Difference among crop species by radiocesium absorption from different soil fractions

*Nihei Naoto[1], Yoshimi Ohmae[1], Makoto Furukawa[1], Syuichiro Yoshida[1]

1. The University of Tokyo, Graduate School of Agricultural and Life Sciences

Radioactive cesium (137 Cs) contaminated widely due to Fukushima Daiichi Nuclear Power Plant accident. The presence form of 137 Cs in soil can be divided into a fraction (adsorbed to ion exchange state or organic matter, defined as f 1 fraction) which crops are considered to be easy to absorb and utilize, and the another fraction (strong acid extraction and total decomposition component by hydrofluoric acid, defined as f2 fraction) which crops are considered to be difficult to absorb and utilize.

If we know how much 137 Cs will be absorbed from which soil fraction, we can grasp the Cs absorption characteristics of a crop. However, there has been no research report on a method showing 137 Cs absorption from each soil fraction. In this study, to grasp the soil fraction absorbing 137 Cs of the crop, the transfer factor (defined as TFf 1 and TFf 2) from each soil fraction were investigated by using the naturally occurring stable isotope cesium (133 Cs) . In addition, absorption ratios (defined as λ 1 and λ 2) in crops derived from each soil fraction were calculated.

Soybean, buckwheat and rice were cultivated for 30 days in a pot, and the 133 Cs and 137 Cs concentrations in the aerial part were measured. Contaminated soil (137 Cs approx 22 kBq / kg, 133 Cs approx. 3.4 mg / kg) obtained by topsoil stripping due to decontamination in Fukushima prefecture was used for soil. The soil after cultivation was successively extracted (ammonium acetate extraction, hydrogen peroxide decomposition, nitric acid decomposition, total decomposition by hydrofluoric acid), and the concentrations of 133 Cs and 137 Cs contained in each fraction were measured. In order to simplify the calculation, the soil fraction was set to two fractions of f1 (ammonium acetate extraction, hydrogen peroxide decomposition) and f2 (nitric acid decomposition, total decomposition by hydrofluoric acid). Measurement of 133 Cs was measured by ICP mass spectrometer (Perkin Elmer, Nex ION 350 S), measurement of 137 Cs by NaI scintillation counter (Perkin Elmer, Wizard). Judgment of each soil fraction absorbed by crops was calculated by 133 Cf 1 ×TFf 1 + 133 Cf 2 ×TFf 2 = 133 Ccrops, 137 Cf 1 ×TFf 1 + 137 Cf 2 ×TF f 2 = 137 Ccrops.

Cf1 or Cf2 is the Cs concentration of the soil in f1 or f2 fraction, TFf1 or TFf2 is Cs transfer factor from f1 fraction or f2 fractionation soil to crop, and Ccrop shows Cs concentration of crop.

TFf 1 and TFf 2 were different depending on the crop, soybean had higher absorption from f 2 fraction than buckwheat. Absorption from f1 fraction in 137 Cs of crops was 66% for soybean, 89% for buckwheat, 76% for rice, confirming the difference between crops. Furthermore, the effect of suppressing Cs absorption by potassium fertilization was shown to be different for each crop. By devising and defining these indices, it was possible to grasp the absorption capacity of crops.

Keywords: Radiocesium, soil fraction, soybean

