## §18. Investigation on Environmental Behavior of Organically Bound Tritium

Momoshima, N., Sugihara, S., Ichikawa, R., Maekawa, A. (Kyushu Univ.), Takahashi, T., Fukutani, T. (Kyoto Univ.), Tamari, T. (Kyushu Environ. Evaluation Assoc.), Miyamoto, K. (NIRS), Yokoyama, S. (Fujita Health Univ.), Ando, M. (JAEA), Kakiuchi, H. (IES), Tanaka, M.

Tritium in plant is found as OBT (Organically Bound Tritium) and FWT (Free Water Tritium). The OBT which are produced by photosynthesis plays a key role in radiation exposure to human through food chain. The OBT is produced by tritium supplied from atmospheric water vapor and from soil water because leaf water contamination occurs by both waters. If atmospheric water vapor contains tritium, it would enter intercellular space of leaf through stoma and permeate into plant cells through cell membrane where photosynthesis is undergoing. The tritium moves depending on tritium concentration gradient between intercellular space and cell though water flux is always from leaf to atmosphere. If soil water contains tritium, it moves to leaf as conducting water and is released to the intercellular space followed by atmosphere. Chloroplast in plant cell usually occupies a position close to cell membrane which makes easy and effective access to $CO_2$ permeating from intercellular space to cell through cell membrane. The FWT concentration is evaluated from analysis of whole leaf water; therefore water using by chloroplast for photosynthesis would have different tritium concentration from FWT because tritium composition of cell water close to cell membrane always vary depending on hydrogen isotopic concentration gradient.

We investigated OBT formation at two different tritium contamination conditions and compared OBT/FWT. We used $D_2O$ for cultivation of plant. The soil contamination condition was modified by hydroculture of peppermint (*Mentha piperita*) in a conical beaker using $D_2O$ containing culture solution. Evaporation and exchange of the culture solution with ambient water vapor was avoided by sealing the mouse of the conical beaker and the plants were grown in open air. The contamination by atmospheric water vapor was modified using a culture system shown in Fig. 1.

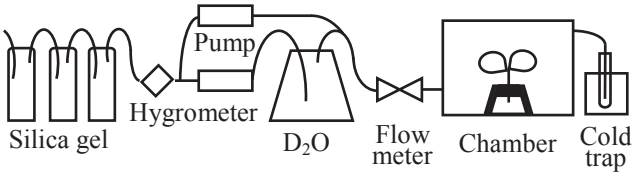


Fig. 1 Culture system for $D_2O$ vapor exposure

Dehydrated air with silica gel was passed in $D_2O$ solution and introduced to the chamber in which hydroculture of peppermint in a conical beaker without $D_2O$ containing culture solution was placed. The culture was carried out for 28 days. Leaf water was recovered by heating the leaf with a microwave oven and FWD concentrations in leaf water and in the culture solution and atmospheric water vapor were determined by gas chromatography. The OBT concentrations were determined by mass spectrometry using water obtained by combustion of dried leaf samples.

The number of leaf became about twice at the end of cultivation. The $D_2O$ concentration of the $D_2O$ containing culture solution was stable during the cultivation, 28780 ± 90 ppm, while on the $D_2O$ vapor exposure the $D_2O$ recovered at the cold trap had larger variation 12270 ± 4360 ppm due to difficulty in controlling humidity in the chamber. We used two pumps and regulated the flow rate of introduction of $D_2O$ vapor to the chamber to prevent condensation of water vapor on the leaf surface at night.

The OBD/FWD of leaf and stem observed is shown in Fig. 2. The OBD/FWD exceeded one for the $D_2O$ vapor exposure while less than one for the cultivation by $D_2O$ solution. The OBD formed by photosynthesis was obviously different from the FWD that is the average of deuterium concentration of leaf water. The tendency of OBD/FWD value is quite reasonable and explains the contamination situation; in case of atmospheric contamination $D_2O$ distribution in chloroplast would be much higher than leaf water due to closer position of chloroplast to intercellular space and in case of soil water contamination $D_2O$ in chloroplast would be diluted with water vapor without $D_2O$ in intercellular space at lager extent than leaf water. The OBD/FWD in the stem supports the above explanation because the stem showed lower value than that of leaf in the $D_2O$ vapor exposure and higher in the $D_2O$ culture experiment. The present results indicate that contamination situation is important in OBT formation in plants.

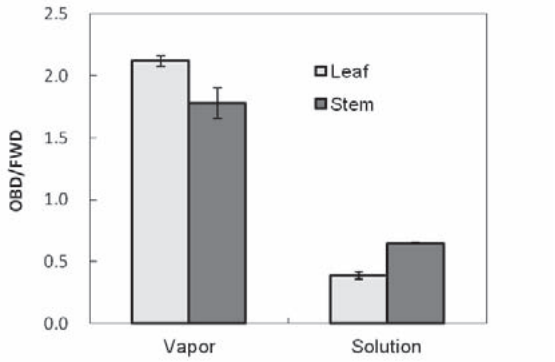


Fig. 2 OBD/FWD ratio of leaf and stem exposed to $D_2O$ water vapor or culture in $D_2O$ solution