Division of Biochemistry
- Molecular Biology -

http://molbio.kuicr.kyoto-u.ac.jp/mbl/index_e.html

Assoc Prof
SUGISAKI, Hiroyuki
(D Sc)

Assoc Prof
AOYAMA, Takashi
(D Sc)

Assist Prof
TSUGE, Tomohiko
(D Sc)

Techn
YASUDA, Keiko

PD
TANIGUCHI, Masatoshi
(D Sc)

Guest Res Assoc
WU, Zhe

Guest Res Assoc
ZHU, Danling

Students

TANIGUCHI Y, Yukimi (D3)
NAKAMURA, Kinu (D3)
AKI, Shiori (D2)
NAKAI, Hideto (D1)
KATAOKA, Mayuko (M2)
WADA, Yukika (M1)

Visitors

Dr MENON, Suchithra	Harvard School of Public Health, USA, 7–17 January 2008
Prof QU, Li-Jia	College of Life Science, Peking University, China, 1–13 August 2008
Prof GU, Hongya	College of Life Science, Peking University, China, 1–13 August 2008
Prof SERINO, Giovanna	University of Rome La Sapienza, Italy, 4–18 November 2008
Ms IAFRATE, Silvia	National Research Council of Italy, Italy, 4–18 November 2008

Scope of Research

This laboratory aims at clarifying molecular bases of regulatory mechanisms for plant development, especially plant morphogenesis, with techniques of forward and reverse genetics, molecular biology, and biochemistry. Current major subjects are phospholipid signalings in cell morphogenesis, the transcriptional network for cytokinin responses, COP9 signalosome modulating signal transduction in the nuclei, and the endoreduplication cell cycle in cell differentiation.

Research Activities (Year 2008)

Publications

Kusano H, Testerink C, Vermeer JEM, Tsuge T, Shimada H, Oka A, Munnik T, Aoyama T: The Arabidopsis Phosphatidylinositol Phosphate 5-kinase PIP5K3 is a Key Regulator of Root Hair Tip Growth. *Plant Cell,* **20**, 367-380 (2008).

Menon S, Tsuge T, Dohmae N, Takio K, Wei N: Association of SAP130/SF3b-3 with Cullin-RING Ubiquitin Ligase Complexes and its Regulation by COP9 Signalosome. *BMC Biochem*., **9**, 1 (2008).

Presentations

Phospholipid Signaling in Root Hair Development, Aoyama T, Kusano H, Testerink C, Vermeer JEM, Tsuge T, Shimada H, Oka A, Munnik T, The 9th International Congress on Cell Biology, 7–10 October 2008 (Seoul).

Identification and Characterization of Novel Proteins Interacting with COP9 Signalosome Subunitl, Kataoka M, Nakai H, Taniguchi M, Aki S, Dohmae N, Heyl A, Oka A, Tsuge T, Zomes-V, 11–14 November 2008 (Yokohama).

COP9 Signalosome Interacts with RNA Processing Factors in *Arabidopsis,* Aki S, Oka A, Tsuge T, Zomes-V, 11–14 November 2008 (Yokohama).

Grants

Aoyama T, Development of Light Molecular Switch for Analyzing Intracellular Information Network, Grant-in-Aid for Exploratory Research, 1 April 2007–31 March 2009.

Aoyama T, Signal Transduction from Nutrient Conditions to Root Hair Morphogenesis, Grant-in-Aid for Scientific Research on Priority Areas, 1 April 2008–31 March 2010.

Tsuge T, Qu LJ, Molecular Mechanism Involved in Maintaining the Flatness of the Leaf Blade, Japan-China

Roles of Phospholipid Signalings in Plant Cell Morphogenesis

Phospholipids are not only major components of the eukaryotic plasma membrane but also signaling molecules leading to a wide variety of cellular responses. Because phospholipids function as site-specific signals on membranes, they likely play pivotal roles in localizing exocytosis and the fine F-actin configuration to regions of cell expansion, such as the tips of growing root hairs. Root hairs are cellular protuberances resulting from highly polarized cell growth of specific root epidermal cells. The process of root hair growth is called tip growth, because all of the growth events including cell wall deposition and plasma membrane expansion are limited to the tip. Root hairs have been intensively studied as a model system for the molecular processes involved in plant cell morphogenesis, owing to the dispensability under laboratory conditions and accessibility for experimental observation of root hairs.

