Reducing Transferability of Radionuclides from Soil to Crops

Akira TAKEDA, Yusuke UNNO, Mutsumi YAMAGAMI,
Yuichi TAKAKU, Shun'ichi HISAMATSU
Department of Radioecology

Abstract

Countermeasures for reducing radiocesium transfer from soil to crops have been investigated extensively since the 2011 accident at the Tokyo Electric Power Company's Fukushima Dai-ichi Nuclear Power Station, and their effectivenesses were found to depend on many factors including types of crop and soil. The aim of this study is to establish the countermeasures suitable for reducing radiocesium transfer from soil to grass and its translocation from rice shoot to brown rice. In FY 2019, we investigated: 1) soil factors controlling the radiocesium transfer to grass from soil in the Sanpachi and Tsugaru region, Aomori; 2) the effect of various methods to reduce the transfer for the selected soils in the Shimokita region, Aomori; and 3) the effects of growth regulators, ion transport blockers and chemicals on Cs translocation to brown rice.

Soil-to-grass (*Dactylis glomerata* L.) transfer factor (TF) of ^{137}Cs was obtained by the small-scale short-term cultivation experiment using soils spiked with ^{137}Cs tracer in an artificial climate chamber. Among the regions we have investigated, a relatively higher transfer factor was observed in the Sanpachi region, where K supplying ability and radiocesium interception potential were low.

The reduced abilities of various soil fertilizers and additives were tested by the cultivation method mentioned above for two soils in the Shimokita region selected from the experimental results obtained in FY 2018: both soils had low abilities for supplying K and retaining ^{137}Cs. The effectiveness of the target substances was evaluated from the viewpoint of not only decreasing ^{137}Cs concentration but also increasing K concentration in pasture grass, because too high a K concentration has a harmful effect on bovines. For both soils, K and P fertilizations were effective, from the viewpoint of ^{137}Cs and K concentrations in the grass. In addition, for soil with different organic matter contents, it was found that an organic matter decomposition accelerator possibly decreased the transfer in the short term but accelerated it in the long term.

Rice plants (*Oryza sativa subsp. japonica* Masshigura) were grown in a greenhouse with a culture solution containing 0.01 μM Cs. The effects of spraying the plant with growth regulators, ion transport blocker and chemicals on the brown rice Cs concentration were investigated. When 20 and 40 mg L^{-1} gibberellin, one of the growth regulators studied, was sprayed onto the ears in the ripening stage after flowering of the rice plants, the Cs concentration in brown rice tended to decrease by 10%. When 20 and 50 mM tetraethylammonium chloride (TEA), one of the ion transport blockers studied was sprayed onto the ears in the ripening stage after flowering, the cesium concentration in brown rice tended to decrease but the rice yield also decreased. In addition, when 10 mM calcium was sprayed onto the ears in the ripening stage after flowering, the Cs concentration in brown rice tended to decrease by 15%.

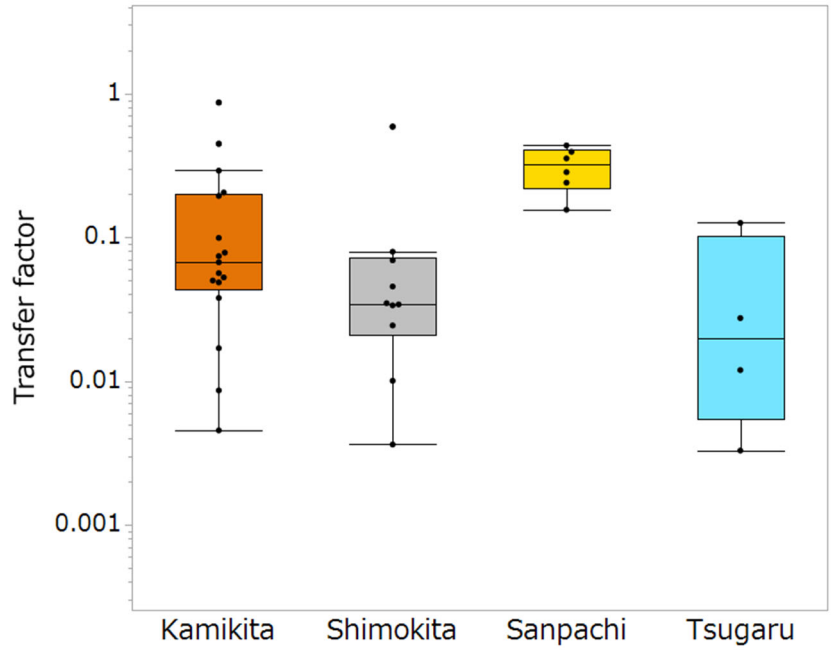

Fig. 1 Box-whisker plot of the soil to-grass transfer factor of ^{137}Cs in four study regions of Aomori Prefecture