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THE BIOACUMULATION AND TRANSLOCATION OF As AND Cd ON THYMUS SERPYLLUM PLANTS - LABORATORY STUDY

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Elements such as arsenic (As) and cadmium (Cd) are not biodegradable, which is why they can be toxic and carcinogenic even at low concentrations, representing a of arsenic are usually lower than its total content because the metalloid adsorbed by the soil tends to form, over time, stable complexes that can penetrate the micropores or form precipitates with iron (Fe) and aluminium (Al), becoming more and more slightly bioavailable. As is an analogue of phosphorus having the same behavior in plant roots. Cd is a common contaminant for the environment, being introduced into the soil through human activities. The main anthropogenic sources for Cd are: mining, rechargeable batteries, alloys, cigarette smoke, vapor lamps, fertilizers or old PVC water supply pipes. The content of Cd in medicinal plants is extremely important due to the very high degree of toxicity as well as the effects on human health. Thyme (*Thymus serpyllum*) is a species of perennial plant in the genus Thymus, family Lamiaceae. *Thymus serpyllum* grows in mountainous areas, on meadows or alpine pastures. *Thymus serpyllum* is used both in seasoning food and for the preparation of teas in naturopathic medicine. It has a diuretic and intestinal antiseptic action; it is recommended for spastic, convulsive and asthmatic coughs. The aim of this study was to evaluate the bioaccumulation of As and Cd in the root, stem, leaves and flowers of thyme grown on a soil polluted in a laboratory experiment.

Materials and methods

Thymus serpyllum seeds were planted in the mini-greenhouse, in universal, unpolluted soil. After the seedlings appeared, they were planted in pots containing soil polluted with As (15 mg/kg d.w.) and Cd (3 mg/kg d.w.). Simultaneously with the experiments on soils polluted with As and Cd, control experiments were carried out. Each experiment performed in three different pots. The experiments carried out were noted as follows: AsI, AsII, AsIII, CdI, CdII, CdIII, Controls (MI, MII and MIII). The experiments took place over a period of 3 months. Monthly, samples of thyme were taken, washed with tap water and then with distilled water, separated by components (root, stem, and leaves) and dried at room temperature. After drying, the plants were milled and a quantity of 0.5÷1 g of the dried plant was used, to which 9 ml of nitric acid and 1 ml of hydrogen peroxide, reagents of ultrapure quality, were added. After cold mineralization, digestion was carried out in a microwave system that has both temperature and pressure control. The samples were filtered and

brought to a 25 mL volumetric flask, the residue was washed with ultrapure water and the resulting water was collected in the volumetric flask. Metal concentrations were determined by inductively coupled plasma optical emission spectrometry (ICP-EOS).

Results and conclusions

The results of the analysis to determine the concentrations of metals showed that As does not accumulate at all in the thyme, it remains in the soil. Cd accumulates in the thyme in all the experiments in which it was added (Figure 1), exceeding the normal value for Cd in plants (1 mg/kg d.w.), the highest value being recorded in the leaves, in the first month of the experiment (CdI).

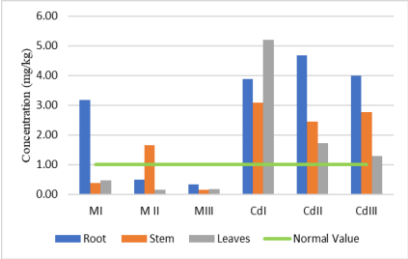

Fig. 1. Cd concentration in organs (mg/kg d.w.)

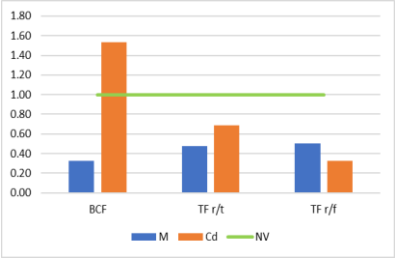

Fig. 2. BCF and TF for Cd

In order to evaluate the ability of the plant to accumulate metals from the soil and to translocate them from the root to the aerial parts (stem, leaves, flowers), the bioaccumulation factor (BCF) and the translocation factor (TF) from the root to the aerial parts of the plant were calculated (leaves, stem). In the experiment in which Cd was added, the bioaccumulation factor was greater than 1, which indicates a bioaccumulation of this metal in the studied plant. From the calculation of the transfer factor, it was observed that this metal was not transferred from the root to the aerial parts of the plant (stem, leaves) (TF root/stem and TF root/leaves lower than 1) (Fig. 2). In conclusion, it was observed that the accumulation of metals in the *Thymus serpyllum* is influenced by the concentration of metals in the soil, by the presence of organic matter, but also by the antagonistic and competitive effects between the metals. The high content of organic matter (minimum 67% organic content) in the soil leads to the immobilization of metals in the soil and, consequently, a decrease in the bioavailability of metals for transfer and translocation in the plant.

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