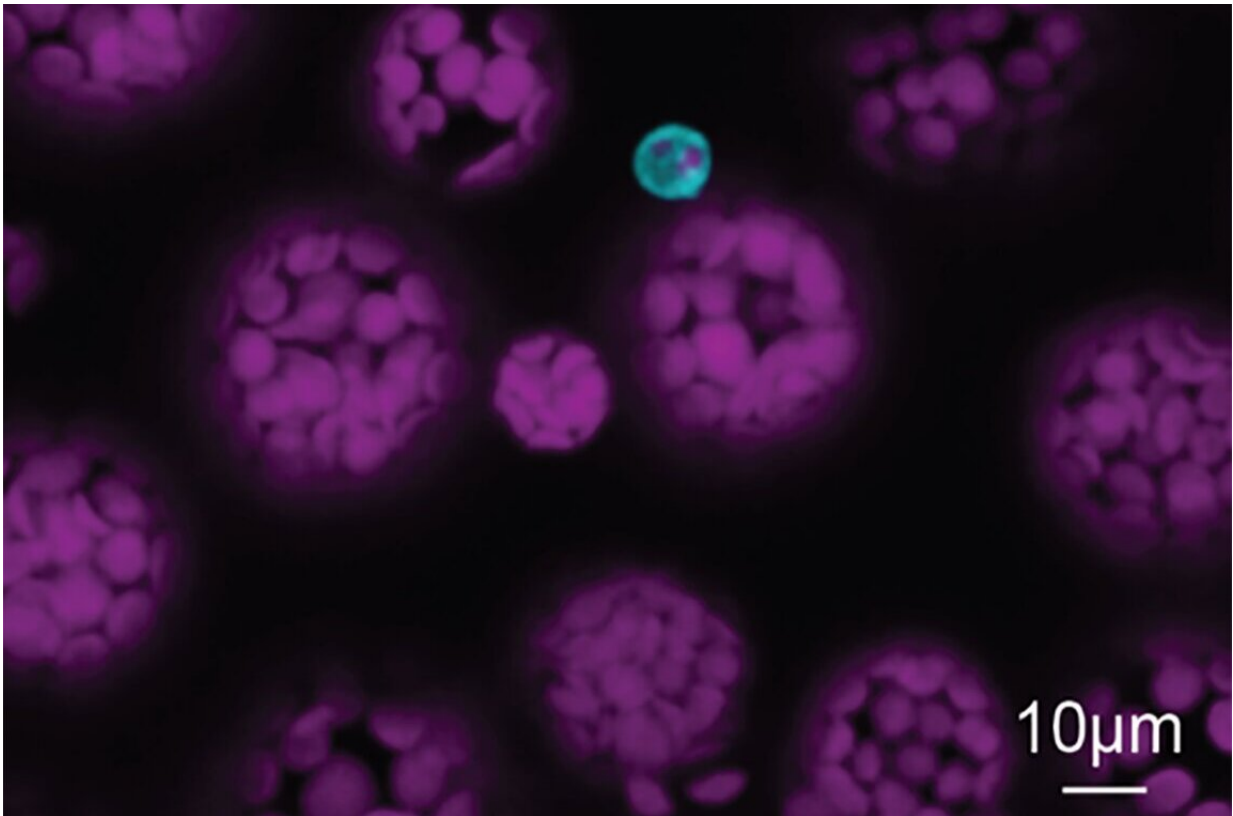


Comprehensive characterization of vascular structure in plants

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Isolated vascular cells of *Arabidopsis*; phloem parenchyma cells are labeled in cyan. Credit: HHU / Ji-Yun Kim

The leaf vasculature of plants plays a key role in transporting solutes from where they are made—for example from the plant cells driving

photosynthesis—to where they are stored or used. Sugars and amino acids are transported from the leaves to the roots and the seeds via the conductive pathways of the phloem.

Phloem is the part of the tissue in [vascular plants](#) that comprises the sieve elements—where actual translocation takes place—and the companion [cells](#) as well as the phloem parenchyma cells. The [leaf](#) veins consist of at least seven distinct cell types, with specific roles in transport, metabolism and signaling.

Little is known about the vascular cells in leaves, in particular the phloem parenchyma. Two teams of Alexander von Humboldt professorship students from Düsseldorf and Tübingen, a colleague from Champaign Urbana in Illinois, U.S., and a chair of bioinformatics from Düsseldorf have presented the first comprehensive analysis of the vascular cells in the leaves of thale cress (*Arabidopsis thaliana*) using single cell sequencing.

The team led up by Alexander von Humboldt Professor Dr. Marja Timmermans from Tübingen University was the first to use single cell sequencing in [plants](#) to characterize root cells. In collaboration with Prof. Timmermans' group, researchers from the Alexander von Humboldt Professor Dr. Wolf Frommer in Düsseldorf succeeded for the first time in isolating plant cells to create an atlas of all regulatory RNA molecules (the transcriptome) of the leaf vasculature. They were able to define the role of the different cells by analyzing the metabolic pathways.

Among other things, the research team proved for the first time that the transcript of sugars (SWEET) and [amino acids](#) (UmamiT) transporters are found in the phloem parenchyma cells which transport these compounds from where they are produced to the vascular system. The compounds are subsequently actively imported into the sieve element companion cell complex via the second group of transporters (SUT or

AAP) and then exported from the source leaf.

These extensive investigations involved close collaborations with HHU bioinformatics researchers in Prof. Dr. Martin Lercher's working group. Together they were able to determine that phloem parenchyma and [companion cells](#) have complementary metabolic pathways and are therefore in a position to control the composition of the phloem sap.

First author and leader of the work group Dr. Ji-Yun Kim from HHU explains: "Our analysis provides completely new insights into the leaf vasculature and the role and relationship of the individual leaf cell types." Institute Head Prof. Frommer adds: "The cooperation between the four working groups made it possible to use new methods to gain insights for the first time into the important cells in plant pathways and to therefore obtain a basis for a better understanding of plant metabolism."

More information: Distinct identities of leaf phloem cells revealed by single cell transcriptomics, *The Plant Cell* (2021). [DOI: 10.1093/plcell/koaa060](#)

Provided by Heinrich-Heine University Duesseldorf

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