Plants can resist climate change challenges and recover from drought by adjusting lignin 'chemical code'

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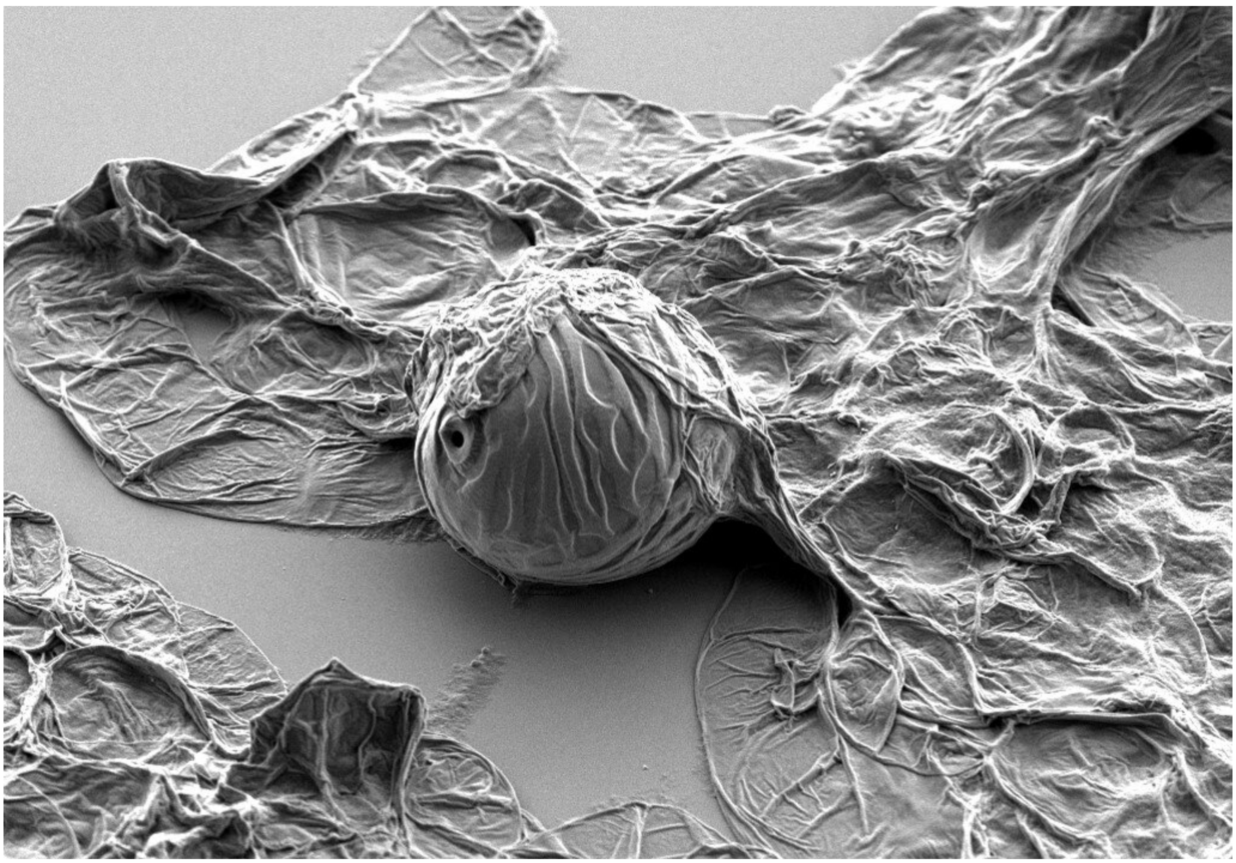

Plant pipe cell reinforced with lignin is highly resistant to negative pressure in contrast to the other flattened cells around. Credit: Cheng Choo Lee

A new study shows that we can create and/or select plants that can better recover from drought without affecting the size of the plant or seed yield by genetically modifying their lignin chemistry. These results could be used in both agriculture and forestry to tackle future climate challenges.

Lignin, the second most abundant biopolymer on Earth, represents about 30 percent of the total carbon on the planet. It allows plants to conduct water and stand upright; without lignin, plants cannot grow nor survive.

"Plants are made of many different cells, some of them are reinforced with lignin and assemble to each other to form a pipe that conducts water, like a straw to drink your cocktail," explains Delphine Ménard, Head of the cell cultures platform at Stockholm University Department of Ecology, Environment and Plant Sciences (DEEP), "lignin is so strong that the pipe cells can resist vacuum while other cells are flattened."

For a long time, scientists did not consider that lignin had a "code" like in DNA or proteins. Researchers led by DEEP in collaboration with Stockholm University Department of Materials and Environment Chemistry (MMK) and Tokyo University of Agriculture and Technology (TUAT) have now challenged this old paradigm by demonstrating the existence of a lignin "chemical code." They showed that each cell uses this "chemical code" to adjust their lignin to function optimally and resist stresses. These results are published in *The Plant Cell* and could be used in both agriculture and forestry to tackle future climate challenges.

"It takes only one simple chemical change, just one hydrogen atom apart from alcohol to aldehyde to make plants highly resilient to drought in conditions where alcohol-rich plants would all die," explains Edouard Pesquet, Associated Professor in molecular plant physiology and senior author of the study.

Interestingly, Professor Shinya Kajita from TUAT showed that such large increases of lignin aldehydes can occur naturally in the wild. In the Japanese silk industry for example, mulberry with the highest lignin aldehyde levels have long been used and loved by silk caterpillar.

"These results revise our understanding of lignin and plant water conduction, but also open great possibilities to use the lignin code to improve crops and trees to face water availability problems. The modification of lignin chemistry at the single cell level is ultimately the mechanism enabling plants to grow, hydrate and resist climate change stresses," says Edouard Pesquet.

More information: Delphine Ménard et al, Plant biomechanics and resilience to environmental changes are controlled by specific lignin chemistries in each vascular cell type and morphotype, *The Plant Cell* (2022). DOI: 10.1093/plcell/koac284. academic.oup.com/plcell/advanc … cell/koac284/6709353

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