## §7. Research on Oxidation Factors of Tritium Gas and Fluctuation Factors of Tritium Level in the Environment

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Tritium is released in the environment from nuclear facilities including reprocessing plants during normal operation or by an accident. A great amount of tritium gas will be used in the future fusion reactors as fuel for DT reaction. Among the chemical forms of tritium released in the environment, tritium gas is less toxic than tritiated water (HTO) but can be oxidized to HTO preferentially by soil microorganisms and HTO makes the most important contribution to dose estimation. Investigations on tritium behavior in plants and soil in the local environment are very limited and required for dose assessment before the start of the operation of a nuclear fusion reactor. However, it is very difficult to conduct tritium release field experiments in this country due to public acceptance problem. Thus heavy water ($D_2O$) vapor release experiments have been carried out in the Mito campus of Ibaraki University using deuterium, a stable isotope of tritium, as a substitute for tritium annually under some different conditions.

In the 1999 $D_2O$ vapor release experiments, two greenhouses, a long rectangular parallelepiped covered with vinyl sheets, were put on a field, one for daytime release and the other for nighttime release. $D_2O$ vapor generated by an ultrasonic humidity supplier with dry air containing $^{13}CO_2$ was introduced into a greenhouse for 8 hours from morning on 22 and from night on 22 in August, respectively. The temperature in the greenhouses was controlled by air conditioner and a shade sheet on the roof.

Main items of research were (1) the measurements of meteorological conditions and the distribution of air $D_2O$ and $^{13}CO_2$ concentration in the greenhouses, (2) $D_2O$ transfer during daytime and nighttime into various kinds of potted plants and plants grown in the greenhouses and their reduction, (3) organically bound deuterium (OBD) formation in plants.

The following results were obtained.

(1) No significant differences in air $D_2O$ concentration at various heights in the greenhouses were observed. Almost constant conditions including temperature and humidity were kept during release (Y. Ichimasa, Okai, Amano, Ando, Sakuma).

(2) Rate constants of $D_2O$ uptake in leaves of rice plant (yumehitachi) and soybean in the daytime release were 4-5 times higher than those in the nighttime release but in potato leaves, about 2 times. The ratios of $D_2O$ concentration in free water in plant leaves to that in air moisture were 0.5-0.6 in the daytime release. OBD contents in unhulled rice and soybean were increased for 4-5 days after $D_2O$ release and the decreased to about one third at their harvest (M. Ichimasa).

(3) $D_2O$ concentrations in free water in leaves of ponkan orange and passion fruits were almost same whereas OBD concentration in a fruit of passion fruits was 2-6 times higher than that of ponkan fruit. OBD content in a fruit of passion fruits was at first very low and then continuously increased after the end of $D_2O$ exposure due to transfer from leaves (Y. Ichimasa).

(4) OBD concentrations of rice (koshihikari) leaves, rice ear, tomato leaves, tomato fruit, leaves of perilla, aloe and parsley after 8 hour exposure were 0.2-0.6% of $D_2O$ concentration in air moisture and the highest were those of rice ear and perilla leaf. The ratio of OBD content in plant samples in daytime release to that in nighttime release was highest in tomato fruit (Ando, Amano).

(5) $D_2O$ uptake rate in leaves of herbaceous plants, corn and hikagenokozuchi, was faster than that to leaves of a tree, kaizukaibuki. The uptake rate in the nighttime was different from each herbaceous plant and that in leaves of hikagenokozuchi was about twice that in corn leaf (Momoshima).