How a molecular switch shapes plant organ growth

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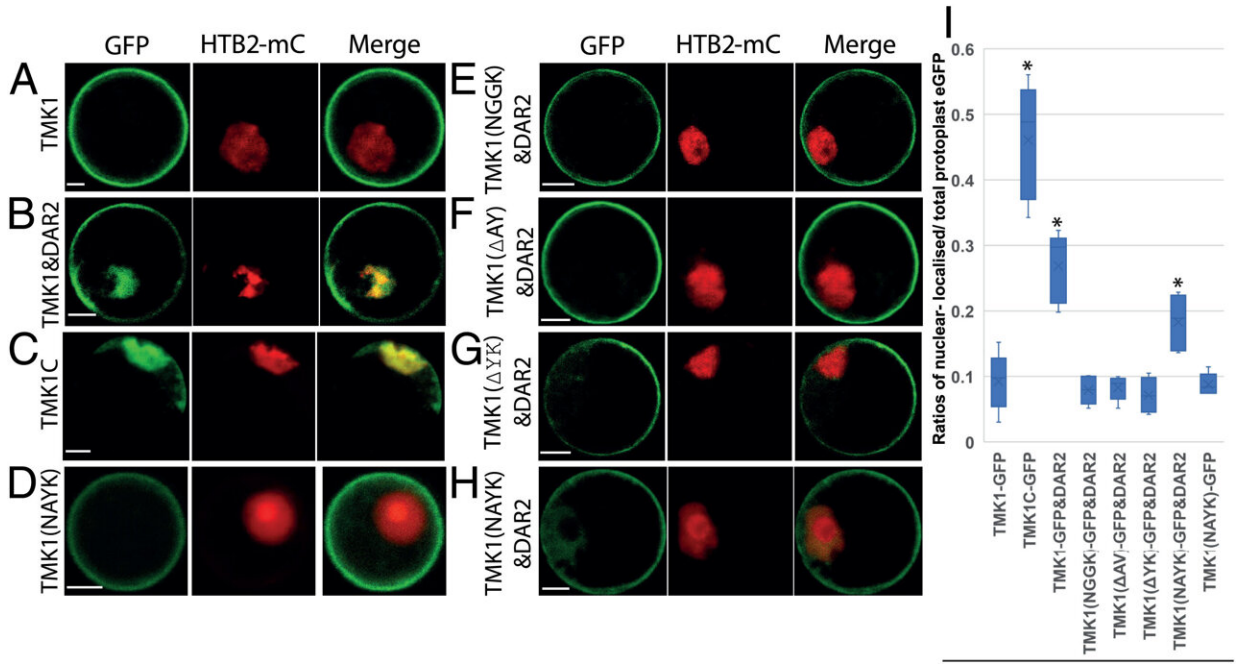

DAR2 cleavage of TMK1-EGFP relocates it from the plasma membrane to the nucleus of *Arabidopsis* root protoplasts. (*A–H*) Confocal images of *dar2-1* root protoplasts transformed with TMK1-EGFP, histone HT2B-mCherry, and cleavage mutants with or without DAR2. HT2B-mCherry marks the nucleus. Colocation of TMK1-EGFP and HT2B-mCherry shows as yellow fluorescence. (Scale bars: 5 μm.) (*I*) Ratios of nuclear-localized/total protoplast EGFP in different TMK1-EGFP cleavage mutants. $n = 20$ protoplasts from each of three independent experiments. All were compared to TMK-EGFP levels without 3HA-DAR2, and significant differences are indicated as *P Proceedings of the National Academy of Sciences (2022). DOI: 10.1073/pnas.2205757119

Researchers at the John Innes Centre and partners at the Chinese Academy of Sciences have identified a molecular switch that establishes differential cell growth and organ shape.

The growth regulator auxin promotes cell growth through a surface protein called Transmembrane Kinase 1 (TMK1). At the cell surface TMK1 modulates cell wall properties that facilitate cell growth. But TMK1 also signals an opposite growth-retarding effect in the cell nucleus, where it represses cell growth by reducing auxin-mediated gene expression.

Dr. Benguo Gu and his colleagues showed how TMK1 carries out these seemingly opposed functions in different parts of the cell. This involves the cleavage of TMK1 protein at the cell surface and transferring part of the cleaved protein to the nucleus. Although this process is reasonably common, identifying the protein-cleaving proteins involved has been difficult due to technical challenges.

The proteins involved are members of the DA1 family of peptidases. These enzymes cleave a variety of proteins involved in growth responses and contribute to shaping organ growth. The demonstration of DA1-family cleavage of TMK1 shows how they modulate information flow from the cell surface to the nucleus to shape cell size and organ growth. Defining these processes makes important contributions to our understanding of plant growth.

Dr. Gu, a research assistant at the John Innes Centre says that their "work proved DA1 family peptidases function on hormone signal transduction, which indicates a general mechanism to transfer signal from plasma membrane to nucleus. The findings potentially offer a way to improve crop seed emergence."

"Modulation of receptor-like transmembrane kinase 1 nuclear

localization by DA1 peptidases in Arabidopsis" is in published in *Proceedings of the National Academy of Sciences*.

More information: Benguo Gu et al, Modulation of receptor-like transmembrane kinase 1 nuclear localization by DA1 peptidases in Arabidopsis, *Proceedings of the National Academy of Sciences* (2022). DOI: 10.1073/pnas.2205757119

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