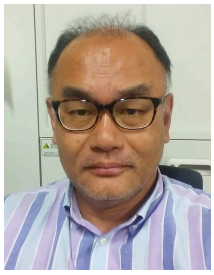
【Grant-in-Aid for Scientific Research (S)】

Broad Section F



Title of Project： Study on the mechanism of nutrient recognition and coordination of nutrient response in plants

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Research Project Number：19H05637　Researcher Number：80242163
Keywords：ribosome, plasma membrane, cell wall, mineral nutrients, growth analysis, modeling

【Purpose and Background of the Research】

Historically, fertilization contributed greatly to global food production and is also necessary in modern agriculture to achieve high yields. Fertilization, on the other hand, faces problem of eutrophication and limitation of resources. Importance of fertilization is based on the limited ability of plants to absorb nutrients from soils.

Plants evolved in the natural soil with mostly nutrient poor soils and carries ability to adapt low-nutrient environments. This ability, however, has a certain limitation, and if we can improve this ability, it contributes realization of “Low input agriculture.” For this, it is important to understand plant mechanisms to adapt low-nutrient environments.

To respond to nutritional conditions, it is essential to sense the nutrient levels in cells and in the environments. Based on the sensing, multiple processes including nutrient transport, metabolism and growth are regulated in a coordinated manner to achieve response as an organism. Our previous study identified mechanism to sense nutrients in cytoplasm which induce regulation of gene expression. Nutrient sensing can also happen in plasma membrane and cell walls. In this project we study mechanisms of nutrient sensing in different cellular compartments and describe multiple phenomena that associates with sensing. Such observation will lead us to comprehensively understand plant responses to low nutrient environments.

【Research Methods】

We previously demonstrated that nutrient sensing occurs in the process of translation of *NIP5;1*, a gene encoding boron transporter (Figure 1, Tanaka et al 2016).

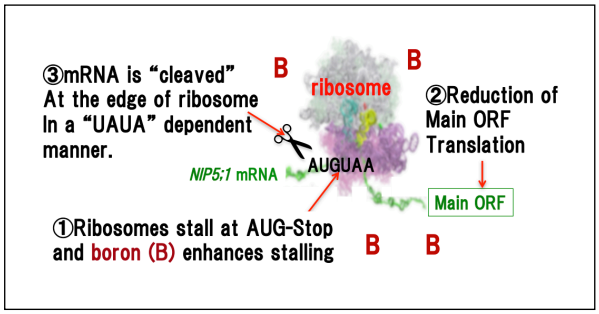

Figure 1 Regulation of boron dependent *NIP5;1* expression

In this project, details of the nutrient sensing mechanisms including structural analysis of ribosome and biochemical analysis will be conducted to elucidate molecular basis of recognition.

Plasma membrane and cell wall are also the subcellular locations where nutrients are recognized. Transporters and polysaccharides chemically interact with nutrients and possibly function for nutrient recognition. Effects of mutations on transporters and/or genes affecting polysaccharides accumulation will be used to examine their effects on transporter expression, nutrient distribution, growth and gene expression. Such analysis will leads to comprehensive understanding of nutrient response in plants.

【Expected Research Achievements and Scientific Significance】

Our study is unique in that nutrient recognition is studied in three different compartments in plants and expected to lead to comprehensive understanding of nutrient response in plants. The outcome of our project will provide useful information for sustainable agriculture in the future.

【Publications Relevant to the Project】

-Tanaka, M., Sotta, N., Yamazumi, Y., Yamashita, Y., Miwa, K., Murota, K., Chiba, Y., Hirai, MY., Akiyama, T., Onouchi, H., Naito, S. & Fujiwara, T “The Minimum Open Reading Frame, AUG-Stop, Induces Boron-Dependent Ribosome Stalling and mRNA Degradation” Plant Cell 28: 2830–2849 (2016) doi: org/10.1105/tpc.16.00481.
-Sotta, N., Duncan, S., Tanaka, M., Sato, T., Marée, A. F.,Fujiwara, T., & Grieneisen, V. A. “Rapid transporter regulation prevents substrate flow traffic jams in boron transport.” eLife 6:e27038 (2017) doi: 10.7554/eLife.27038

【Term of Project】

FY2019-2023

【Budget Allocation】

153,900 Thousand Yen

【Homepage Address and Other Contact Information】

http://park.itc.u-tokyo.ac.jp/syokuei/index_e.html