Mechanisms of zinc redistribution from roots to shoots at zinc deficiency

Food deficient in zinc (Zn) is one of the nutritional problems in the present world. This is among others, due to its low bioavailability in soil, consequently, the insufficient content in plant derived food. Plant parts consumed by humans should contain the optimal amounts of this trace element. A significant amount of food eaten by humans comes from the aerial parts of plants. For this reason, understanding the mechanisms underlying root-to-shoot Zn transport may result in the future in improved mineral composition of consumed plant parts.

Most described so far studies on the molecular basis of root-to-shoot Zn transport regulation have been carried out on whole roots or on apical parts. However, our latest research suggests that the apical, middle and basal part of the root (differing in age and anatomical structure) play unique and distinct roles in the regulation of this process. Based on our preliminary study, in this project the following hypothesis was forwarded: a decrease in the Zn content in the medium induces processes leading to the redistribution of the pool of Zn accumulated in the middle part of a root to the shoot in order to provide the appropriate concentration of this microelement for the proper development of aerial parts.

The aim of this project is to verify the presented hypothesis by: (a) determining changes in the level of Zn accumulation in shoot and apical, middle and basal part of the roots of plants growing in optimal and Zn deficiency conditions, (b) identifying of genes that show increased expression in roots under Zn deficiency conditions which potentially participate in the redistribution of Zn from roots to shoots; (c) cloning of three genes with a potential role in the root-to-shoot Zn redistribution; (d) determining the subcellular localization and substrate specificity of proteins encoded by three cloned genes; (e) studying tissue-specific expression of one gene chosen from three (examined as described in points c-d) which encodes a protein with confirmed Zn transport activity; (f) generating plants with mutation in the gene selected and characterized as described in point f; (g) phenotypic analysis of the obtained mutants in order to recognize the function of the selected one gene at the whole plant level in the root-to-shoot Zn redistribution under Zn deficiency. The research proposed in this project will significantly broaden the knowledge on the processes underlying the root-to-shoot distribution at Zn deficiency condition by demonstrating mechanisms not taken into account so far.