Long-term Concentrations of Sr-90 and Cs-137 in Rice Seeds as Predicted for Acute Radioactive Deposition

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Body of Abstract: A model for predicting time-dependent radionuclide concentrations in edible parts of crop plants after acute radioactive deposition was made on the basis of our experimental results concerning direct and indirect pathways of the radionuclide transfer to crop plants. The direct pathway comprises the plant interception of deposited radionuclides and subsequent translocation to edible parts. The indirect pathway consists of the root uptake of radionuclides deposited to soil. This model does not include differential equations on which traditional compartment models are based. Using the present model, 50 years' concentrations of Sr-90 and Cs-137 in polished rice seeds were estimated for unit dry deposition on 4 different dates of the year. After the non-growing season deposition, the concentrations of Sr-90 and Cs-137 gradually decreased with time. The Sr-90 concentration was an order of magnitude higher than the Cs-137 concentration in the 1st year, whereas the difference was not significant in the last year. After the growing season deposition, the Cs-137 concentration dropped drastically in the 2nd year and decreased gradually for remaining years. The concentration drop in the 2nd year was much less drastic for Sr-90. In the 1st year, the Cs-137 concentration was 2-3 orders of magnitude higher after the growing season deposition than after the non-growing season deposition, whereas the difference was much less significant for the Sr-90 concentration. The 50-year-integrated concentration was several times higher for Cs-137 than for Sr-90 after the growing-season deposition, whereas it was not much different between Sr-90 and Cs-137 after the non-growing season deposition. Contributions of direct and indirect pathways to the plant concentration were dependent on radionuclide species and date of deposition. The effect of resuspension was estimated to be negligible. For the application of the present method to a wider range of crop plants, experiments on the plant contamination pathway need to be carried out with many other major food crops for different dates of deposition. The use of the present model may be more realistic approach to the concentration prediction for acutely released radionuclides than the use of differential equations because great uncertainties normally exist in transfer rate constants of the equations.