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THE ASSESSMENT OF INFLUENCE OF SOME ABIOTIC STRESS FACTORS ON THE ELEMENTAL CONTENT OF LETTUCE

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INTRODUCTION

Heavy metals became important pollutants due to their potential toxicity and their persistence in soil. One additional problem consists of spreading of nanomaterials in environment while their effects on living organisms are almost unknown. All these pollutants can be considered abiotic stress factors that can affect the growth of the plants.

AIM OF WORK

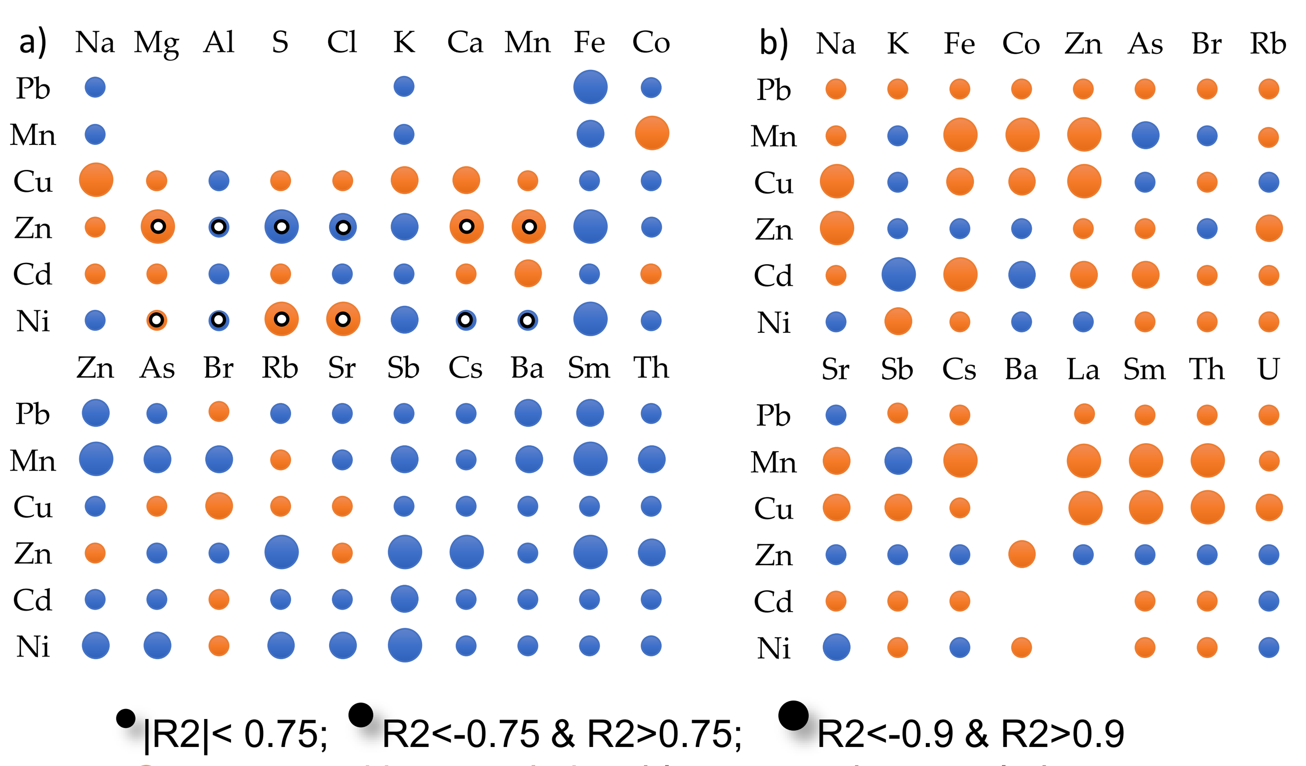
The aim of this work is to assess the impact of several salts of heavy metals (Cd, Cu, Zn, Mn, Ni and Pb) in different concentration (I, II, III), and six nanomaterials (CNT-COOH, CNT-MnO_2, CNT-Fe_3O_4, CNT-MnO_2-Fe_3O_4, MnO_2 and Fe_3O_4) on the elemental content of the lettuce (*Lactuca sativa* L.) plants.

