Preliminary investigations to assess the usefulness of Be-7 as a radiotracer in soil covered by vegetation

Andra-Rada Iurian[1,2,], Gerd Dercon[2], Joseph Adu-Gyamfi[2], Lionel Mabit[2], Gyula Kis-Benedek[3], Alessia Ceccatelli[3], Sandor Tarjan[3] and William Blake[4]*

[1]*Faculty of Environmental Science and Engineering, Babes-Bolyai University, Cluj-Napoca, Romania*
[2]*Soil and Water Management & Crop Nutrition Laboratory, Joint FAO/IAEA Division for Nuclear Techniques in Food and Agriculture, Seibersdorf, Austria*
[3]*Terrestrial Environment Laboratory, IAEA Environment Laboratories, Department of Nuclear Sciences and Applications, International Atomic Energy Agency, Seibersdorf, Austria*
[4]*School of Geography, University of Plymouth, Plymouth, UK*
[*]*Current address: Terrestrial Environment Laboratory, IAEA Environment Laboratories, Department of Nuclear Sciences and Applications, International Atomic Energy Agency, Seibersdorf, Austria*

Different factors may affect the extent of radionuclides' interception by plants and therewith their inventories in soil covered areas. In particular, there is interest in assessing the impact of the vegetation factor for different soil coverage conditions, when using ^{7}Be as radiotracer of soil redistribution in cropped farmland.

Common beans at the early growing stage were selected to conduct this experimental study in the Soil and Water Management & Crop Nutrition Laboratory in close collaboration with the Terrestrial Environmental Laboratory, as these plants are known to provide a large foliar surface in a relatively short time. ^{7}Be activity concentration was determined using high resolution gamma-ray spectrometry. A relatively high ^{7}Be interception factor (normalized to the leaf area index-LAI) of 0.62 (LAI value 0.85) was determined after 0.4 mm precipitation. After a second 7.2 mm rainfall, the interception factor had a value of 0.37, for a 3.0 LAI value. Wash-off experiments with deionized water determined several hours and 10 days after the wet foliar interception showed that the released ^{7}Be fraction was limited to only 35% of the initial concentration of leaf deposit. ^{7}Be incremental depth profiles confirmed that the radionuclide reached only the upper 20 mm of the soil, independently of precipitation amount or soil coverage, having a maximum in the first 2.5 mm layer. Moreover, ^{7}Be was not found in plant roots, thus excluding its direct uptake from soil.

Our results suggest that ^{7}Be foliar interception of bean plants is likely to affect the radionuclide inventories and their spatial uniformity in covered soil. Reliable results on short-term erosion using ^{7}Be can be obtained in cropped farmland with limited cover, but only when taking into account the interception factor. The impact of the interception factor is highly dependent on rainfall intensity and duration, crop species and the growing stage of the plants. Further investigations into these variables are required.

Update on ^{13}C-labelling of plant materials through the use of walk-in growth chambers

Leo Mayr, Christian Resch, Georg Weltin and Gerd Dercon

In 2013, the Soil and Water Management & Crop Nutrition Laboratory installed a pair of walk-in growth chambers with an effective volume of about 12 m^3 each (Figure 1). These growth chambers with temperature, relative humidity and carbon dioxide (CO_2) control, are being used within the framework of research activities for improving climate-smart agriculture in Member States.

Fig. 1. Walk-in growth chambers

In the first phase, the growth chambers were sealed to minimize CO_2 losses and more important losses of ^{13}C labelled CO_2. Such $^{13}CO_2$ is currently being used in the labelling of plant materials for incubation experiments, to better understand soil organic carbon dynamics under a changing climate.

Leakage rates were measured by filling the chambers with elevated levels of CO_2 (about 300 ppm) and monitoring the decline of the CO_2 concentration over time. Leakage rates were calculated from the decay constant of the exponential decay curve of the CO_2 concentration (Figure 2). The delivered growth chambers were originally found to have a leakage rate of about 25% per day. The feed through of the CO_2 supply and the cooling tubes were identified as the major source of leaking. Sealing these leaks with silicone reduced the leakage rate to less than 5% per day.