Transfer of Iodine and Cesium from the Surface of Leaf, Trunk or Fruit to the Interior of Apple Fruit

Hitoshi KAWABATA, Masumi YANAI, Yasuhiro TAKO
Yuichi TAKAKU, Shun'ichi HISAMATSU
Department of Radioecology

Abstract

When radionuclides are released into the atmosphere during nuclear fuel processing, some are deposited on the surfaces of crop plants, followed by absorption and translocation to other parts of the plants. Apples are one of the important agricultural products in Aomori Prefecture, where the first commercial nuclear fuel reprocessing plant is undergoing final construction activities. Since the behavior of radiocesium and radioiodine deposited on apple tree surfaces and their transfer to fruit are not well known, a research project to determine them was launched in FY 2016. In FY 2018, we studied the absorption and translocation of stable Cs applied onto leaf or trunk surfaces. The Cs was applied as liquid droplets or solid particles on these surfaces. Potted 2 year-old Plumleaf crab apple trees (*Malus sp.* cv. ALPS OTOME) were used for our experiment since they are easy to grow and handle.

We cultivated the apple trees in artificial climate chambers and applied droplets of CsCl solution onto the leaf or trunk surfaces of apple trees at early and late fruit development stages, corresponding to 87–92 and 118–119 days after flowering, respectively. Solid aerosols of NaCl containing CsCl were sprayed onto the leaf or trunk surfaces of other apple tree groups before bearing fruit (35 to 43 d after flowering). The whole apple trees were periodically collected after the application and separated into their parts. The Cs-applied leaf and trunk samples were washed with solution containing detergent, followed by analyzing the samples and the washed solution for Cs together with other plant part samples.

The washable proportion of Cs applied as liquid droplets on both of the leaf and trunk surfaces at the early development stage, decreased in two steps, an initial rapid step and a later slow step, while that of Cs applied at the late development stage rapidly decreased but was then followed by fairly constant values without the later slowly decreasing step. Higher summed values of washable and un-washable proportions of Cs remaining until harvest in the applied trunk were found compared to those of Cs in the applied leaf. This showed that the absorption/translocation rate from the leaf surface was higher than that from the trunk surface.

The washable Cs applied as particles on the leaf surfaces before bearing fruit also decreased in two steps, while that on the trunk surfaces decreased in an initial rapid step followed by fairly constant values. The washable proportions of particulate Cs in each applied part, leaf and trunk, were higher than those of dissolved Cs applied as the droplets in the corresponding part (results in FY 2017) throughout the cultivation period until harvest. This demonstrated the absorption rate of particulate Cs from the surfaces was lower than the absorption rate of dissolved Cs. The summed values of washable and un-washable proportions of particulate Cs remaining until harvest in the applied leaf were found to be higher than those of dissolved Cs, implying the absorption/translocation rate of particulate Cs was lower than that of dissolved Cs; however, those proportions of dissolved and particulate Cs in the applied trunk were similar to each other.

Some of the Cs applied on each surface was found in fruits in all experiments, demonstrating absorption from the surfaces and translocation of Cs to fruits.

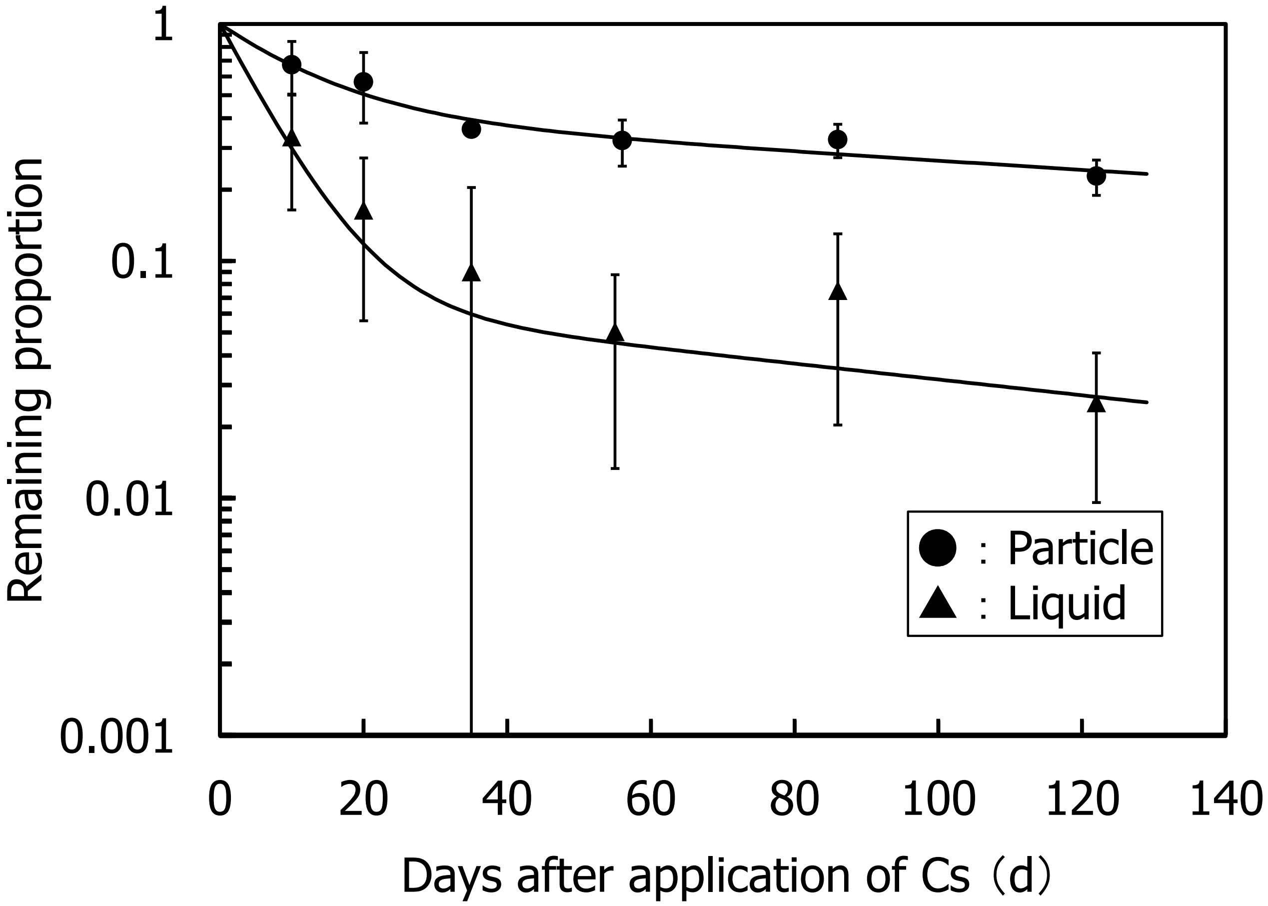

Fig. 1 Change in remaining proportion of Cs after application of Cs. Remaining proportion of Cs was defined as the ratio of the amounts on leaf surfaces to that loaded initially on the leaf surfaces. Vertical bars indicate a standard deviation of 2 or 3 samples. The lines show least square approximation by a function with two exponential terms of days after application of Cs.