Mobility of selenium in soil under differentiated fertilization and crop rotation

Mobilność selenu w glebie w warunkach zróżnicowanego nawożenia i zmianowania

Katarzyna Borowska[1], Jan Koper[1], Roman Łyszczarz[2], Anetta Siwik-Ziomek[1]

[1]Department of Soil Science and Soil Protection and Biochemistry, [2]Department of Meadow Plants, University of Technology and Sciences, Bydgoszcz, Poland
e-mail: kborowska@utp.edu.pl

Anthropogenic factors, and including the agricultural activity can lead for enriching the outer level of the soil, both into elements essential to living of life forms, as well as not essential from a point of view of needs of nutritional plants and animals. And there is a need of the evaluation not only total contents of microelements, but also their forms available to plants.

Methods of speciation of the selenium in soils let to obtain information concerning geochemical processes of the selenium, possible mechanisms of reaction its soluble forms and the impact of such factors like the pH and the oxidation state on chemical forms and the mobility of the selenium in the soil environment. Many authors show that the content of the available selenium for plants differs depending on, both bioclimatic and geochemical environmental conditions.

The aim of the research was to estimate the mobility of selenium in soil environment and its availability to plants using sequential spatial dissolution.

The soil samples were gathered from long-term static field experiment conducted by the Department of Plant Nutrition and Soil Cultivation IUNG in the RZD in Grabow on the Vistula river. The experiment was a two-factorial, randomized complete sub-blocks in the system (split-plot) in four replications. First factor was the kind of rotation: rotation systems A "depleting the soil organic matter" (potato – winter wheat – spring barley – corn) and rotation systems B "enriching the soil with organic matter" (potato - winter wheat + intercrop – spring barley with under sown – red clover + grass). Second factor was the fertilization with manure, at one time during the rotation, under the potato in doses of 0, 20, 40, 60 and 80 $t \cdot ha^{-1}$ fresh weight. Soil samples were collected from the layer of 0–20 cm, dried and sieve through 2 mm screen. Total selenium content in soil was determined by Watkinson's method using the Hitachi F-2000 spectrofluoromether. Soil samples were analyzed for Se fractions using the five-step sequential extraction method described by Chao and Sanzolone in modification of Wang and Chen.

Total selenium content in soil from control plots was on the very low level. Fertilizing with manure contributed to the substantial increase of the total content of the selenium in the soil with increasing doses applied, in addition from objects of crop rotation B was stated indeed higher contents of this microelement than from crop rotation A. In soils from both crop rotations the significant correlatin was assayed with total selenium content and the content of organic carbon. Selenium content in the investigated fraction and its share in the total Se content, in the experimental conditions, was as follows: Se complexed with organic matter (SeFIV) > selen complexed with metal oxide (SeFIII) > selenite (SeFII) > selenate(VI) (SeFI) > selenium in residua fraction (SeFV). In the soil under study the dominating fraction, especially under potato and winter wheat cultivation, was Se complexating with organic matter, and its share in the total Se was about 40% and increased with increasing doses of FYM.

The participation of phytoavailable selenium fractions (SeFI i SeFII) in total selenium content was from 28 to 47%, and was the highest in the second year after FYM application.