Geophysical Research Abstracts
Vol. 20, EGU2018-632, 2018
EGU General Assembly 2018

Assessment of Cs-137 pollution influence on soil phytotoxicity and the radionuclide transfer into oat and salad: model pot experiment

Maria Godyaeva (1), Tatiana Paramonova (1), and Natalia Kuzmenkova (2)

(1) Moscow State University, Faculty of Soil Science, Department of radioecology and ecotoxicology, Moscow, Russian Federation (airrune@yandex.ru), (2) Moscow State University, Faculty of Chemistry, Department of radiochemistry, Moscow, Russian Federation

Complex application of instrumental and biological methods can provide essential information on ecotoxicological consequences of soil radioactive contamination.

To realize the potential of combined use of gamma-spectrometry, autoradiography and phytotoxicical test a model pot experiment with artificially contaminated chernozems, and oat and salad growing as test-crops was conducted. To simulate a case of ^{137}Cs-containing atmospheric fallout CsCl solution with activity 5 MBq/L was deposited on undisturbed Luvic Chernozems in a monthly rate of atmospheric precipitation in post-Chernobyl forest-steppe region (50 mm/month). Final level of soil radioactive contamination comprised 2 kBq/cm^2. Oat (*Avena sativa L.*, typical monocotyledonous) and salad (*Lactuca sativa L.*, typical dicotyledonous) crops were then planted and grown for 16 weeks, by which time oat plants reached vegetative phase of slicing and salad plants entered phase of budding; average shoot height was 46 cm and 26 cm correspondently.

Throughout the vegetation period, the crops did not show any visible signs of depression due to extremely high level of radioactive soil contamination. Moreover, standard test with germination of oat seeds in a series of water extracts from contaminated chernozems (with dilutions from nil to 1:50) showed no phytotoxic effect in comparison with distilled water. Maximal length of the main root of the oat sprout (2.2 cm) was fixed at 1:10 dilution that seemed to be stochastic deviation from the mean value 1.7 cm.

At the same time soil-to-plant transfer of ^{137}Cs during vegetation period was evident for both test-crops. Autoradiography images demonstrated incorporation of the radionuclide into all parts and tissues of the crops without specifying the plant's organ accumulating ^{137}Cs. More detailed gamma-spectrometric investigations of above- and belowground biomass of the plants have revealed definite difference between roots and shoots as well as between test-crops: ^{137}Cs activity varied in a range 8-11 Bq/g for oat leaves and steams, 40-121 Bq/g for oat roots, 33-49 Bq/g for salad leaves and steams, 26-55 Bq/g for salad roots. Average relationship between aggregated transfer factor values of ^{137}Cs (Bq/g in plants / kBq/m^2 in 10-cm topsoil layer) for above- and belowground biomass of oat was 0.018/0.161, and of salad – 0.082/0.081 accordingly. The data prominently supported the fact of ^{137}Cs relative accumulation in roots and a suppressing of its translocation into aerial parts for oat, while intensity of the radionuclide incorporation into salad was uniform.

Taking into account biomass of crops yielded from the model pots (oat – 78 g/m^2, salad – 58 g/m^2) the radionuclide inventories were estimated correspondently as 0.93 kBq/m^2 for oat, and as 2.35 kBq/m^2 for salad. Total value of ^{137}Cs root uptake in salad was $\approx$2.5 times more with translocation about 95% of the engaged radionuclide to aboveground biomass, while the share of translocated ^{137}Cs in oat was not exceeded 75%.

In sum, in conditions of the model pot experiment ^{137}Cs promoted into the biological cycle of elements with slight intensity and in so doing mono- and dicotyledonous crops can use different strategy of adaptation to radioactive soil pollution.