A protein controlling root structure could play a widespread role in plant cellular signaling

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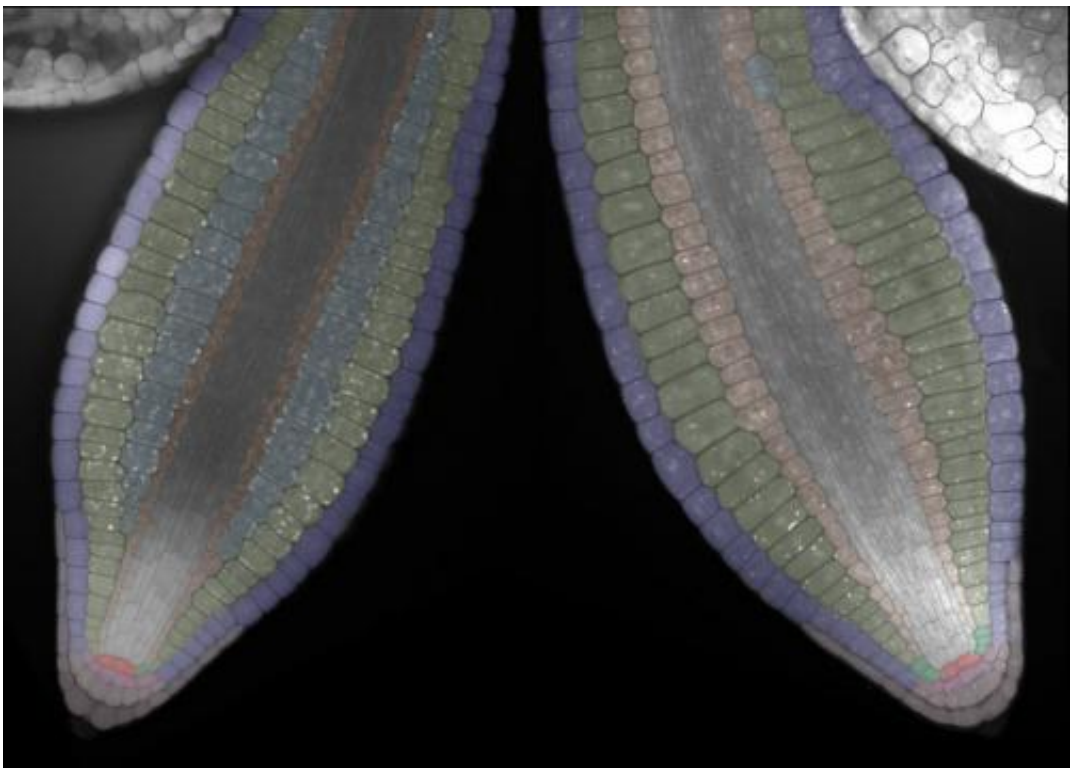

Figure 1: Enhanced image showing normal wild-type root growth (left) and abnormal root growth (right) in a pub4 mutant strain. Credit: Atsuko Kinoshita, RIKEN Center for Sustainable Resource Science

A novel protein, PUB4, that regulates cell division in root tips has been uncovered by genetic research led by the RIKEN Center for Sustainable

Resource Science.

Plant growth requires precise coordination between cell division and differentiation to produce an optimally structured organism. Most growth in plants occurs in specialized regions known as meristems. In the root meristem, stem cells undergo asymmetric cell division to produce new stem cells and also meristematic cells, which proliferate into new tissues.

The molecular pathways controlling the root meristem are poorly understood compared to those of the shoot meristem. Yet, as Atsuko Kinoshita from the RIKEN team points out, "Cell proliferation in the root meristem, which contributes to root elongation, is essential for the life of plants, as meristematic root cells absorb water and nutrients from soil."

Using mutant Arabidopsis, Kinoshita's team—a collaboration of researchers from Japan, the Netherlands and the United States—found that plants with defective PUB4 produced abnormally long roots. These roots contained increased numbers of stem cells, meristematic cells and other root tissue cells, and also displayed delayed stem cell division (Fig. 1). These abnormalities suggest that PUB4 is important for root development, including asymmetric division in stem cells.

"Asymmetric cell division is a key step in generating diverse, functional cell types," notes Kinoshita. "Our findings provide an insight into the mechanism controlling asymmetric division in the root meristem."

The pub4 mutants were also insensitive to molecular signaling that usually inhibits root cell proliferation, suggesting that PUB4 controls root meristem activity downstream of this signaling process.

Together, these results suggest that PUB4, which also has a role in pollen

development, could regulate cell proliferation and the timing of cell division throughout the plant. According to Kinoshita, who is now at the Max Planck Institute for Plant Breeding Research in Germany, components such as PUB4 are important for understanding the robustness and complexity of the signaling networks that ensure correct development throughout higher organisms.

PUB4 is one of a class of proteins that mediate certain protein modification reactions. The next step for the RIKEN team is to identify the targets of PUB4, and thus the mechanism by which PUB4 controls cell division. "We need to identify the targets of PUB4 in order to understand its precise function and to picture the whole signaling pathway," says Kinoshita. "We would also like to explore the integration of PUB4 signaling with plant hormonal pathways to get an overall understanding of these complex, but well-organized signaling networks."

More information: "A plant U-box protein, PUB4, regulates asymmetric cell division and cell proliferation in the root meristem." *Development* 142, 444–453 (2015). DOI: 10.1242/dev.113167

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