EXPERIMENTAL CONDITIONS

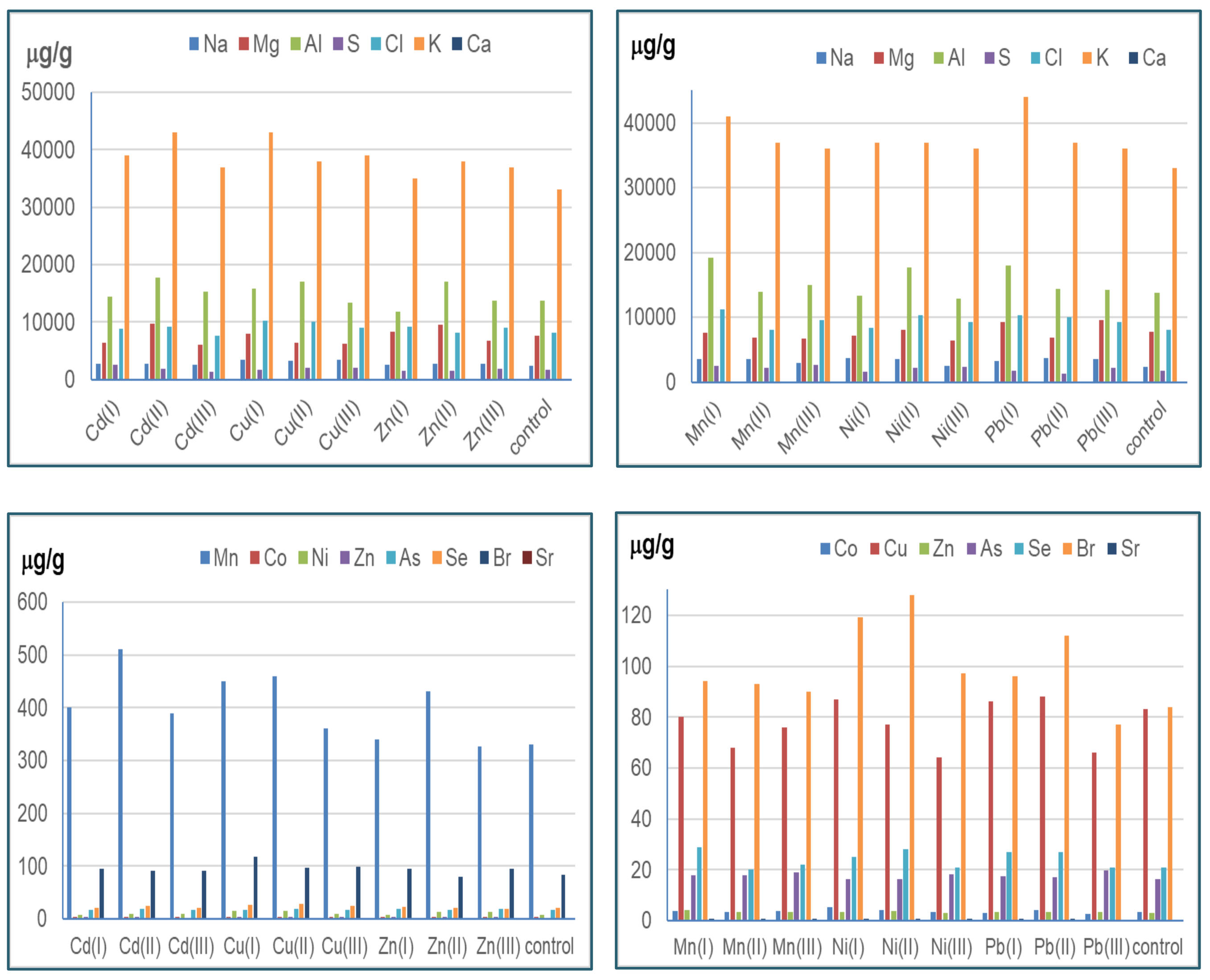
- The concentrations of the heavy metal salts used for plant treatments were: Cu (15, 30, 100 mg kg^{-1}); Cd (0.75, 1.5, 3 mg kg^{-1}); Zn (75, 150, 300 mg kg^{-1}); Mn (0.675, 1.35, 1.5 mg kg^{-1}); Ni (15, 30, 75 mg kg^{-1}) and Pb (15, 30, 50 mg kg^{-1}).
- The *L. sativa* plants treatment with nanomaterials consisted of growing them in 100 g soil substrate with 0.023 g CNT-COOH, CNT-Fe_3O_4, CNT-MnO_2, CNT-MnO_2-Fe_3O_4, MnO_2, Fe_3O_4.
- All plants, including control, were grown in a Memmert (ICH260L) climate chamber under controlled light conditions (for 12 h from 24 h), 60% humidity and a day/night temperature cycle of 20/10°C. Three replicates of each plant were grown. Plant samples were taken six weeks after sowing.

