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Effect of organic amendments and mineral fertilizer on zinc bioavailability, plant content and translocation

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Organic matter plays a key role in heavy metal bioavailability through changes in soil chemical characteristics, and by its metal-chelating ability, the latter being one of the most important factors controlling the mobility and bioavailability of heavy metals in the soil-plant system.

In this research, rocket (Eruca vesicaria L. Cavalieri), a common edible plant species in the Mediterranean regions, was used as bio-indicator to evaluate the effect of different organic amendments on Zn toxicity, absorption, and translocation. The main objectives of this study were to investigate the bioavailability of Zn in an artificially contaminated soil after the addition of compost, manure and chemical fertilizers at agronomically recommended doses and to evaluate their ability to reduce Zn concentration in the edible plant part.

A greenhouse pots experiment was carried out using rocket plant grown on an artificially contaminated soil. In this study, the effect of compost, manure and chemical fertilizers on Zn fate in a soil-plant system was evaluated. At the end of the experiment main growth parameters and Zn content in plants were determined. In addition, Zn speciation in the soil was assessed using the original BCR sequential extraction and the DTPA extraction.

The overall assessment of experimental results is that compost, followed by chemical fertilizers treatments, was the most efficient in enhancing plant growth and decreasing metal toxicity and concentrations in plant tissues. Manure amendments increased plant Zn content and toxicity in rocket plants. In the case of compost treatment, this effect can be attributed to the humified OM present in compost; while the negative effect of manure is due to its content in low molecular weight organic acids. The effect of chemical fertilizers treatment could be attributed to the addition of P fertilizer in soluble and highly available forms to the plants. On the contrary, using DTPA and BCR sequential extraction procedure, all treatments seem to not affect Zn bioavailability in the soil.

In conclusion, compost was effective in binding heavy metals, reducing plant uptakes as well as translocation to aerial parts, ameliorating also plant tolerance and growth.