How plants manage calcium may reduce effects of acid rain

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A new understanding of how plants manage their internal calcium levels could lead to modifying plants to avoid damage from acid rain. The pollutant disrupts calcium balance in plants by leaching significant amounts of the mineral from leaves as well as the agricultural and forest soils the plants live in.

"Our findings should help scientists understand how plant ecosystems respond to soil calcium depletion and to design appropriate strategies to protect the environment," said Zhen-Ming Pei, a Duke University biologist who led the study, which is published in the March 9, issue of the journal *Science*.

The research was supported by the National Science Foundation (NSF), the U.S. Department of Agriculture and Xiamen University in China.

To grow, a plant needs a reliable supply of calcium, which enters the plant dissolved in water the roots take in from surrounding soil. As the water circulates through a plant, dissolved calcium gets shuttled where it is needed to give the plant's cells their structural rigidity. But calcium supplies coming into the plant cycle up and down over the course of the day, dropping to a minimum at night.

"Calcium is a key regulator of vital physiological functions in both plants and animals," said Maryanna Henkart, director of NSF's Division of Molecular and Cellular Biosciences. "The discovery of the relationship between calcium in soil, in plant cells, and cellular mechanisms sheds

new light on the role of this important mineral in plant growth and development."

Plants use molecular sensors and flows of chemical messengers to detect and regulate the storage and distribution of vital nutrients such as water and calcium. To track the calcium sensors in the laboratory plant Arabidopsis, Pei and his coworkers used molecules originally found in jellyfish that emit light in the presence of calcium. To deduce the calcium sensor's role, the researchers also introduced an altered version of the sensor protein that abolishes the sensor's effects.

According to Pei, the sensors try to detect how much calcium there is and coordinate that level with growth and development. "If the sensors detect there is not enough calcium, they may tell the plant to hold off on growing, at least until it gets more calcium."

Although acid rain robs soil of much of its calcium, enough is still left for plants to live on, Pei added. But he suspects that sensors may misinterpret "less" as "too little" in those plants and unnecessarily signal for growth shutdowns.

"Some soils have lost as much as 75 percent of their calcium during the past century," Pei said. "One way to respond is to add new calcium to the soil. But we can't do that everywhere that it's needed, and it is also expensive. Perhaps a plant's calcium sensors could instead be tricked into interpreting "less" as "still enough" and keep building new cell walls."

Source: National Science Foundation