特別セミナー

2018 年 3 月 27 日(火)　9:00～11:30　計算科学研究センター4 階大会議室

Dr. Yuree Lee (Center for Plant Aging Research, Institute for Basic Science, Republic of Korea)

Spatiotemporal coordination of cellular activities and architecture for organ separation in Arabidopsis

The cell wall, a defining feature of plants, provides a rigid structure critical for bonding cells together. To overcome this physical constraint, plants must process cell wall linkages during growth and development. However, little is known about the mechanism guiding cell-cell detachment and cell wall remodeling. Here, we identify two neighboring cell types in Arabidopsis that coordinate their activities to control cell wall processing, thereby ensuring precise abscission to discard organs. One cell type produces a honeycomb structure of lignin, which acts as a mechanical 'brace' to localize cell wall breakdown and spatially limit abscising cells. The second cell type undergoes transdifferentiation into epidermal cells, forming protective cuticle, demonstrating de novo specification of epidermal cells, previously thought to be restricted to embryogenesis. Loss of the lignin brace leads to inadequate cuticle formation, resulting in surface barrier defects and susceptible to infection. Understanding the coordination between these two cell types will give a new insight to the abscission processes, which will be further applied to understanding general mechanisms of cell wall processing.

Dr. Michael Wrzaczek (Department of Biosciences, University of Helsinki, Helsinki, Finland)

Cysteine-rich receptor-like kinases are an evolutionarily diverse group of kinases and regulate ROS production and signaling

Biotic and abiotic stresses induce reactive oxygen species (ROS) production in plants as a signalling strategy. The receptor-like protein kinases (RLKs) are largely responsible for communication between cells and the extracellular environment, and ROS production is a frequent result of RLK signalling in a multitude of cellular processes (Kimura et al., 2017). However, many of the components for extracellular ROS perception, signal transmission, and specificity of downstream responses remain unknown. Cysteine-rich receptor-like kinases (CRKs) represent a subgroup of RLKs, defined by a conserved pattern of cysteines in their extracellular domain. Based on their expression profile, loss-of-function phenotypes, and the potential for redox regulation in their extracellular domain, CRKs are promising candidates to be involved in ROS signalling, potentially as extracellular ROS sensors (Wrzaczek et al., 2010; Idänheimo et al., 2014; Bourdais et al., 2015).

We have identified several CRKs including CRK2, an evolutionarily ancient member of this protein family, as essential components which can directly phosphorylate and thereby activate plasma membrane-localized NADPH oxidases (respiratory burst oxidase homologs; RBOH) in a calcium-independent manner. CRK2 forms a pre-assembled complex with RBOHD to activate ROS production in response to signal perception. Intriguingly, CRK2 also interacts with a number of different proteins for example to modulate callose deposition.

Most genomes of higher plants encode a large number of CRK genes; however, expansion of different subtypes of CRKs has happened very differently in various plant lineages. This variation is an interesting tool for studying the origin and evolution of large protein families. It however also highlights the difficulties in translating results from model species to crop. A combination of physiological, biochemical and evolutionary/genomic approaches using the CRKs could pave the way for future understanding of large families of receptors or other protein families in plants.

Wrzaczek M et al. 2010. BMC Plant Biol 10: 95.
Idänheimo N et al. 2014. Biochem Biophys Res Commun 445(2): 457-462.
Bourdais, et al. 2015. PLoS Genetics 7(11): e1005373.
Kimura, et al. 2017. Plant Cell 29(4): 638-654.

東京理科大学理工学研究科が国際交流協定を結んでいるヘルシンキ大学の研究者。参考文献の筆頭著者で、現在 Wrzaczek 研究室で活躍中の木村幸恵博士は、理工学研究科応用生物科学専攻博士課程の卒業生です。

理工学部応用生物科学科･農理工学際連携コース　朽津 和幸