Laboratory of Plant Cell Biology

Graduate School of Science

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Plants, which cannot move freely like animals, survive in the natural world by sensing fluctuations in external environmental factors and responding skillfully to them. When we see such plant behaviors, two questions emerge from different perspectives: How are these things achieved (the "how" question) and what is the significance of these things (the "why" question)? Both questions are strong motivations that drive biological research. We are interested in a variety of behaviors of plants, and we value the questions that each of us asks to deepen our understanding for how they work and what they mean.

Unwind the Phenomenon

We are analyzing the process from stimulus perception to response, with a particular focus on events at the cellular level. We focus on factors that have a significant impact on plant life, such as light, CO_2, and mechanical stress. We are always aware of both the mechanisms and significance of interesting phenomena such as the induction and maintenance of circumnutation and the intracellular positioning and movement of organelles (chloroplasts, mitochondria, and nuclei). For example, it is well known that chloroplasts change their location within the cell in response to changes in environmental conditions (see Figure 1).

We have revealed that mitochondria and nuclei also exhibit intracellular relocation, and are investigating the stimulus-perception mechanisms, cytoskeleton, and signaling factors involved in these responses. We are also analyzing the significance of these responses, focusing on the efficiency of photosynthetic reactions and avoidance of DNA damage.

Explore the mechanism

Plant cell organelles share some properties with animals while others are unique to plants. For example, the actin-binding protein vilin, whose activity is regulated by Ca^{2+}, is conserved in plants and animals. We have found that vilin is involved in chloroplast positioning through actin cytoskeleton rearrangement and are analyzing its mode of action.

The inner nuclear membrane is lined by a mesh-like structure called nuclear lamina. The main component of the animal nuclear lamina is lamin, which regulates nuclear movement, morphology, and chromosome arrangement. We have proposed that, in plants, the product of a gene named CRWN may play a role equivalent to that of lamin (see Figure 2). We believe that this is an important factor that contributed to the diversification of cell types and the expansion of plant species on land.

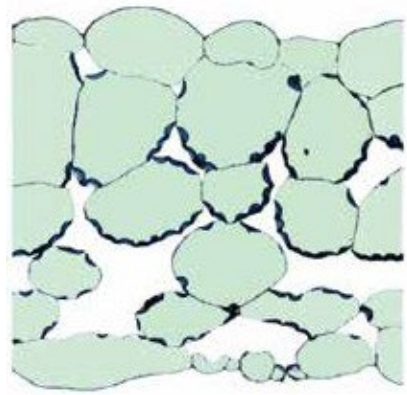

Figure 1: A transverse section of a leaf shows that chloroplasts (dark blue) are distributed in areas adjacent to the intercellular spaces (white areas), rather than adjacent to neighboring cells.

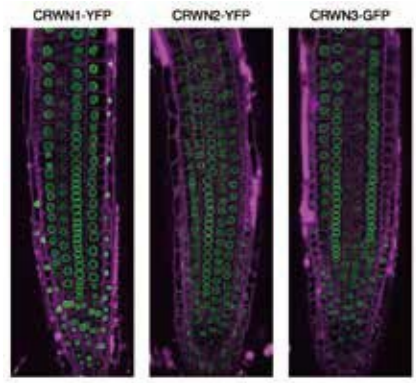

Figure 2: Fusion proteins of CRWNs with a fluorescent protein are localized just beneath the nuclear membrane in each nucleus observed in root tips.

This lab will not accept students in 2023

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