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PRESS RELEASE

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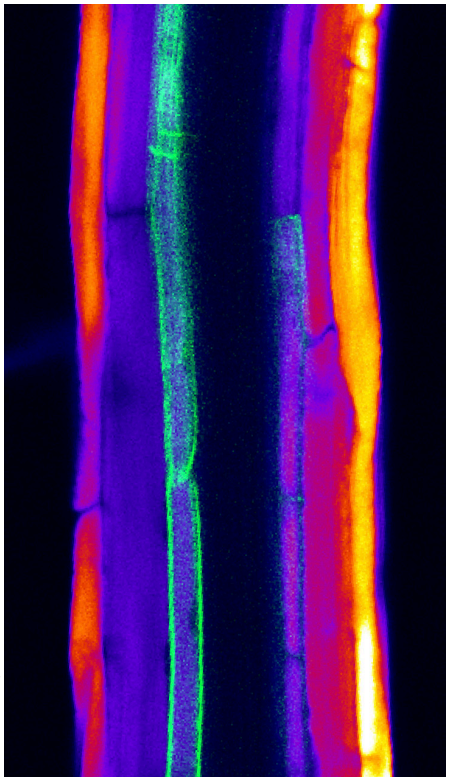
Plants feed through one-way routes

UNIGE scientists reveal unidirectional nutrient transport in roots, opening new avenues to enhance plant resistance to drought stress.

Plants transport water and nutrients from their environment through specialised pores. Researchers at the University of Geneva (UNIGE) have shed light on a little-known but essential mechanism for proper plant function: the directionality of nutrient transport in roots. The team demonstrates that this transport becomes unidirectional as the root develops. This discovery highlights the central role of the pores connecting plant cells and opens up new perspectives for improving plant resistance to water stress. These findings are published in the journal *Molecular Plant*.

Roots play a vital role in water and nutrient uptake, which is essential for plant growth, development, reproduction, and productivity — particularly in crops of agronomic interest. Water and nutrients from the surrounding soil are first actively absorbed by the outermost root layer, the epidermis. From there, they must pass through several concentric layers of cells to reach the central vascular tissues, which distribute these elements throughout the plant via the sap.

These root layers are organized into distinct structures: epidermis, cortex, endodermis, and vascular tissues. For over a century, scientists have assumed that water and nutrients cross these layers through plasmodesmata – microscopic pores that connect plant cells and form channels for molecule exchange. “Although this has been widely taught, it had never been directly proven. We wanted to test this assumption experimentally,” explains Marie Barberon, professor in the Department of Plant Sciences at UNIGE’s Faculty of Science.



Detection of a fluorescent probe transported from the root periphery to the inner layers via plasmodesmata

High resolution pictures

A Challenged Assumption

Professor Barberon’s lab investigates how nutrient uptake is regulated during root development and cell differentiation. Using small fluorescent molecules (GFP – Green Fluorescent Protein), the team was able to trace how substances travel through plasmodesmata in *Arabidopsis thaliana*, a model plant species. In young roots, where cells are not yet fully specialised (e.g., before vascular tissues are formed), GFP molecules could freely move in both directions – from outer to inner layers and vice versa.

“But in mature roots, we found that transport becomes unidirectional – strictly from the periphery toward the central vessels,” explains Léa Jacquier, researcher in Marie Barberon’s laboratory and first author of this study. GFP molecules placed in the outer layers were later found in deeper tissues, but never the other way around. “This was

unexpected, but it likely reflects an optimised system that ensures essential resources efficiently reach the vascular tissues," adds Celeste Fiorenza, PhD student in Marie Barberon's laboratory and co-author of the study.

Mutant Plants With Better Drought Resistance

To understand what controls this one-way transport, the scientists looked for genetic mutants that would allow bidirectional movement. They identified a mutant, called *sesame*, whose plasmodesmata were abnormally wide. This suggests that the size of these pores is key to ensuring one-way flow. While *sesame* mutants showed only minor nutrient defects under optimal growth conditions, they were much more resilient during drought. After two weeks without water, only a few normal plants resumed growth upon rewatering – but most *sesame* plants recovered robustly.

"We don't yet know exactly how these plants cope better with drought," says Marie Barberon, "but our findings show that understanding intercellular transport mechanisms could lead to crops that absorb nutrients more efficiently or withstand water stress – a crucial issue for agriculture in the face of climate change."

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