

Transfer of ^{14}C in rice plants directly exposed at different growth stages

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1. Introduction

If radionuclides are released into the atmosphere during the growing seasons of crop plants, direct contamination of the above-ground plant parts will generally contribute much more to radiation doses to man than will root uptake[1,2,3]. At the time of such a release, therefore, it is very important to be able to estimate the radiation dose due to direct plant contamination as reliably as possible. Accordingly, radionuclide transfer data concerning direct plant contamination need to be obtained for various food crops through properly designed experiments. This is applied equally from agriculture system. It is important that establish scenario and calculate exposure dose that human can deliver through food or breath. It is need to path analysis through crops specially to calculate exposure dose for imagination scenario of nuclear accident. Transfer phenomena of nuclide for crops are various kinds with root uptake, airborne deposition, transpiration, translocation etc. Modeling for these transfer phenomena can be founded through experimental data that use suitable nuclide and plant. This study conducted to produce data concerning the direct contamination pathway through exposure experiments of ^{14}C in which rice at different growth stages were exposed to ^{14}C . On the basis of the experimental results, radionuclide concentrations in mature rice seeds was estimated for unit deposition of the radionuclide at different growth stages..

2. Methods and Results

Rice plant was choose and grew as target of ^{14}C exposure in main cultivation flora in Korea. Rice was cultivated in culture box on similar condition to agricultural practice. The culture boxes, installed in trenches, were 30 cm wide, 40 cm long and 50 cm high. The bottom 5 cm of the box was filled with small broken stones and the rest was filled with a field soil.. Seedlings of the rice cultivar Dongjin-byeo were transplanted on May 20, 2006. The exposure box manufactured to achieve exposure experiment of ^{14}C for culturing rice. To measure transfer phenomena of ^{14}C from air into rice, the exposure box was composed with acryl of 90 cm wide, 90 cm long and 130 cm high. The exposure box was showed in figure 1. Exposure experiment was carried out over 5th achieve using experiment device as shown figure 1. ^{14}C applications

for rice plants were performed on August 4, August 17, August 31, September 20 and October 10. $^{14}\text{CO}_2$ gas formed by reacting with liquid $\text{Na}_2^{14}\text{CO}_3$ and hydrochloric acid solution was supplied into the exposure box for density preservation of ^{14}C in the air. Temperature, humidity and solar intensity in the exposure box were measured necessary to calculation of

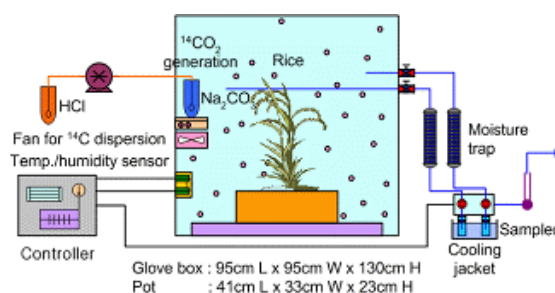


Figure 1. Schematic diagram of ^{14}C exposure apparatus on the rice plants.

^{14}C concentration in the air during the exposure experiment. Occurrence of $^{14}\text{CO}_2$ was kept during 20 minutes in the exposure box. The exposure time was continued for 40 minutes including the occurrence time of $^{14}\text{CO}_2$. Two CO_2 capture lines were established on the exposure box for the density measurement of ^{14}C in the exposure box and CO_2 was captured alternately each 5 minutes to 20ml vial by 0.3 ℓ/min flow rate. Vials used for capturing of $^{14}\text{CO}_2$ were prepared with Carbo-sorb and Permafluor put by each 10 ml beforehand in cooling state. Captured samples were analyzed using liquid scintillation counter(Winspectral 1414, Wallac). A time that achieve exposure experiment of ^{14}C was divided particularly growth in stages. The growth stages were just before be in the ear, just after be in the ear, the first stage in ripening, the former term in ripen yellow, the latter term in ripen yellow. $^{14}\text{CO}_2$ formed in the exposure box was prepared from $\text{Na}_2^{14}\text{CO}_3$ raw material solution in $1.85 \times 10^7 \text{Bq}$. ^{14}C concentration in the exposure box was increased until early 30 minutes and was kept or decreased a little during the exposure experiment. After elapsed 40 minutes of the exposure experiment process, the blowing was enforced. It confirmed that decrease of ^{14}C concentration in the exposure box was accelerated. ^{14}C concentration of air during the exposure experiment of ^{14}C on rice plants was expressed in figure 2. Samplings of plants were enforced just after the exposure experiment of ^{14}C and at harvest. After second exposure experiment, each

sampling of plants was added after 1 day, 5 days, 15

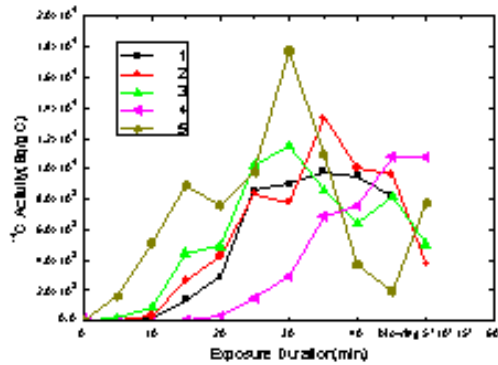


Figure 2. ^{14}C concentration of air in the exposure box during the exposure experiment of ^{14}C on the rice plants.

days. Whole straw was carried out sampling before ear of rice creation. After ear creation, straw and ear of plant were divided. After ear ripens, the rice samples were air-dried in the greenhouse for more than 3 weeks and then divided into straw, chaff and hulled seed. ^{14}C in rice was recovered using the sample oxidizer (Canberra-Packard, 306) and ^{14}C concentration was analyzed using liquid scintillation counter. ^{14}C concentration in elapsed time different grain of rice after the second exposure of ^{14}C was shown in figure 3. After show the highest concentration of ^{14}C in hulled rice seeds at 1 day elapse after exposure of ^{14}C , looked tendency decreasing slowly until harvesting time.

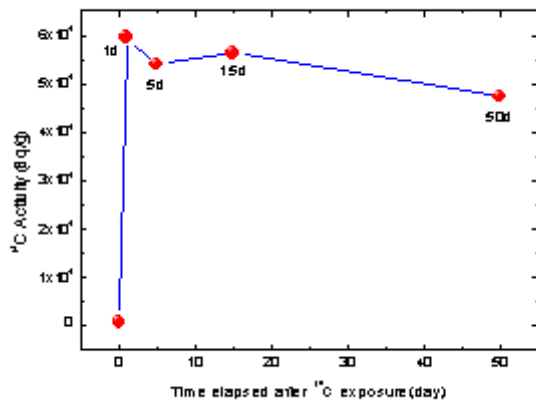


Figure 3. ^{14}C concentration in elapsed time grain of rice after the second exposure of ^{14}C .

3. Conclusion

The exposure box manufactured to achieve exposure experiment of ^{14}C for culturing rice. Exposure experiment was carried out using the exposure box for

40 minutes. Occurrence of $^{14}\text{CO}_2$ was kept during 20 minutes in the exposure box. ^{14}C concentration in the exposure box was increased until early 30 minutes and was kept or decreased a little during the exposure experiment. After second exposure experiment, each sampling of plants was added after 1 day, 5 day, 15 day. After show the highest concentration of ^{14}C in hulled rice seeds at 1 day elapse after exposure of ^{14}C , looked tendency decreasing slowly until harvesting time.

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