PLANT CELL BIOLOGY

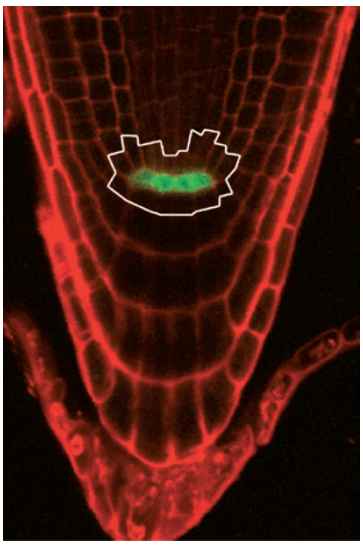
The roots of quiescence

The growth and development of roots depend on the function of the root meristem, which has a well-defined cellular organization: highly proliferative stem cells surround a quiescent centre (QC), comprised of a few cells that only rarely divide. The QC is crucial for maintaining the meristem as it controls the proliferation and differentiation of surrounding stem cells, and slow QC self-renewal is central to these functions. De Veylder and colleagues now identify the ERF115 transcriptional activator as a rate-limiting factor of QC cell division. ERF115 belongs to the ETHYLENE RESPONSE FACTOR family, members of which control the transcription of genes involved in growth and development.

ERF115 was identified in a screen for proteins that bind to an activating subunit of the APC/C (anaphase promoting complex; also known as the cyclosome) — CCS52A2 (CELL CYCLE SWITCH PROTEIN 52 A2) — that promotes QC cell proliferation when ectopically expressed in *Arabidopsis thaliana*. APC/C targets cell cycle proteins for degradation, and biochemical data confirmed that ERF115 is an APC/C^{CCS52A2} target.

CCS52A2 is known to restrain QC cell division, whereas the authors observed low expression of ERF115 in QC cells. However, *ERF115* mRNA levels increased in conditions that promote QC cell division, such as a modest temperature rise or treatment with brassinosteroids, confirming that it marks dividing QC cells. Importantly, a modified (dominant-negative) version of ERF115, unable to activate transcription, prevented hyperproliferation of QC cells induced by brassinosteroids, indicating that brassinosteroid-dependent QC division at least partly depends on ERF115.

PHYTOSULFOKINE PRECURSOR 5 (*PSK5*) — which encodes a peptide hormone that controls root growth and cell proliferation — was identified as a target of ERF115. Consistently, both overexpression and stabilization of ERF115 (through mutation of APC/C^{CCS52A2}) led to increased *PSK5* transcript levels. Furthermore, in the absence of a functional receptor for PSK peptides, overexpression of *ERF115* was unable to induce QC proliferation, which indicats that ERF115-dependent QC proliferation depends on PSK signalling.



Confocal microscopy image of a root tip of *Arabidopsis thaliana*, showing quiescent centre cells (green fluorescence) surrounded by stem cells (within the white frame). Image courtesy of L. De Veylder, Ghent University, Belgium.

This work suggests that QC proliferation depends on the levels of ERF115, on which the APC/C^{CCS52A2} and brassinosteroids have antagonistic effects. In addition, the authors suggest that ERF115-dependent QC proliferation replenishes surrounding stem cells upon damage, thereby contributing to the longevity of the stem cell niche.

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ORIGINAL RESEARCH PAPER Heyman, J. *et al.* ERF115 controls root quiescent center cell division and stem cell replenishment. *Science* http//dx.doi.org/10.1126/science.1240667 (2013)