Weathering of Iodine Deposited on Grass Leaf Surfaces

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Abstract

Radionuclides released into the atmosphere are deposited on the leaf surfaces of crop plants, taken up by the plants, and translocated from the leaves to other parts. Some amount of the radionuclides deposited onto the leaves is removed from the surface by the environmental process called weathering, i.e. removal by rain, wind, etc. Although weathering, foliar uptake and translocation are important processes involved in the radiation dose assessment of radionuclides from crops, parameters to describe those processes for ^{129}I, which is an important radionuclide for the safety assessment of the nuclear fuel reprocessing plant in Rokkasho, have not yet been elucidated. Since grasses are cultivated for livestock farming which is one of the important industries in Rokkasho, a research project to determine the behavior of iodine on the surface of grasses was launched in FY 2011. In FY 2012, we studied: 1) the effect of the growth stage of grasses on the foliar uptake and volatilization of iodide deposited on leaf surfaces as dry aerosol; 2) the effect of light intensity on the volatilization of iodide deposited on leaf surfaces as dry aerosol; and 3) the effect of wind on the weathering of iodine deposited on leaf surfaces as dry aerosol, solution or inorganic I vapor (I_2).

After applying a dry aerosol of NaCl containing NaI onto the leaf surfaces of Orchard grass (*Dactylis glomerata* L. var. Akimidori II) at different growth stages, we placed each plant within an acrylic chamber and cultivated them for 7 d in the artificial climate chamber. The plant leaves were periodically collected, and the leaf surfaces were washed with solution containing detergent. The foliar uptake of I was measured by analyzing the plant leaf and the solution samples obtained by washing the surface. The volatilized I from the leaf surface was collected on activated carbon paper filters. The amounts of I on the leaf surface of plants at all growth stages removable by washing decreased with time, while the amount of the volatilized fraction increased. The I content in the plant was almost constant throughout the experiment. The time constant of the I volatilization rate was not affected by the growth stage of the plant.

After applying the dry aerosol of NaCl containing NaI onto the leaf surfaces of the Orchard grass at 32th day after sowing, each plant was placed within an acrylic chamber and cultivated them for 3 d at different light intensities. The volatilized fraction of applied I was almost constant and had no dependence on the examined light intensities.

After applying 1) gaseous I_2, 2) liquid droplets containing NaI or $NaIO_3$, 3) dry aerosol containing NaI or $NaIO_3$, onto the leaf surfaces of Orchard grass, the plants were exposed to a wind with a speed of 2 m s^{-1} for 1 h. These plants were treated after the wind exposure in the same manner as mentioned above. The I contents in the plants applied as various physical and chemical forms were not statistically different from those for the control plants not exposed to the wind. Therefore, the exposure to the 2 m s^{-1} wind for 1 h did not affect the weathering of iodine.

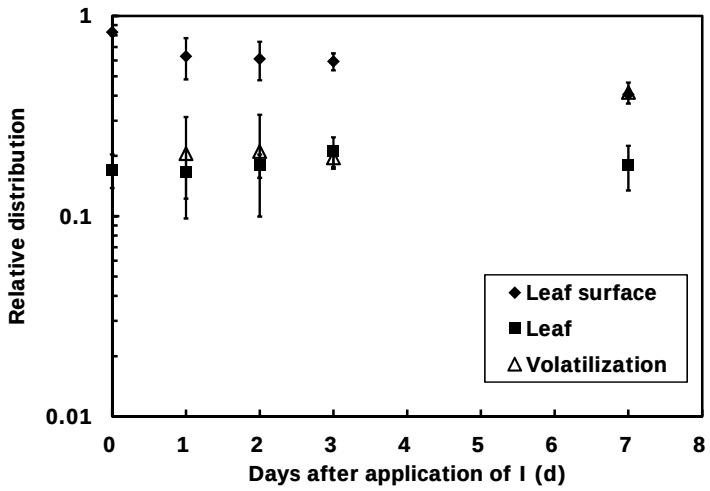

Fig. 1 Relative distribution of iodide applied on the leaf surface of Orchard grass on the 32th day after sowing. Vertical bars indicate standard deviation of three samples.