§18. LHD Project and Estimation of Biological Effects of Tritium

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An extremely great amount of tritium will be used in the future nuclear fusion reactors as fuel for DT reaction. Investigations on tritium behavior in the crops in the local environment are now required for dose assessment purpose. Thus heavy water (D_2O) vapor release experiments in a greenhouse have been carried out in the Mito campus of Ibaraki University using deuterium as a substitute for tritium. Two greenhouses were set up separately in the Mito campus of Ibaraki University, one for daytime release experiment (8:00 – 16:00) and the other for the nighttime release (20:00 – 4:00). D2O vapor generated by an ultrasonic humidity supplier was introduced into a greenhouse for 8 hours. The temperature in a greenhouses was controlled. Rice plants grown in flooded pots, potted tangerine, soybean and sweet potato were used.

Kinetics of D_2O uptake and loss in leaves of tangerine, soybean, sweet potato, Chinese cabbage, and rice plants, and the steady state concentration ratios of D_2O in free water of leaves and fruits to air moisture were determined. Concentration of organically bound deuterium in leaves, rice grains, pea and fruits were also determined. In order to investigate the changes of these parameters under different growth phases, several times of daytime and nighttime D_2O release experiments were conducted during the growing period of rice grain, soybean pea and tangerine fruit and up to the harvest time, that is, in July, August, September and December (for tangerine fruit).

In the case of tangerine, kinetic parameters of D_2O uptake and loss in free water in leaves of tangerine were very low in both daytime and nighttime release experiment conducted in December, about one fifth and one seventh those in summer time release experiments, respectively. The steady state concentration ratios of D_2O in free water of leaves to air moisture were affected by the relative humidity in air. Under low relative humidity, D_2O transfer rate in leaves in daytime release was low and almost similar to that in nighttime release provably due to closed stomata in daytime. Deuterium transfer in a tangerine fruit depended on its growth phase in the form of tissue free water and organically bound form. Organically bound deuterium concentration in fruit was increased during one week after D2O release, and then the concentration decreased at a very slow speed. In the cases of rice and sweet potato, 5 times of daytime release of, D_2O and 4 times of nighttime release were carried out from July to September. , D_2O transfer rates in leaves of rice plant and sweet potato in daytime release were higher than that in nighttime release and both loss rates in daytime release were 2-3 times higher than those in nighttime release.

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