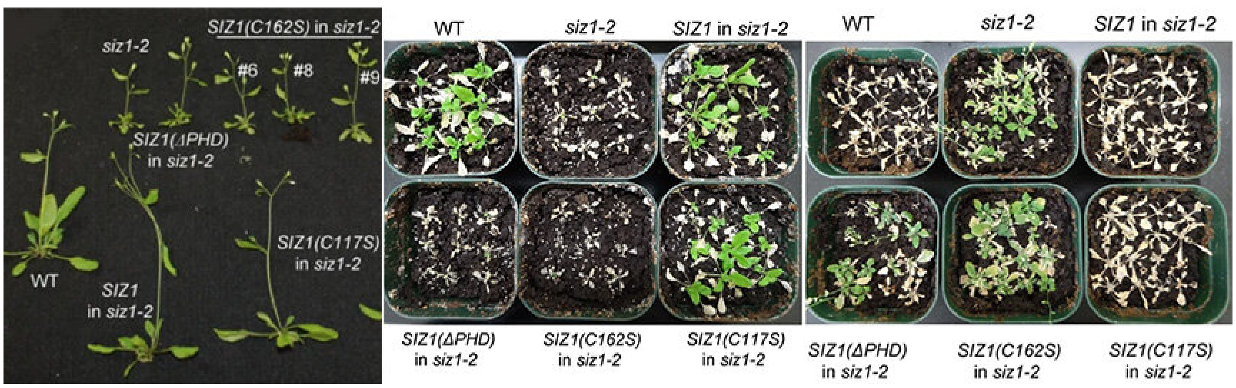
PHYS.ORG

Putting a finger on plant stress response

February 5 2020



Credit: University of Tsukuba

Post-translational modification is the process whereby proteins are modified after their initial biosynthesis. Modification can take many forms, including enzymatic cleavage of the protein or the addition of sugars, lipids, or small chemical groups. Amongst other things, post-translational modification enhances protein stability, mediates interactions between proteins, and can be used to mark proteins for transport or degradation.

In a report published this month in *Communications Biology*, researchers from the University of Tsukuba have found that one such post-translational modification, called sumoylation, in Arabidopsis thaliana relies on a single zinc finger domain within SUMO E3 ligase SIZ1. Without this domain, the function of the SIZ1 protein is impaired, resulting in stunted plant growth and increased sensitivity to stressful conditions such as low temperature.

Sumoylation involves the attachment of small SUMO proteins to target proteins, affecting how they function, where they are situated within the cell, and when they are degraded. In plants, this post-translational modification is involved in the response to cold, salt, and drought stresses, as well as in innate immunity and the regulation of signaling pathways. In A. thaliana, the attachment of SUMO to target proteins is mediated by an E3 ligase called SIZ1, which, although very similar to homologous proteins in yeast and animals, contains a unique PHD zinc finger-like domain.

"The importance of SIZ1 for effective sumoylation in Arabidopsis is well known," explains lead author of the study Professor Kenji Miura. "However, the significance of the PHD finger in the function of SIZ1, and ultimately sumoylation, was less clear."

To investigate the biological importance of the PHD finger, the researchers expressed intact SIZ1 or SIZ1 missing the PHD finger in an Arabidopsis siz1 mutant. While intact protein restored normal growth, plants expressing SIZ1 without the PHD finger continued to show the growth retardation, cold sensitivity, and drought tolerance that are characteristic of the siz1 mutant, confirming that the PHD finger is required for SIZ1 function.

The researchers also showed that PHD containing a point mutation no longer recognized tri-methylated histone, a protein involved in gene regulation, and a SIZ1 protein containing this mutation also failed to rescue the siz1 phenotype.

"Based on our findings, we predict that PHD is essential for recognition of trimethylated histone," says co-author Associate Professor Takuya

Suzaki. "Because tri-methylated histone accumulates at high levels in the promotor region of a stress response-associated transcription factor in the siz1 mutant, it is likely that PHD is essential for transcriptional gene suppression by SIZ1/SUMO in response to abiotic stress in Arabidopsis."

More information: Kenji Miura et al. The PHD finger of Arabidopsis SIZ1 recognizes trimethylated histone H3K4 mediating SIZ1 function and abiotic stress response, *Communications Biology* (2020). DOI: 10.1038/s42003-019-0746-2

Provided by University of Tsukuba