Cadmium (Cd) is one of the most serious pollutants for soil and foods. The aim of this study is to elucidate the dynamics of Cd absorption, transport and accumulation in a rice plant body, using the positron-emitting tracer imaging system (PETIS) and radioactive Cd tracer. PETIS is a planar-type imaging system specially designed for plant researches, which non-invasively captures serial images of distribution of a positron-emitting radioactive tracer within an intact plant body (Fujimaki, 2007).

Rice plants (*Oryza sativa* L. cv. Nipponbare) at vegetative and grain-filling stages were applied. A positron-emitting radioisotope ^{107}Cd (half-life: 6.5 hr) was produced by bombarding a natural silver foil with an energetic proton beam delivered from a cyclotron. ^{107}Cd in the irradiated target was chemically purified and dissolved in an appropriate volume of water for the subsequent plant experiments. The test plants were placed at the mid-plane between the opposing detector heads of the PETIS apparatus. All the settings were installed in a growth chamber, and the conditions were controlled to 30°C, 65% relative humidity and continuous light. The imaging with PETIS was performed for 24-36 hr after feeding of ^{107}Cd tracer into the hydroponic culture. We developed and applied an automatic system for keeping the surface level of the culture solution during the imaging and for monitoring water uptake and ^{107}Cd absorption by the test plants.

As a result, serial images of Cd transport inside living rice individuals and absorption curves of Cd from the culture were obtained. The rates of Cd absorption by the roots were proportional to the Cd concentration below 100 nmol L^{-1} in the culture solution. In the plants at vegetative stage, approximately 10% of Cd which was absorbed by the roots accumulated in the basal region of shoot after a time lag of 1 hour. This region, which contains many nodes and unelongated internodes, was the dominant site of Cd accumulation in the shoot. A part of Cd moved from this region into crown roots, probably via phloem. In the plants at grain-filling stage, Cd accumulated strongly in the nodes in the culm, increasingly in the grains but hardly in the leaf sheaths and blades in the first 36 hours. It is considered that Cd undergoes xylem-to-phloem transfer on the route from the soil to the grain (Tanaka *et al.*, 2007). Our study suggests that the nodes are the likely organ where the transfer takes place and this mechanism enables Cd to enter the grains without passing through the leaves at grain-filling stage.

References

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