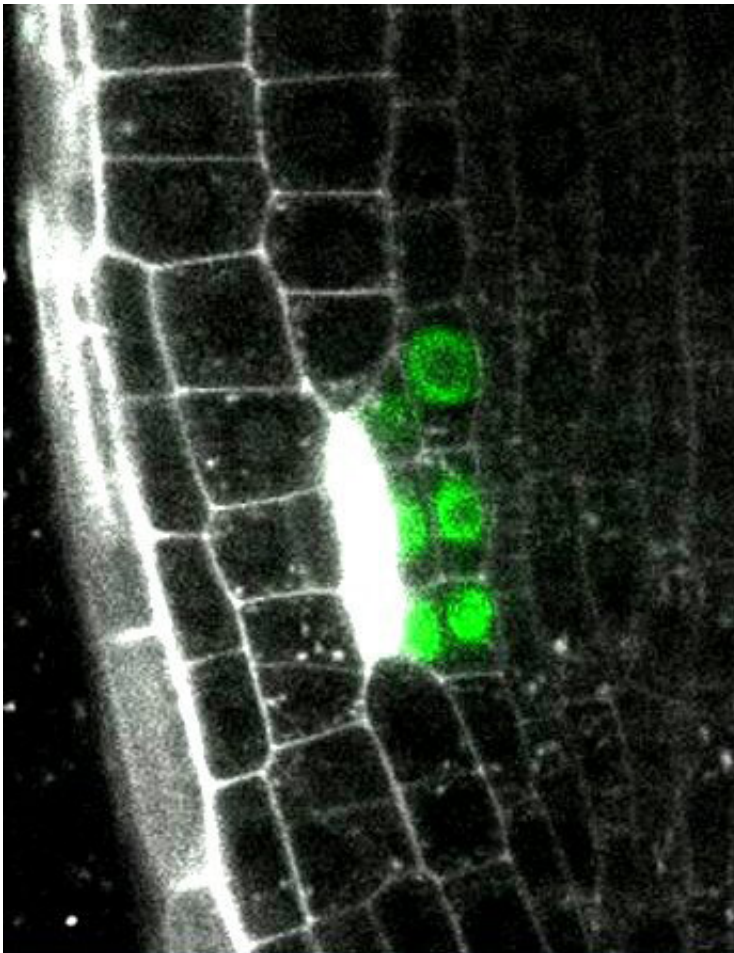


Specialized plant cells regain stem-cell features to heal wounds

May 2 2019



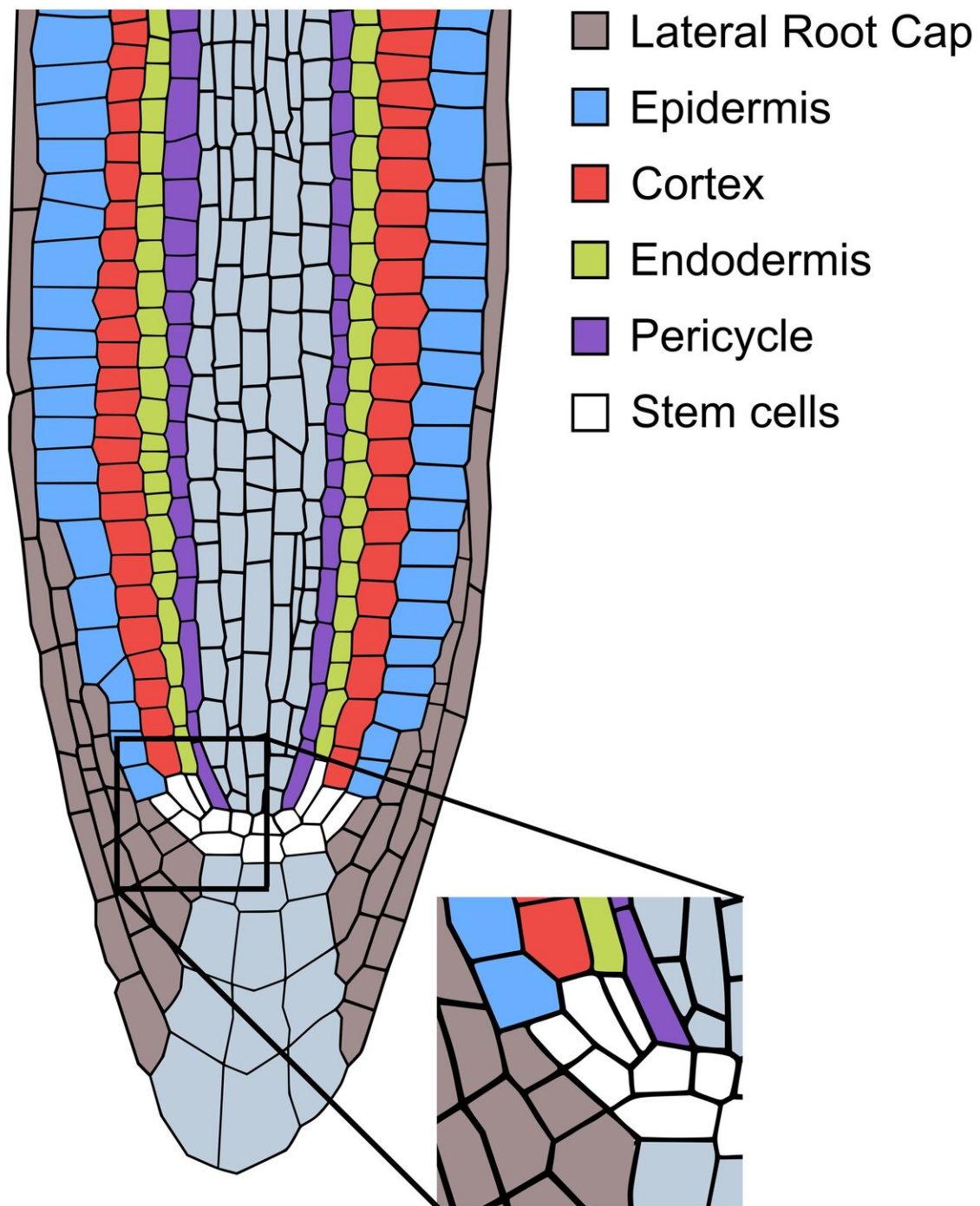
Confocal microscopy image of an Arabidopsis root tip with the cell cycle inducing gene ERF115 stained green. The expression of ERF115 is specific for the inner adjacent root cells, which undergo restorative cell divisions to generate daughter cells that eventually replace the wound (white patch). Credit: IST Austria/Lukas Hörmayer

