Water 'thermostat' could help engineer drought-resistant crops

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Duke University researchers have identified a gene that could help scientists engineer drought-resistant crops. The gene, called OSCA1, encodes a protein in the cell membrane of plants that senses changes in water availability and adjusts the plant's water conservation machinery accordingly.

"It's similar to a thermostat," said Zhen-Ming Pei, an associate professor of biology at Duke.

The findings, which appear Aug. 28 in the journal *Nature*, could make it easier to feed the world's growing population in the face of climate change.

Drought is the major cause of crop losses worldwide. A dry spell at a crucial stage of the growing season can cut some crop yields in half.

Water shortages are expected to become more frequent and severe if climate change makes rainfall patterns increasingly unreliable and farmland in some regions continues to dry up. Coupled with a world population that is expected to increase by two billion to three billion by 2050, researchers worldwide are looking for ways to produce more food with less water.

Some researchers hope that genetic engineering—in addition to improved farming practices and traditional plant breeding –- will add to the arsenal of techniques to help crops withstand summer's swelter. But

engineering plants to withstand drought has proven difficult to do, largely because plants use so many strategies to deal with dehydration and hundreds of genes are involved.

The problem is confounded by the fact that drought is often accompanied by heat waves and other stresses that require different coping strategies on the part of the plant, Pei said.

One way that plants respond to water loss is by boosting the levels of calcium within their cells. The calcium surge acts as an alarm signal that triggers coping mechanisms to help the plant rebalance its water budget. But until now, the molecular machinery that plants use to send this signal –- and monitor water availability in general—remained unknown.

Pei and Duke colleagues Fang Yuan, James Siedow and others identified a gene that encodes a protein in the cell membranes of plant leaves and roots, called OSCA1, which acts as a channel that allows calcium to surge into the cell in times of drought.

The gene was identified in Arabidopsis thaliana, a small unassuming plant related to cabbage and canola that is the lab rat of plant research.

Plants with defective versions of the calcium channel don't send an alarm signal under water stress like normal plants do.

When the researchers grew normal plants and plants with defective versions of the gene side by side in the same pot and exposed them to drought stress, the mutant plants experienced more wilting.

The findings could lead to new ways to help plants thrive when water is scarce.

The team's next step is to manipulate the activity of the OSCA1 gene

and related genes and see how those plants respond to drought –- information that could lead to crops that respond more quickly and efficiently to dehydration.

"Plants that enter drought-fighting mode quickly and then switch back to normal growth mode quickly when drought stress is gone should be able to allocate energy more efficiently toward growth," Pei said.

More information: "OSCA1 mediates osmotic-stress-evoked Ca2+ increases vital for osmosensing in Arabidopsis," Yuan, F. and Pei, Z., et al. *Nature*, 2014. dx.doi.org/10.1038/nature13593

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