Shedding light on the building blocks of photosynthesis at the cellular level

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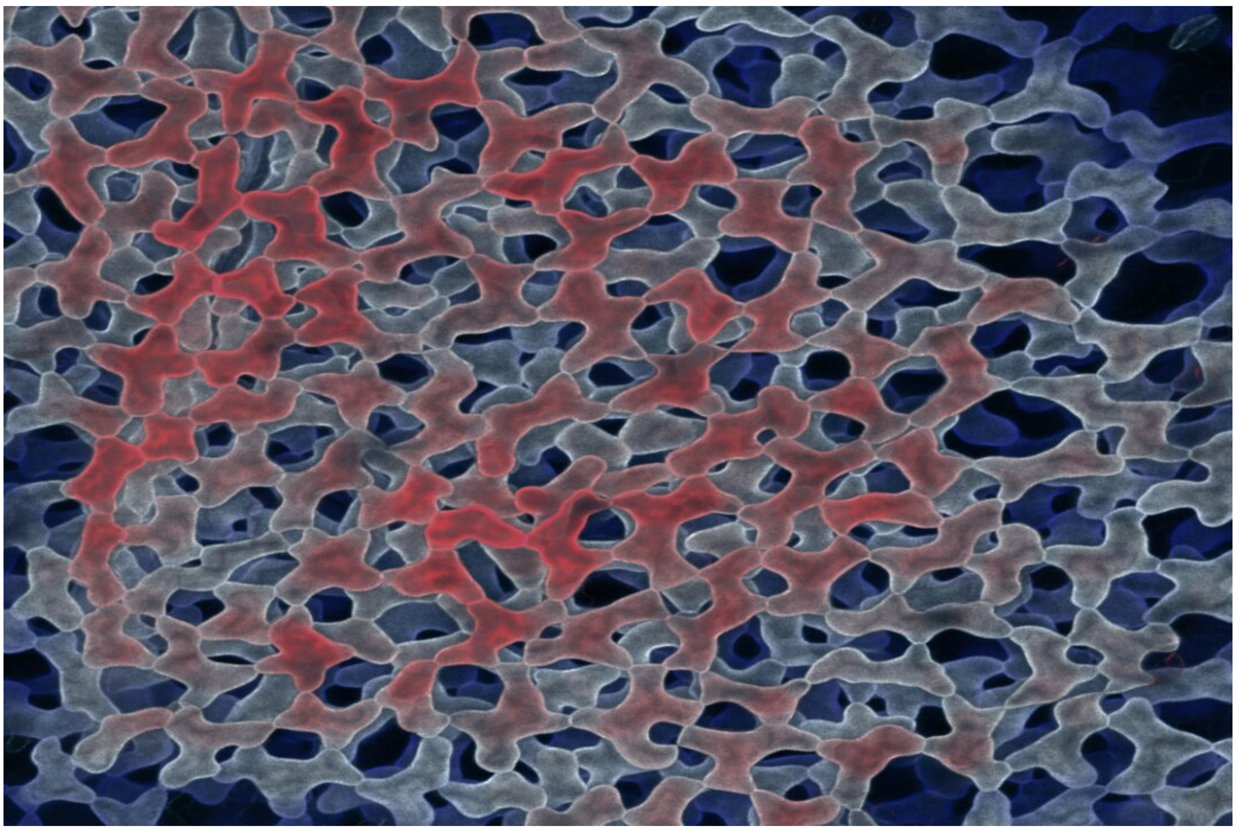

Microscope image of mesophyll cells. Credit: Dr. Chris Ambrose

In a new study recently published in *Nature Plants*, University of Saskatchewan (USask) researchers took a deeper look into how plants control the growth of the important cells that allow them to convert sunlight into chemical energy.

"Mesophyll cells are the site of one of the defining traits of the plant kingdom—the ability to capture sunlight and convert it into chemical energy through photosynthesis—and are arguably the most important cells inside every plant," said Dr. Chris Ambrose (Ph.D.), an associate professor in the Department of Biology at USask's College of Arts and Science.

How mesophyll cells grow and develop their delicate, network-like structure can have many implications on their ability to turn sunlight into energy. Plant cells are unique in that they are encased within rigid cell walls that do not allow them the ability to rearrange during growth, which is a fundamental step in the development of animal cells. To maintain their structure, plant cells need to grow and develop only in specific directions—referred to as the cell division plane.

To tackle the question of how cell division patterns influence the organization of the photosynthetic mesophyll cells in plant leaves, Ph.D. student Liyong Zhang and supervisor Ambrose used confocal light microscopy to watch cell divisions in living leaves over the course of several days.

The team found that each successive cell division occurs perpendicular to the previous, creating T-shaped cellular intersections. These intersection points provide the starting location of intercellular space formation. However, as the intercellular spaces enlarge over hours to days, cell divisions stop alternating, and instead cells begin to point toward the enlarging intercellular space. In contrast to alternating cell divisions, these space-oriented divisions do not establish new T-shaped cell junctions. This halts the production of new intercellular spaces, which ultimately dictates leaf size, shape, and photosynthetic efficiency.

An important discovery by the team was that this delicate balance between two cell division planes is controlled by a protein called CLASP. In plants lacking a functional CLASP protein, this balance of cell divisions is broken, resulting in highly disorganized mesophyll cells, which may ultimately compromise the plant's ability to properly photosynthesize.

"This study sheds new light on a fundamental pillar of plant biology—cell division patterning—and establishes a new link with one of the defining cell types in plants, the leaf mesophyll," said Ambrose.

Ambrose's research group plans to build on this work by further studying how oriented cell division planes influence later processes in a cell's life, such as cell size and shape, and ultimately how this contributes to the shape and functioning of leaves.

More information: Liyong Zhang et al, CLASP balances two competing cell division plane cues during leaf development, *Nature Plants* (2022). DOI: 10.1038/s41477-022-01163-5

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