ZINC ACCUMULATION BY *SOLANUM NIGRUM* GROWN IN CONTAMINATED SOILS: EFFECTS OF THE APPLICATION OF MANURE AND COMPOST AND INOCULATION WITH ARBUSCULAR MYCORRHIZAL FUNGI

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Phytostabilisation can be defined as the combined use of plants, soil amendments and agronomic practices to decrease pollutants toxicity in the environment. Addition of organic matter (OM) amendments, such as compost or manure, is an inexpensive practice to facilitate re-vegetation of contaminated soils. Organic amendments can decrease heavy metal bioavailability. Some microorganisms, such as arbuscular mycorrhizal fungi (AMF) can also facilitate the re-vegetation of polluted soils by enhancing plant growth and improving plant reproduction. When the time established for recuperation is not prolonged, and other faster techniques are to be considered for soil remediation, phytostabilisation can be an intermediary step in a wider process of site recovery.

S. nigrum, being able to establish and grow in soils presenting high Zn levels, seems to be a good candidate for the application of this type of strategy. The capacity of *S. nigrum* to thrive in soils presenting Zn levels considered as phytotoxic is a valuable characteristic for its application in re-vegetating and stabilising Zn polluted soils. However, the high metal accumulation presented in past studies by the plant is a handicap, especially the levels observed in the aboveground tissues. The application of OM amendments may increase the stabilisation capacities of this system, by reducing plant accumulation and the amount of Zn stored in *S. nigrum*, as well as reducing water percolation through the soil. A greenhouse experiment was thus carried out to assess the influence of the addition of OM amendments on the growth and metal accumulation by *Solanum nigrum* in Zn contaminated soils, and to evaluate the effect of the application of different AMF on the bioavailability of Zn. The production of percolates and the corresponding Zn contents was also considered. The experiment was a factorial design with two matrix Zn levels (soil collected from a metal contaminated site with 433 mg Zn kg^{-1}, and the same soil spiked with 500 mg Zn more per kg of dry soil), three amendment treatments (no amendment, 10% compost and 5% manure) and three AMF treatments (no AMF, *Glomus claroideum* and *Glomus intraradices*).

The application of the amendments, especially manure, induced a significant decrease on the percentage of root colonisation of both AMF. Addition of manure to the growing matrix always resulted in a significant increase of the biomass of all plant parts when comparing with the control, while the application of compost only resulted in a significant higher leaf biomass of plants growing on both contaminated soils - AMF inoculation generally did not significantly affect the biomass of *S. nigrum*.

Zinc accumulations of up to 7465 mg kg^{-1} in the roots, 5446 mg kg^{-1} in the stems and 2082 mg kg^{-1} in the leaves were registered for plants grown in the non-amended soils. After the addition of manure and compost to the soil, reductions of respectively 80% and 48% in the levels of metal accumulated in the plant tissues were obtained. AMF generally did not seem to have any effect on this accumulation in amended soils. The establishment of *S. nigrum* in combination with the application of the used OM amendments also provided a reduction in the quantity of Zn leached through the soil in the order of ca. 70 to 80%. Therefore, the addition of manure to the soil increased the ability of the plant to decrease the percolation of Zn from the contaminated matrix.

The use of *S. nigrum* in the stabilisation of Zn contaminated soil amended with manure can thus be seen as a feasible phytostabilisation practice, as this association has the potential to inhibit further contamination of the food chain through herbivores and dissemination of the contamination throughout the soil and to other environmental compartments via leaching. This application can not be considered as a permanent solution, but should be considered for metal contaminated sites, as it will be able to reduce the levels of contamination. The plant will be accumulating a small part of the metal in its tissues and can act like a go-between step until other solutions can be developed.

Keywords: arbuscular mycorrhizal fungi, organic matter amendments, phytostabilisation, *Solanum nigrum*, Zn