Reducing Transferability of Radionuclides from Soil to Crops

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Abstract

Countermeasures for reducing radiocesium transfer from soil to crops have been investigated extensively after the 2011 accident at the Tokyo Electric Power Company 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 2018, we investigated: 1) soil factors controlling the radiocesium transfer to grass from soil in the Shimokita region, Aomori; 2) the effect of various methods to reduce the transfer for the selected soils in the Kamikita region, Aomori; and 3) the effect of a growth regulators 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. Correlation analysis between the TFs and various soil factors, showed that the K concentration extractable by boiling in 1 M nitric acid was the best independent variable to explain the variation of TFs, suggesting that the K supplying ability in grassland soils in the Shimokita region controls their TFs.

The reducing abilities of various soil fertilizers and additives were tested by the cultivation method mentioned above for two soils in Kamikita region selected from the experimental results in FY 2017: 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 reduction of ^{137}Cs concentration but also increase of K concentration in the grass, because too high K concentration has a harmful effect on bovines. For the first soil, zeolite materials showed the highest effect, which may arise from their abilities of retaining ^{137}Cs and supplying K. For the second soil, K and P fertilization were effective, especially from the viewpoint of K concentration in the grass. In addition, for soil with high organic matter content, it was found that an organic matter decomposition accelerator possibly reduced the transfer.

Two varieties of rice (*Oryza sativa subsp. japonica* Nipponbare and Masshigura) were grown in a greenhouse with a culture solution containing 0.01 μM Cs. The effect of spraying the plant with growth regulators on the brown rice Cs concentration were investigated. When gibberellins (GA) was sprayed to ripening stage ears after flowering of the rice plants, the Cs concentration in brown rice tended to decrease by ~10% for both varieties. In addition, when kinetin was sprayed to the leaves of the late vegetative growth stage, the Cs concentration in brown rice tended to decrease.

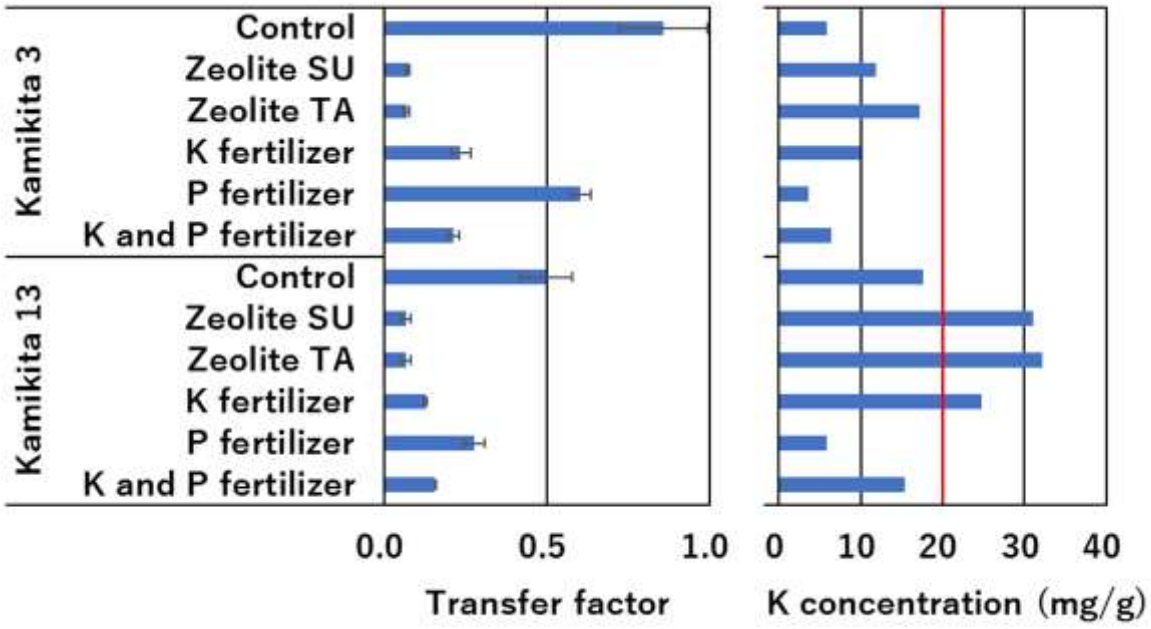

Fig. 1 The effect of various fertilizers and additives for transfer factor of ^{137}Cs in two soil samples from the Kamikita region to grass, and the shoot potassium concentration of grass plant. Red line: Feeding management using grass with K concentration lower than 20 mg/g is recommended for dairy cattle during dry periods.