Leafy social network: Scientists study how stomata communicate

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Plants take in carbon dioxide through pores or ‘stomata’ in their leaves without losing water. Utah State University scientists are exploring how stomata communicate in a sophisticated network to accomplish this continuous task without a central processing unit.

(PhysOrg.com) -- To survive, leafy plants need to take in as much carbon dioxide as possible through pores in their leaves without losing water. Known as stomata, these pores somehow work together, processing and exchanging the information necessary to open and close at opportune times to achieve constant, optimal balance.

An amazing and puzzling aspect of this process is that plants have no central processing unit, says Utah State University physicist David Peak.

"What we're observing is a very primitive form of intelligence," Peak says. "But how these stomata communicate, in what amounts to a sophisticated social network, remains a mystery."

Peak and colleague Keith Mott, a professor of plant physiology at USU, have studied the function of stomata in intact leaves, with an emphasis on information processing, for nearly a decade. The team challenged a recent study on stomatal responses to radiant energy in a paper published in the Nov. 21, 2011 issue of *Proceedings of the National Academy of Sciences.*

"Colleagues in the science community made a potentially revolutionary proposal that stomata respond to total absorbed radiant energy rather than to visible radiation alone," Mott says. "If true, this would have represented a major departure from currently accepted models of plant physiology. But our findings revealed an error in the proposal."

In addition, Mott and Peak's efforts to test the hypothesis yielded a "happy accident." The scientists' data and analysis led to the discovery of a method for accurately determining the internal temperature of a leaf.

"Previously, scientists have been able to measure the surface temperature of a leaf," Peak says. "But a small difference in surface and internal temperature makes a big difference in the study of evapotranspiration. This process, nature's water cycle, is very sensitive to temperature."

The ability to ascertain internal leaf temperature will serve the USU scientists well as they continue their studies. The pair recently received an award of more than $500,000 from the National Science Foundation to further their research.

"Being able to measure internal temperature will allow us to test our theories," Mott says.

Unlocking knowledge of stomatal communications has important implications for understanding how plants evolve and adapt to their environment – especially in light of climate change, he says. But the study also sheds light on the complex, collective dynamics of all biological systems.

"Study of the human brain is complicated because it's so complex and there are so many, simultaneous connections," Peak says. "Studying a simpler organism, such as a plant that doesn't move around, can offer clues from evolutionary history about the emergence of intelligence."

Provided by Utah State University

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