RADIOLOGICAL ANALYSIS OF SOIL SAMPLES: THE PHYSICOCHEMICAL CHARACTERISTICS OF THE SOIL AND RADIONUCLIDE MIGRATION

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The physical and chemical characteristics of the soil, along with other environmental conditions, affect the migration of radionuclides in the soil and, therefore, their absorption by the plants growing there. In this paper, soil samples from three locations (Aleksinac, Despotovac, and Stara Pazova) were analyzed. The specific activities of ^{137}Cs, ^{40}K, and ^{210}Pb were determined, and the obtained values were discussed and related to the soil's characteristics. At the Aleksinac location, where a temperate continental valley climate prevails, smonica (clay-rich soil with hygroscopic properties) dominates. The Despotovac location is characterized by more acidic soils (cambisol) and a temperate continental-mountainous climate that is cooler and wetter. At the Stara Pazova location, within the Pannonian temperate-continental climate, chernozem (dark, humus-rich soil with neutral to alkaline pH) prevails.

As a result of nuclear accidents, artificial radionuclides (primarily ^{137}Cs) are present in our environment. The ^{137}Cs activity concentrations at Aleksinac and Stara Pazova were (6.1±0.4) Bq/kg and (4.2±0.3) Bq/kg, respectively, while at the third location, Despotovac, the highest concentration was detected (54.2±2.8) Bq/kg. The reason for this may be the soil type (cambisol), which has a lot of silt, and silt has been shown to have the greatest affinity for retaining ^{137}Cs.

For ^{40}K, the measured values at the three locations were: (604±32) Bq/kg for Aleksinac, (733±37) Bq/kg for Despotovac, and (634±33) Bq/kg for Stara Pazova. Soil pH, texture, and moisture strongly influence the availability of potassium, with higher moisture, favorable structure, and organic matter improving mobility, while different soil types show different patterns of potassium supply. In the Aleksinac area, the soil is rich in minerals, and its clayey structure, combined with frequent dry periods, limits the availability of ^{40}K. At the Stara Pazova site, the soil contains abundant humus and potassium. Its alkaline pH reduces ^{40}K uptake, while the recurring summer droughts characteristic of this region further limit the diffusion of potassium ions to the roots.

Along with ^{40}K, ^{210}Pb is a natural radionuclide that originates from the decay of ^{222}Rn in the ^{238}U series and accumulates in the upper soil horizons due to its strong binding to organic matter and fine minerals. The following specific activities of this radionuclide were determined in the analyzed soil samples: Aleksinac - (69.3±5.0) Bq/kg, Despotovac - (41.5±3.1) Bq/kg, and Stara Pazova - (74.3±4.6) Bq/kg. Neutral, clay-rich soils effectively immobilize lead at neutral pH, thereby limiting its mobility towards plant roots. On the other hand, acidic, loose soils increase lead mobility. Based on the above, it can be expected that plants from smonica soil will have the lowest ^{210}Pb uptake, whereas plants from chernozem and cambisol soils will have higher ^{210}Pb accumulation.