RESULTS

Heavy metals

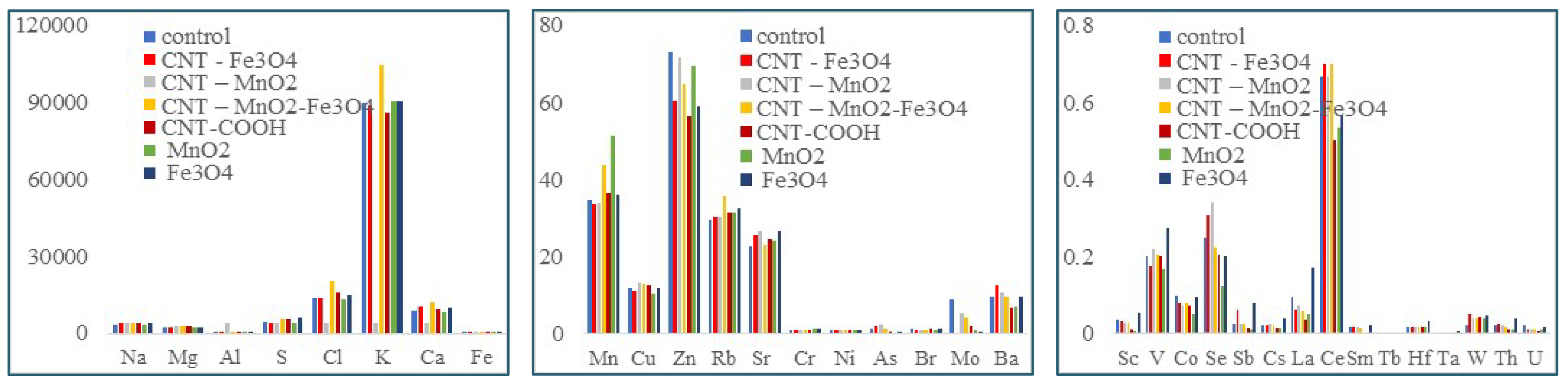


The correlation between the elemental content in the *L. sativa* leaves (a) and root (b) and the concentration of heavy metals applied to the soil

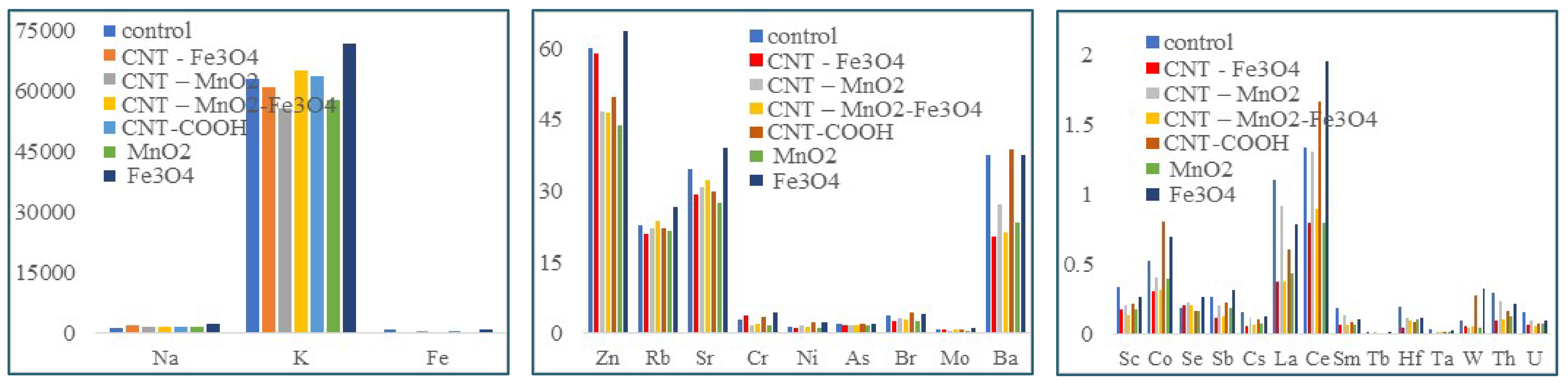


Variation of elemental content in the **soil** where the L. sativa Grown with heavy metals.

