



# The influence of heavy metals on the biological activity of sod-podzolic soil

Tatyana Guseva<sup>1</sup>, Yury Mazhaisky<sup>2</sup>.

<sup>1</sup>Federal State Budgetary Educational Institution of Higher Education Ryazan State Medical University n. I.P. Pavlova, Ryazan, Russia

<sup>2</sup>Meshchersky Branch of the All-Russian Scientific Research Institute of Hydraulic Engineering and land reclamation n. A.N. Kostyakova, Ryazan, Russia

## Introduction

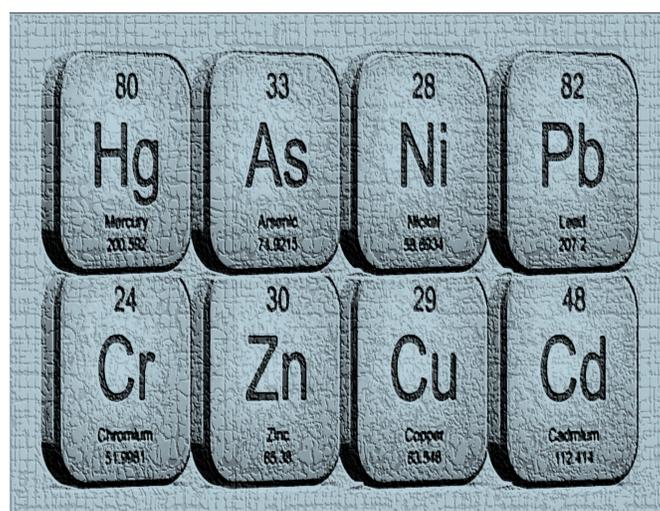
The state of soil in agricultural landscapes requires special attention, since the influence of technogenesis leads to a change in their agrochemical and physical properties, as well as microbiological and biochemical parameters, that deprives the soil cover of the ability to perform ecological functions. The aim of the research was to assess the influence of the level of heavy metal pollution in sod-podzolic soil on the parameters of its phytotoxicity and the activity of soil enzymes. To achieve this goal, the following tasks were solved:- in a model experiment, the phytotoxic effect of heavy metals was evaluated by biometric characteristics;- in the experiment, the accumulating ability of the pea-cereal grass mixture was determined depending on the content of heavy metals in the soil;-the influence of the level of heavy metal contamination of sod-podzolic soil on the activity of soil enzymes is estimated.

## Methodology

The study was conducted on the territory of the Ryazan region (Russia) in a model experiment using vegetative vessels. Sod-podzolic soil and oat-pea mixture were chosen as the objects of research. Heavy metals: copper, zinc, lead and cadmium, selected on the basis of the priority of pollutants in the agricultural landscapes of the Ryazan region, were introduced into the upper soil layer in the form of easily soluble salts in concentrations based on the general pollution index (Zc), in order to cover pollution from acceptable to extremely dangerous. To assess the safety and environmental cleanliness at the end of the experiment, the storage capacity of the pea-grain mixture was determined by atomic absorption spectrometry on a spectrophotometer. In the experiment, the activity of hydrolytic enzymes that form the nutrient regime of the soil was determined: invertases, ureases and phosphatases by standard methods of soil enzymology.

## Results

In the experimental version with the concentration of heavy metals (TM) in the soil within the standard, more intensive growth and development of plants was observed compared to the control. In the variants of the experiment with an increased content of TM, a decrease in the biometric parameters of the oat-bean mixture was observed, which was expressed in the suppression of the growth and production of chlorophyll, a decrease in the turgor of plant tissues. For almost all 4 elements, there was a tendency to increase their content in phytomass as the degree of soil contamination increased, and the concentration of zinc exceeded the phytotoxic one. The combined effect of HMS at their concentrations in the soil exceeding the normative values has a negative effect on the activity of hydrolytic enzymes. Due to the violation of the functioning of the soil microbiome under the influence of pollutants, the activity of enzymes decreased in the variant with a dangerous level of contamination for invertase, urease and phosphatase by 11%, 36% and 16%, respectively, for the variant with an extremely dangerous level, these indicators were already: 22%, 42% and 45%.



## Main conclusions

The studied elements, mainly zinc and copper, act as chemical meliorants for sod-podzolic soil depleted by trace elements, with their content not exceeding the normative values.

The combined effect of heavy metals (Cu, Zn, Pb, Cd) at doses corresponding to a dangerous and extremely dangerous level of contamination is phytotoxic.

The combined effect of TM leads to a synergistic effect, which is expressed in the inhibition of the functioning of the microbiome in sod-podzolic soil and a decrease in the activity of hydrolytic enzymes.