【Grant-in-Aid for Specially Promoted Research】

Biological Sciences

Title of Project： Integrated analysis of mineral transport system in crops

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Research Project Number：16H06296　Researcher Number：80260389
Research Area：Plant Nutritional Physiology
Keyword：mineral element, transporter, crystal structure, modelling, crop

【Purpose and Background of the Research】

Fourteen mineral elements in soil required for plant growth are taken up by the roots, translocated to the shoots and then distributed or redistributed to different organs according to their demands. On the other hands, many toxic mineral elements will also be taken up, which affect human health through food chain. Therefore understanding of mineral element transport system from soil to seeds is a very important topic for both crop productivity and safety. The purpose of this research is to isolate genes involved in uptake, translocation, distribution and redistribution of mineral elements in crops (mainly in rice and buckwheat), to reveal their physiological roles, functions and structures and finally to develop mathematical models for mineral transport systems for comprehensive and integrated understanding of mineral transport in crops.

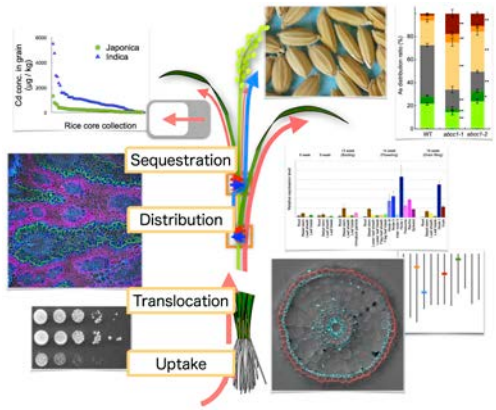

Fig. 1 Transport processes of mineral elements from soil to seed.

【Research Methods】

Various approaches including physiological, genetic, molecular biological, biochemical, structural and mathematic modelling methods will be applied in this research. We will use genotypic difference in mineral accumulation and mutants to identify transporter genes involved in transport of mineral elements. We will functionally characterize these transporters in terms of expression pattern, tissue/cellular and subcellular localization, transport activity, etc. We will also investigate the regulating mechanisms of transporter genes/proteins. Furthermore, we will express the genes identified in this project in cultured cell for crystallization and X-ray structural analysis. Finally, based on the experimental data, we will develop mathematical models for various mineral transport systems.

【Expected Research Achievements and Scientific Significance】

Nutrient requirements and mineral stress tolerance greatly differ with plant species. This project focuses on crops (mainly rice and buckwheat), which may have different mineral transport systems from model plants. This project will have a deep impact on better understanding of mineral transport system in crops. The outputs from this project will contribute to breeding high nutrient-use efficient and toxic metal free crops.

【Publications Relevant to the Project】

・Yamaji, N., Sakurai, G., Mitani-Ueno, N. and Ma, J. F. 2015. Orchestration of three transporters and distinct vascular structures in node for intervascular transfer of silicon in rice. Proc Natl Acad Sci USA 112:11401-11406
・Clemens, S. and Ma, J. F. 2016. Toxic Heavy Metal and Metalloid Accumulation in Crop Plants and Foods. Annu. Rev. Plant Biol. 67: 489–512

【Term of Project】FY2016-2020

【Budget Allocation】412, 500 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.rib.okayama-u.ac.jp/plant.stress/index.html