Measurement of elements in plants by in-air PIXE —Concentrations of elements in leaves of cadmium-toxic sorghum and manganese deficient soybean—

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Abstract

We measured the concentrations of leaves of sorghum (*Sorghum bicolor* cv. Sudax) and soybean (*Glycine max* cv. Yukine) by using In-air PIXE. In the experiment with sorghum, the following treatments for the plant growth were conducted with hydroponical media of half strength of Hoagland and Arnon No.2 medium; 1. Normal (0.25 μM Mn), 2. normal Mn + Cd toxic (0.25 μM Mn, 2 μM Cd), 3. excess Mn + Cd toxic (12.5 μM Mn, 2 μM Cd). Sorghum was grown in the growth chamber with the regime 14 hours day 17 degree C and 10 hours night 10 degree C. Plants were treated with Cd for 3 weeks and applied to in-air PIXE analysis. Soybean was also grown in green house. Soybean was germinated in perlite in the seed box. When the 2nd leaves were developed, the seedlings were transferred to the pot filled with Hoagland and Arnon No.2 medium with or without Mn. The plants were grown for 2 weeks and applied to in-air PIXE analysis. The concentration of Mn was higher in the order lower leaves> middle leaves> upper leaves in Normal and Normal Mn+Cd toxic treatment. It was higher in the order middle leaves> lower leaves> upper leaves in excess Mn + Cd toxic treatment. Necrotic leaves showed higher Mn concentration. In soybean, the concentrations of Mn, Zn and Cu were higher in upper leaves than that of lower leaves. The concentration of Cl in soybean was higher in lower leaves but data of upper leaves of Cl concentration was not obtained.

The most advantageous feature of in-air PIXE is that elements in intact plant tissues can be measured without analytical pre-treatments. In these experiments, the biological data similar to known information in the past were obtained. But the data about Cl needed to be more examined in the future. The 1st experiment by using sorghum was conducted to investigate the Cd toxicity in plants. Measurement of Cd concentration in the plant, however, was not possible. Development of methodology is needed for the measurement of Cd. The analysis gave us reliable data of the concentrations of the elements such as Mn, Cl, Fe, P, S, K, and Ca. The data of Zn, however, was not always obtained. One of the features of in-air PIXE was the fact that measurement of anions, such

as P, Cl, S, and cations could be obtained simultaneously. The method of in-air PIXE is considered to be valuable for the investigation and needs to be more developed for scientific analysis in the future. At present, there is a restriction in the species of measurable elements. Experiments need to be conducted taking the restriction of elements into account. If experiments with in-air PIXE will be conducted considering the species of applicable elements to the method and focusing on the specific elements, valuable data in plant bio-science will be obtained.