of the metals. Addition of organic matter to polluted soils can be used to modify metal bioavailability, speciation, plant uptake and translocation processes. In order to determine the effect of organic amendment in the form of compost (highly humified organic matter) on zinc speciation in soil and plants, a greenhouse pot experiment was carried out using edible plants (Rocket: *Eruca vesicaria Cavalieri*, family *Brassicaceae*) grown on an artificially Zn-contaminated soil (665 mg/kg) amended or not with compost. At the end of the vegetative cycle the plants were harvested and analyzed for zinc concentration in roots and shoots. Main agronomical growth parameters were also determined. Zinc speciation in soil was assessed by using the original BCR sequential extraction procedure, and by determining the redistribution between available and less available chemical forms. In addition, zinc toxicity under compost application, and plant uptake processes were evaluated.

Zinc, though an essential element for plant growth, caused toxicity effects in plants grown on the non-amended soil, inhibiting root and shoot growth. In the amended soil, compost reduced zinc toxicity, and increased significantly shoots and roots growth. The concentrations of zinc in roots were similar for plants grown on the treated and un-

treated soil, while significant differences were observed for shoots. In fact, the plants grown on the soil amended with compost showed the lowest zinc concentration in shoots. From our observations, compost amendment seems not to affect zinc speciation in soil. Only zinc uptake and translocation seems to be affected. Higher zinc uptake and accumulation rates were observed in plants grown on the non-amended soil in comparison to the compost amended soil. In general, the concentration of zinc in shoots exceeded the concentration in roots, but plants amended with compost showed the lowest translocation.

Fresh living plants and freeze dried plant parts were analyzed by using synchrotron radiation (SR) X-ray based techniques, without the need of extensive sample manipulation. The chemical forms of zinc in the plants were determined at the molecular level by mean of Zn μ-XANES. An elemental distribution map of zinc concentration in different plant organs (roots, petioles, and leaves) was generated using 2D and 3D μ-SR-XRF. The use of synchrotron X-ray radiation to determine metal distribution and speciation inside plant tissues offers scientists an innovative tool for research. Using the non-invasive technique of X-ray absorption spectroscopy, we have been able to determine the ligands environment of zinc in different matrices.

The results obtained using μ-XRF tomography and μ-XANES reveal that the two different plant theses show a different zinc distribution and speciation inside plant organs. In plants grown in the presence of compost, a well defined zinc compartmentalization is visible while, in plants grown on the untreated soil, zinc distribution is much more homogeneous. μ-XANES speciation of zinc in rocket salad plants as well as the determined distribution in different plant organs are providing extremely important hints to understand the role of compost in influencing zinc uptake, and detoxification mechanisms as well as translocation processes in plants, at the microscopic level.