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Evaluation of the Selected Soil Enzymes Activity in Soils Contaminated With Risk Elements

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Extended Abstract

Risk elements (RE) have an impact on the enzymatic activity that is involved in chemical processes in the soil. Soil enzymes (SE) play a key role in maintaining soil ecology, physical and chemical properties, soil fertility, and health [1]. For example, SE include β-glucosidase (BGL), acid phosphatase (PACID), and leucine aminopeptidase (LAP), which hydrolyse glucose, organophosphorus compounds, and leucine with other hydrophobic amino acids, respectively [2]. Due to their sensitivity, SE can be a good indicator of the RE toxicity in the soil [3].

This study aimed to compare the enzymatic activity of BGL, PACID, and LAP in soils with different levels of contamination by arsenic (As), cadmium (Cd), lead (Pb), and zinc (Zn). Simultaneously, the influence of individual RE in experimental soils on the activity of the SE was examined.

The pot experiment was created with three soils from different locations of Czech Republic – Suchdol (control; haplic chernozem; pH = 7.5 ± 0.1), Podlesí (low contamination; modal cambisol; pH = 6.0 ± 0.04) and Litavka (high contamination; gley fluvisol; pH = 6.1 ± 0.3). Each variant had six repetitions, and 5 kg of soil was weighed into each pot. In each pot was planted one plant of As hyperaccumulator *Pteris cretica* (L.) 'Albo-lineata'. Soil sampling was carried out after 219 days, along with the harvest of ferns. To determine enzymes, a suspension was prepared by homogenizing 0.2 ± 0.002 g of lyophilized sample and 20 ml of phosphate buffer (pH = 7.0). 200 µl of homogenized suspension was pipetted into the appropriate wells in the microtitre plate, and then 40 µl of a solution of 10 ml of dimethyl sulfoxide and the substrate was added. For BGL, 9.30 mg 4-methylumbelliferyl-β-D-glucopyranoside (c = 2.75 mmol/l), PACID 7.04 mg 4-methylumbelliferyl-phosphate (c = 2.75 mmol/l), and LAP 8.12 mg L-leucine-7-amido-4-methylcoumarin (c = 2.50 mmol/l) were used as substrate. Subsequently, the fluorescence of the substrates was measured using a Tecan Infinite® M200 device after 5 and 120 minutes in an incubator at a temperature of 40 °C. The enzymatic activity was calculated from the difference between the initial and final values.

The measured average values of enzymatic activity (µmol/hour/g soil) of the SE were as follows: PACID (Suchdol: 35.4 ± 4.8; Podlesí: 13.9 ± 2.2; Litavka: 10.6 ± 4.6), BGL (Suchdol: 14.4 ± 4.7; Podlesí: 6.9 ± 1.1; Litavka: 7.4 ± 2.0), and LAP (Suchdol: 12.3 ± 3.3; Podlesí: 9.7 ± 1.4; Litavka: 6.2 ± 0.7). The results proved that in soils with increased contamination was a reduction in the activity of BGL (Podlesí: 52%; Litavka: 49%), PACID (Podlesí: 61%; Litavka: 70%) and LAP (Podlesí: 21%; Litavka: 49%) compared to the control. Podlesí and Litavka had, compared to the Suchdol, a statistically significant decrease of all the examined enzymes. Only LAP showed a statistically significant difference between Podlesí and Litavka. Linear regressions proved a negative effect of Cd, As, Pb, and Zn on the examined SE. The toxicity of individual RE in the soil was as follows: Cd > As > Pb > Zn.

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