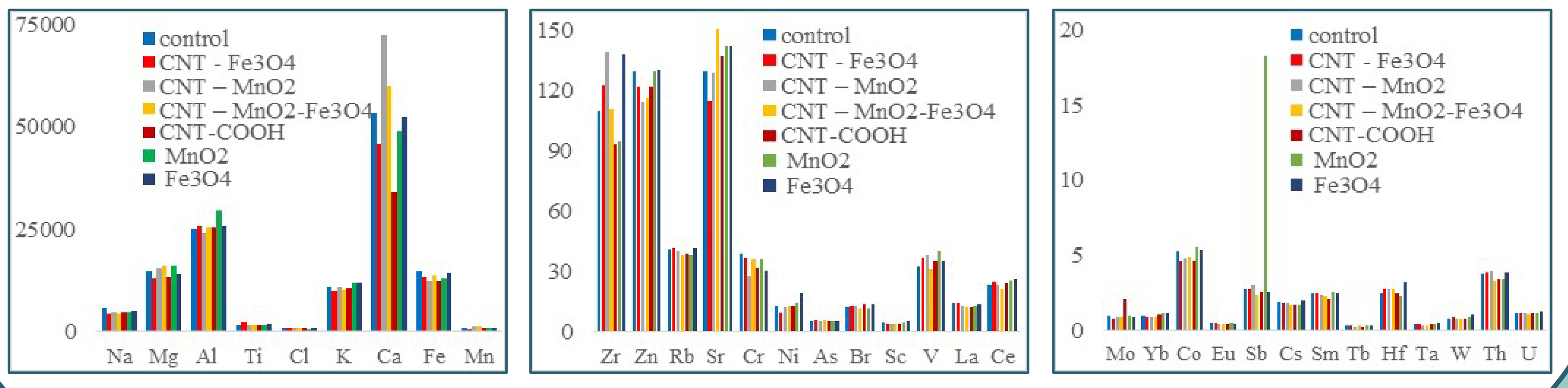
Nanomaterials



The element concentration (µg/g) in each type of investigated *L. sativa* **leaves**



The element concentration (µg/g) in each type of investigated *L. sativa* **roots**.



The element concentration (µg/g) in each type of investigated **soil**.

CONCLUSIONS

The increase in the concentration of Pb in the soil is strongly correlated with the decrease in the content of Fe, Zn, Ba, Sm in leaves, while the root reaction to the increase in Pb concentration is a weakly positive correlation of all elements except Sr. Cu is the only element whose concentration increase is strongly positively correlated with the content of Na, K, Ca and Br in leaves. Increasing the content of Cu in the soil intensified the content of Na, Zn, La, Sm, Th and Fe, Co, Sb in roots. The increase in the concentration of Zn seems to be strongly correlated with the content of Mg, Ca, Mn and uncorrelated with S, K, Ca and Fe in leaves. The increase in the Zn content induces the increase in the content of Na, Rb and Ba in root. The variation of Fe and Sb to a greater extent, and K, Zn, As, Rb and Sr more moderately are also in contradiction with the variation of Ni content in the soil. The influence of Ni to the root is moderated for K and Sr. The use of an increasing concentration of Mn only induces an increase in the content of Co in leaves, while the content of the other elements, if it varies, decreases. On the other hand, in the root, the elemental content is strongly correlated for Fe, Co, Zn, Cs, La, Sm. Th.

The soil amended with CNT functionalized with MnO2 and iron dioxide respectively and simultaneously with both oxides influences in different extents the content of elements in leaves, roots and soil at the end of the growth period.

It can be concluded that the elemental content of plants subjected to abiotic stress in the form of a high HM and CNT content in the soil is obviously influenced by the extend of the stress factor. The degree of their influence must be followed in the wider context of the variation of bioactive compounds from plants.

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