If plants are injured, cells adjacent to the wound fill the gaps with their daughter cells. However, which cells divide to do the healing and how they manage to produce cells that match the cell type of the missing tissue has been unclear. Scientists from the Institute of Science and Technology Austria (IST Austria) have now shown that to correctly replace dead cells, neighbors to the inside of the wound re-activate their stem cell programs.

All plant organs—from the leaves to the root—regularly endure injuries to their [tissue](#), whether due to mechanical forces, grazing animals, or other factors. While animals rely on specialized migrating [cells](#) for wound [healing](#), plants, whose cells are immobile, had to evolve other mechanisms.

It has been known for almost a century that in plants, cells adjacent to the wound replace harmed tissue with new daughter cells. Yet, a completely new aspect of plant wound healing in the sensitive root tip has only recently been discovered: The research team including first authors Petra Marhava, former Ph.D. student at IST Austria, current Ph.D. student Lukas Hörmayer, and former IST postdoc Saiko Yoshida reports that injured or destroyed root cells are not simply replaced by a proliferation of healthy cells from the same cell type above and below to the wound. Instead, the cells adjacent to the inner side of the injury reactivate their stem cell programs to produce de novo cells of the correct type to replace missing neighbors. The researchers termed this newly discovered restorative cell division process "restorative patterning."

The missing neighbor: Tissue gaps activate division of "healing cells" in adjacent tissue



A root tip consists of constantly dividing cells of specific types. These cell types are oriented in concentric circles around the middle cells and originate from a few stem cells in the stem cell niche located in the very tip of the root (white

cells). Credit: IST Austria/Lukas Hörmayer

With a UV laser, Marhava et al. removed individual cells or small cell groups in the root tip of the model plant *Arabidopsis thaliana*. Live imaging via vertical stage microscope allowed them to track the wound healing process in vivo. Restorative patterning could be observed in various specified tissue layers: epidermis, cortex, endodermis, and in innermost pericycle cells encircling the vascular tissue.

In all tissue layers, the restorative patterning started with the division of the inner adjacent cells in response to a damaged or missing neighbor cell. However, compared to regular proliferative divisions, the cell cycle of these "healing cells" happened significantly faster and included a shift of division planes by 90 degrees, allowing the cells to arrange perpendicular to the root axis (for the root to grow in length, root tip cells usually arrange parallel to the root axis).

Identity switch: Daughter cell of different type than mother cell

After cell division was complete, genetic marking showed that the resulting cell types matched those of the missing cells. For example, if a missing cortex cell was to be replaced by a newly generated daughter cell from an adjacent endodermis cell, this daughter cell acquired the new and "correct" cell type of a cortex cell. Thus, activated "healing cells" are able to divide asymmetrically, i.e. they generate [daughter cells](#) of a different type than the mother cell, a process that typically only occurs in the root's stem cell niche, from which stem cells emanate.

The roots of curiosity: Next generation scientist is looking closely at

plant growth processes

How a stem cell program in an already specialized cell is activated remains unknown. However, for Lukas Hörmayer, this study is only the beginning. "We are convinced that in further studies, molecular genetics, among other methods, will reveal not only a broader understanding of the underlying mechanisms of plant wound healing, but also how plants establish and maintain their body patterns."

Having grown up on a winery in Lower Austria, [plants](#) have always fascinated the young scientist: "This is a look far into the future, but the mere thought of what other discoveries beyond present knowledge my plant root research may bring about, drives my curiosity," Hörmayer concludes.

More information: *Cell* (2019). [DOI: 10.1016/j.cell.2019.04.015](https://doi.org/10.1016/j.cell.2019.04.015)

Provided by Institute of Science and Technology Austria

Citation: Specialized plant cells regain stem-cell features to heal wounds (2019, May 2) retrieved 17 July 2024 from <https://phys.org/news/2019-05-specialized-cells-regain-stem-cell-features.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--