Plant growth enhanced through promotion of pore opening

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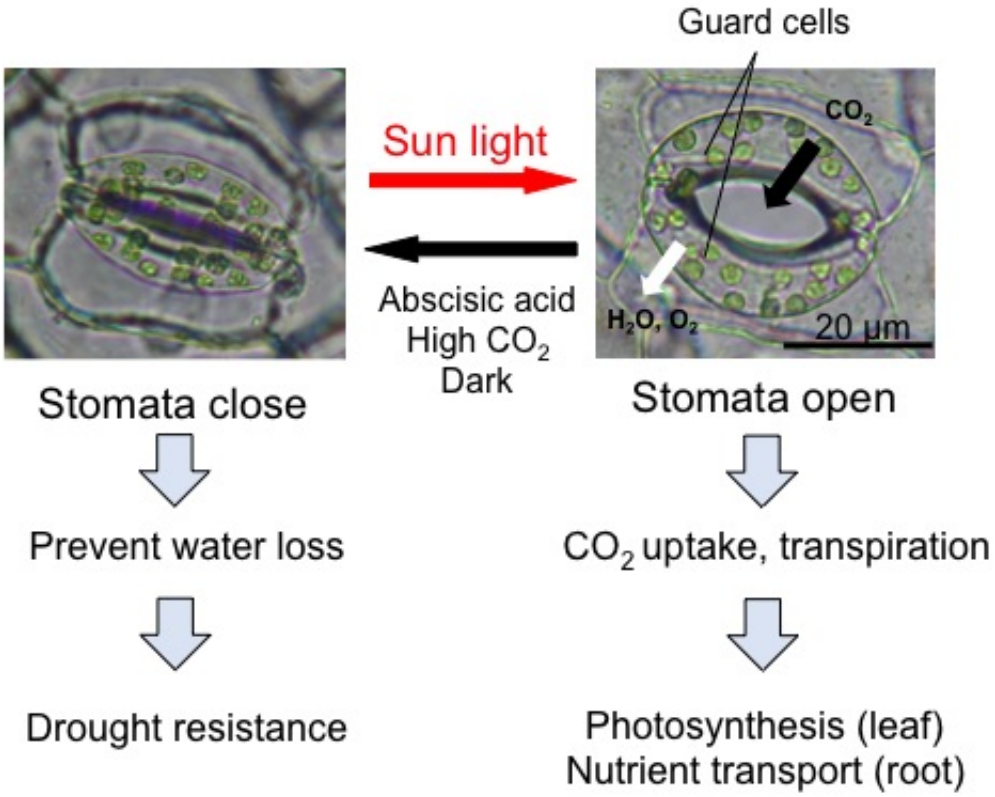

Light induces stomatal opening. Abscisic acid (a phytohormone synthesis respond to drought stress), high carbon dioxide, dark may induce stomatal closure. Stomata pore is the essential pathway of carbon dioxide uptake for photosynthesis. Credit: ITbM, Nagoya University

By determining the key factor in regulating photosynthesis and plant growth, Professor Toshinori Kinoshita, Dr. Yin Wang and co-workers at

Nagoya University's Institute of Transformative Bio-Molecules (WPI-ITbM) have succeeded in developing a method to increase photosynthesis (carbon dioxide uptake) and plant growth through the promotion of stomatal opening. The study, published on the online Early Edition in the week of December 23, 2013 of *Proceedings of the National Academy of Science* (*PNAS*), is expected to contribute to the promotion of plant production and towards the development of a sustainable low-carbon society.

Stomata are small pores located on the surface of leaves that control gas exchange with the external environment, and are the primary inlet for the uptake of carbon dioxide (Figure 1). "Stomatal resistance, which suppresses gas exchange through the stomata, is considered to be the major limiting factor for carbon dioxide uptake by plants during photosynthesis," explains Professor Kinoshita, "very few reports have existed focusing on the induction of stomatal opening. Therefore, we decided to develop a method to manipulate stomatal opening in view of increasing photosynthesis (carbon dioxide uptake) and plant production."

Kinoshita's group has already revealed some of the key factors that mediate stomatal opening (Figure 2). The plasma membrane proton (H+)-ATPase or proton pump, an enzyme creating electrochemical gradients in the cell membranes of plants, has been identified as one of the key components. "An increase in photosynthesis (carbon dioxide uptake) by approximately 15% and a 1.4~1.6 times increase in plant growth of Arabidopsis plants was observed by enhanced stomatal opening achieved through overexpression of the proton pump in guard cells that surround the stomata pore," elaborates Professor Kinoshita (Figure 3).

Professor Kinoshita and his co-workers envisage that application of this method will contribute to the increase in the production of crops and fuel plants as well as towards the reduction of carbon dioxide in the

atmosphere. Professor Kinoshita states, "Identifying that the manipulation of stomatal opening is the key limiting factor in photosynthesis and plant growth enables us to consider strategies to solve current issues in food production and carbon emissions."

More information: Yin Wang, Ko Noguchi, Natsuko Ono, Shin-ichiro Inoue, Ichiro Terashima, and Toshinori Kinoshita. "Overexpression of plasma membrane H+-ATPase in guard cells promotes light-induced stomatal opening and enhances plant growth." *PNAS* 2013 ; published ahead of print December 23, 2013, DOI: 10.1073/pnas.1305438111

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