Part 2
Elements in a Plant

When we consider the fundamental activity of plants, many questions remain: do we know the plant itself well? Plants require 17 elements. Do we know how the elements move or how the profile of the element change during the long-term of the developmental stage when the plant is growing under normal conditions, that is, how most plants live? When we regard the plant as an integrated system to let the elements work in the most efficient way, there must be some regulations even within the same tissue. Elements move according to the requirements of each tissue, since the age of each tissue within a plant is different, i.e. the plant consists of tissues at various stages, from meristem to senescent. In each tissue, the element concentrations or requirements are always changing. In mammalian tissue, for example, there are not such drastic changes in element concentration among different muscles as in plant tissues, because the growth stage of all the muscle tissue is about the same. The different concentrations of the elements in different tissues within the plant must reflect the plant-specific activities of life. An approach to determining the barriers or gradients of the element profiles or movement must be developed to understand the sophisticated regulation in a living plant.

An element absorbed by the root is transferred through the xylem and redistributed by the phloem with photosynthate, where the sieve tube is considered to regulate the element flow into tissues. However, the mechanism for the selective transport of chemicals in general is unclear. Additionally, the element flow varies with respect to the growth stage, especially at the flowering and fruit ripening stages. Since there is no well understood systematic approach to determine the kinetics of the element concentrations throughout the life cycle of a plant, to obtain fundamental knowledge of element profiles, neutron activation analysis was employed to measure the concentration of multiple elements in every tissue of the plant in detail throughout all developmental stages, from germination to seed ripening.

The advantage of neutron activation analysis to determine the elements in plant tissue is that this method provides the absolute amount of the elements. There is no other method to determine the absolute amounts of elements for two reasons. One is that neutron activation analysis can be performed nondestructively. Other sensitive analytical methods, such as inductively coupled plasma spectroscopy (ICP) and atomic absorption spectroscopy, require the sample to be prepared as a solution. That is, the sample must be dissolved in chemicals. However, even in highly purified reagents, trace amounts of other elements are present as contaminants, and this contamination from the reagent cannot be prevented. The second is that there is no way to measure how much of the sample is dissolved or what amounts of trace elements remain as a residue in solution, affecting the yield. In nondestructive analysis, there is no need to estimate how much of the sample remained undissolved.