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

Title of Project : Molecular dissection of plant development and cell-to-cell signaling mediated by posttranslationally modified peptides

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Research Area : Biology
Keyword : Posttranslational modification, Peptide signaling, Receptor, Plant development

【Purpose and Background of the Research】

Cell-to-cell signaling mediated by secreted signals and membrane-localized receptors is one of the critical mechanisms by which growth and development of multicellular organisms are cooperatively regulated. Signal molecules that specifically bind receptors are generally referred to as ligands. Because membrane-localized receptors act as master switches of complex intracellular signaling, identification of the ligand-receptor pair is one of the central issues of post-genome research.

One structurally characteristic group of extracellular signals in plants is post-translationally modified small peptides. Posttranslational modification requires co-substrates synthesized using ATP. Thus, biosynthesis of posttranslationally modified peptides requires considerably higher energy compared to normal peptides. Nevertheless, a number of posttranslationally modified peptides has been evolutionally conserved, suggesting that these “expensive” modified peptides afford physiological merits to the plants greater than their energy costs. In other words, post-translational modifications can be indicative of biologically active peptides.

Our goal in this project is to uncover the mechanisms by which plant development is regulated through identification of novel signals, especially posttranslationally modified peptides, and their specific receptors using genome information, biochemical analysis and phenotypic observation.

Figure 1. Restoration of a phenotype by a novel peptide signal supplemented in the medium.

【Research Methods】

Our approach is mainly based on the assumption that the phenotypes of the mutant of modification enzymes reflect deficiencies in the biosynthesis of all the functionally modified peptides, including undiscovered peptide signals.

We will (1) identify enzymes required for posttranslational modifications of peptides, (2) analyze phenotypes of their loss-of-function mutants in a variety of plant species, (3) identify peptide(s) responsible for loss-of-function phenotypes of modification enzymes, and (4) identify their receptors and downstream signaling components.

【Expected Research Achievements and Scientific Significance】

Ligand-receptor pairs act as master switches of complex intracellular signaling that directly or indirectly regulates plant growth and development. Molecular dissection of these signaling pathway greatly promote our understanding of plant growth mechanisms. In addition, these signaling pathways are attractive targets for the development of new plant growth regulators.

【Publications Relevant to the Project】

- Matsuzaki, Y., Ogawa-Ohnishi, M., Mori, A., and Matsubayashi Y. Secreted peptide signals required for maintenance of root stem cell niche in *Arabidopsis*. *Science* 329, 1065-1067 (2010).
- Ohyama, K., Shinohara, H., Ogawa-Ohnishi, M. and Matsubayashi, Y. A glycopeptide regulating stem cell fate in *Arabidopsis thaliana*. *Nature Chem. Biol.* 5, 578-580 (2009).

【Term of Project】 FY2013-2017

【Budget Allocation】 161,400 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.nibb.ac.jp/ligand/