DIFFERENCES IN THE BIOGEOCHEMISTRY OF ANTIMONY AND ARSENIC

Shtangeeva, I.

St. Petersburg University, Universitetskaya nab., 7/9, St. Petersburg, 199034, Russia
E-mail: shtangeeva@gmail.com

The understanding of the mechanisms of uptake of trace elements by different plant species is of critical importance for the environmental ecotoxicology. The toxic effects from metal bioaccumulation may take place even at very low concentration levels. Although there is a great interest in the metal uptake from soil and metal accumulation in different plants, list of the elements that have attracted attention of researchers is rather short.

Arsenic and antimony are similar chemical elements. They are found in trace quantities in various environmental samples. Arsenic is mainly distributed in the environment as an anion (negatively charged ion). This is different from most metals, which form cations (positively charged ions). Antimony is a naturally occurring mineral component. Antimony is considered by some researchers to be more toxic than arsenic [1], but others say it is less toxic [2]. As was recently reported [3], almost nothing is known about the mechanisms of Sb uptake by plants. Moreover, so far the data on the biogeochemistry of As and Sb are quite contradictory.

The aims of the present research were to estimate an ability of cereal crops grown in soil enriched with Sb and As to accumulate these trace elements and evaluate the potential of the plants to remove Sb and As from contaminated soils.

Seedlings of wheat, rye, and oat were grown in soil spiked with either Sb, or As, or Sb+As. Plants and soil were collected several times after planting and then analysed by ICP-MS.

Despite botanical similarity of the crops, their elemental compositions differed significantly. The biggest differences were observed between leaves of the different plant species. Concentrations of many elements in roots were higher than in leaves, thus suggesting that roots serve as a natural barrier preventing transfer of certain metals to upper plant parts.

Growth of seedlings in soil spiked with Sb and/or As influenced the plant development. Oat and rye were more affected by the treatments than wheat. Significant increase of concentrations of Sb and As in the plant roots was registered when the plants were grown in soil enriched with these metalloids. The accumulation of Sb and As in leaves was not so marked. Uptake and translocation of Sb and As were different when the elements were added to soil separately or together. All plants accumulated more As in roots and leaves when it was added to soil as single element. On the other hand, Sb uptake by roots as well as translocation of the element to leaves were more significant when Sb was added to soil together with As. Thus, bioaccumulation of Sb was positively affected by As, while Sb negatively influenced on As uptake.

The significant accumulation of Sb in plants resulted in a decrease of Sb concentration in the rhizosphere soil of wheat, rye, and oat. Meanwhile, the increase of As concentration in plants did not lead to significant decrease of As level in soil.

Although Sb and As are chemical analogues and thus, similar behaviour of the elements in plants could be expected, no correlation between Sb and As in plants and in the rhizosphere soil was found. Therefore, in spite of similar chemical properties, As and Sb demonstrated different biogeochemical behaviour. This indicates that in order to enter biological systems these elements probably form different metalloid-organic compounds.