

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

Biological Sciences (Biology)



Title of Project : The transduction of light signal to ion transport in stomatal guard cells

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Research Area : Plant Physiology

Keyword : Stomata, Light signaling, Environmental response, Phototropins, H⁺-ATPase

【Purpose and Background of the Research】

Stomata respond to various environmental stimuli, including light, phytohormone, CO₂, Ca²⁺, and O₃, and this capability is based on the function of stomatal guard cells. The guard cell is the cell which greatly developed the perception and transmission of the signals. The light is the most important environmental cue, and phototropins act as photoreceptor and the plasma membrane H⁺-ATPase functions as a final target for the light signal. In this study, we will elucidate the unidentified signaling components in the light signaling pathways of stomatal guard cells.

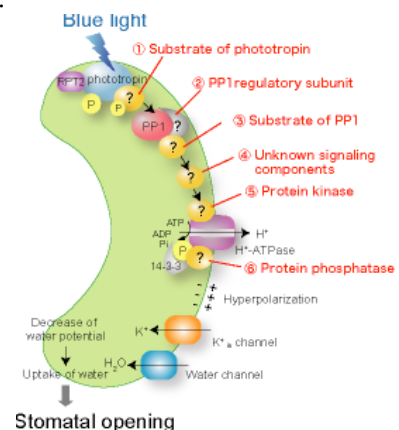
【Research Methods】

We will use the methods of biochemistry, molecular biology, and physiology. We will isolate the proteins that are involved in the signaling pathway using guard cell protoplasts, and identify the genes encoding the signaling proteins by mass analyses. Then, we will analyze the functional role of the target proteins using the mutant lines of the plants. If we could not obtain the appropriate mutant lines, we will utilize the transient expression method of the genes in guard cells, and determine their functions. We will also generate the mutant lines by mutagenesis and isolate the mutant plants which are devoid of the opening response of stomata. Using these lines, we will identify the genes that are responsible for the altered responses.

【Expected Research Achievements and Scientific Significance】

In the responses of opening stomata, phototropins, the plasma membrane H⁺-ATPase, and type 1 protein phosphatase that transmits the signal from phototropins to the H⁺-ATPase function in guard cells. These components

are the main signaling proteins in the pathways so far, however, there are multiple unidentified components remain to be determined as noted in Figure I in red-colored letters. We will identify these components, and the products will illustrate the mechanisms of the typical light signaling in plant cells. We believe that the identification of the signaling components are the most essential at present time.



【Publications Relevant to the Project】

Takemiya, A., Kinoshita, T., Shimazaki, K. (2006)

Proc. Natl. Acad. Sci. USA. 103: 13549-13554.
Shimazaki, K., Doi, M., Assmann, SM., Kinoshita,

T. (2007) Annu. Rev. Plant Biol. 58: 219-247

Inoue, S., Kinoshita, T., Matsumoto, M., Nakayama, KI., Doi, M., Shimazaki, K. (2008)

Proc. Natl. Acad. Sci. USA. 105: 5626-5631

【Term of Project】 FY2009-2013

【Budget Allocation】 158,400 Thousand yen

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