

Reducing Transferability of Radionuclides from Soil to Crops

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Abstract

Countermeasures to reduce 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 2020, we investigated: 1) Regional distribution of soil properties affecting the radiocesium transfer to grass from soil in Aomori; 2) the effect of various methods to reduce the transfer for the selected soils in the Sanpachi and Tsugaru regions, Aomori; and 3) the effects of ion transport blockers and chemicals on cesium (Cs) translocation to brown rice.

Radiocesium interception potential and non-exchangeable potassium (K) content, which are the indices of abilities for radiocesium fixation and long-term K supply in soil, respectively, were found to be relatively lower in Sanpachi and Kamikita regions. The reduced abilities of various soil fertilizers and additives were tested by the cultivation method mentioned above for two soil samples in the Sanpachi region selected from the experimental results obtained in FY 2019: both soil samples 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 soil samples, K and phosphorus (P) fertilizations were effective, from the viewpoint of ^{137}Cs and K concentrations in the grass. In addition, for soil with high organic matter contents, we found that an organic matter decomposition accelerator possibly decreased the transfer in the long term.

Rice plants (*Oryza sativa subsp. japonica* 'Masshigura') were grown in a greenhouse with a culture solution containing $0.01\ \mu\text{M}$ Cs. The effects of spraying the plant with ion transport blocker and chemicals on the brown rice Cs concentration were investigated. The concentration of Cs in brown rice was reduced by spraying calcium (Ca) chloride onto the ears in the ripening stage after flowering. In particular, spraying 10- and 20-mM Ca on the ears reduced the Cs concentration in brown rice by approximately 20 to 30%. There was a negative correlation between concentrations of Cs and Ca in brown rice, and the correlation coefficient, r was -0.6. We determined that the combined use of 10-mM Ca and a transpiration inhibitor further reduced the concentration of Cs in brown rice.

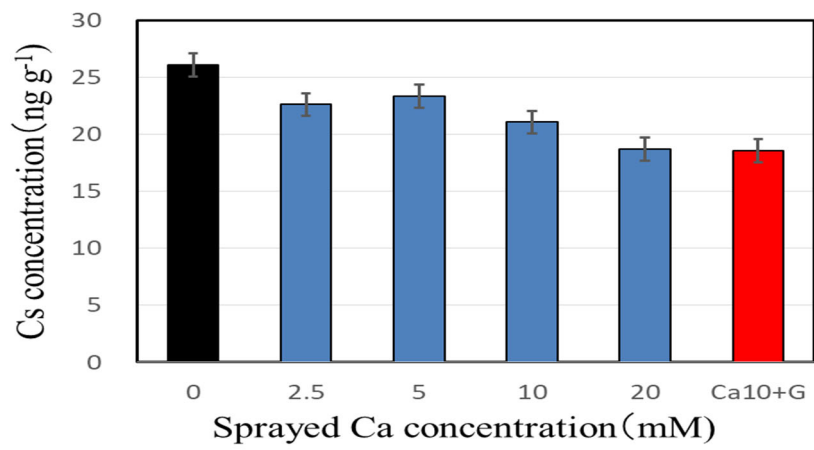


Fig. 1 Effect of calcium spraying on rice ears on cesium concentration in brown rice.
+ G indicates combined use of transpiration inhibitor spraying.