Among phospholipid signaling factors involved in plant cell morphogenesis, we focused on phosphatidylinositol 4,5-bisphosphate [PtdIns(4,5)P_2] and its producing enzyme phosphatidylinositol 4-phosphate 5-kinase (PIP5K). The localization of PtdIns(4,5)P_2 to apices of growing root hairs suggests that it is involved in tip growth. However, it is unclear how the spatiotemporal pattern of PtdIns(4,5)P_2 is established at the tip and which aspect of tip growth it regulates. We found that the *Arabidopsis thaliana PIP5K3* gene encodes PIP5K, and is expressed preferentially in root hair cells. All the T-DNA insertion mutations that we examined exhibited significantly shorter root hairs than in the wild type. Reciprocally, its overexpression caused longer root hairs in addition to multiple protruding sites on a single root hair cell. A yellow fluorescence protein fusion of PIP5K3 (PIP5K3-YFP), directed by the *PIP5K3* promoter, complemented the short root hair phenotype of the mutants, and localized intensively at the plasma membrane of elongating root hair apices, at growing root hair bulges, and notably, at sites expected to form root hair bulges. PIP5K3-YFP accumulated most in apices of root hairs elongating rapidly. These results provide evidence that PIP5K3 is involved in the localization of PtdIns(4,5)P_2 to the elongating root hair apex and acts as a key regulatory component of the machinery initiating and promoting root hair tip growth.

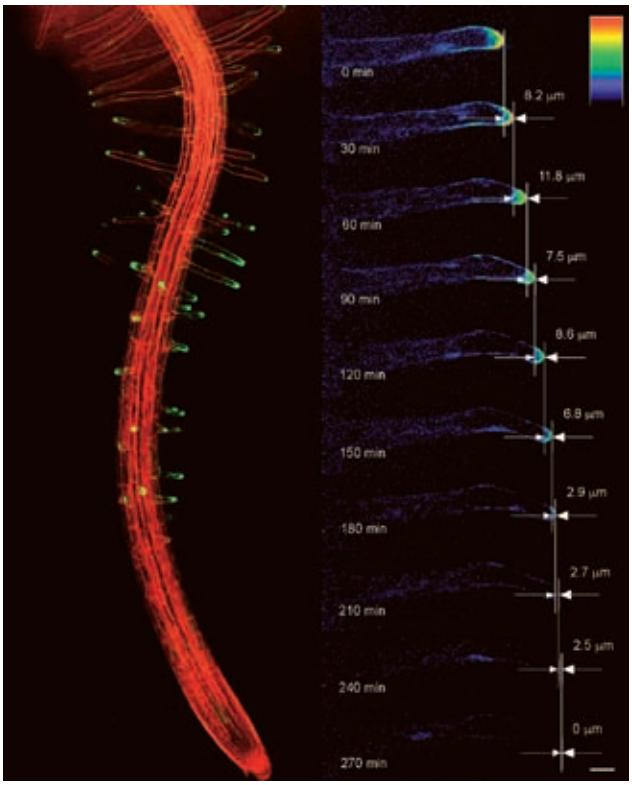

Figure 1. Localization pattern of PIP5K3-YFP in root hairs. Left: PIP5K3-YFP (green color) localized at elongating root hair apices. Right: The intensity of the PIP5K3-YFP fluorescence (index colors) is tightly correlated with the rate of root hair elongation.

Scientific Cooperation Program (JSPS), 1 April 2007–31 December 2009.

Tsuge T, Mele G, Transcriptional Regulations on Higher Plants by COP9 Signalosome, Japan-Italy Scientific Cooperation Program (JSPS), 1 April 2008–31 March 2010.

Tsuge T, Stress-response Regulator, COP9 Signalosome, is Involved in Regulation of both Human Carcinogenesis and Plant Photomorphogenesis, Research Grant (The Naito Foundation), 1 December 2006–30 September 2008.

Tsuge T, Novel Functions of COP9 Signalosome, the Key Signaling Component is Conserved in both Human Carcinogenesis and Plant Photomorphogenesis, Research Grant (Research Foundation for Opto-Science and Technology), 1 April 2007–3 March 2009.

Aki S, Functional Analyses on the Interaction of SAP130 and COP9 Signalosome, Plant Protein Analysis Research Project Graduate-Student-Grant (NAIST Science Research and Education Promotion Unit), 1 April 2008–31 March 2009.

Award

Aki S, Best Poster Award, ZOMES-V, "COP9 Signalosome Interacts with RNA Processing Factors in *Arabidopsis* ", 14 November 2008.