How plants regulate sugar deposition in cell walls

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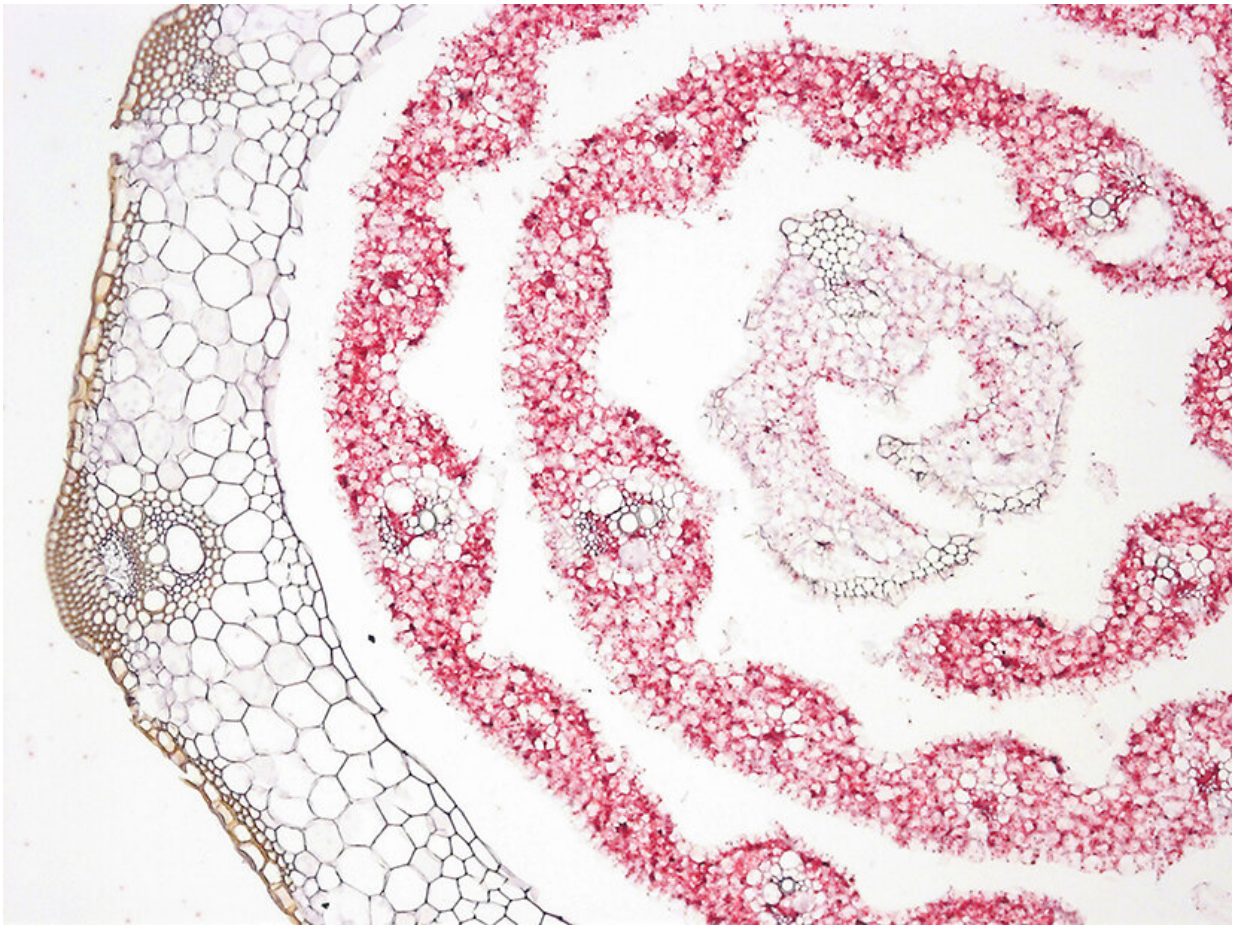

Inside the long leaf and leaf sheath of a model grass, plants store a six-carbon sugar (red, immunolabeling). Understanding how plants pack in the sugar could help in engineering sorghum plants to produce more sugars for biofuels. Credit: US Department of Energy

Ultimately, researchers want to engineer bioenergy crops to accumulate large amounts of easy-to-use sugars. Researchers from the Great Lakes Bioenergy Research Center identified a major part of the sugar production process in a model leafy grass. They discovered a transcription factor, which turns a gene on and off. The gene triggers the synthesis of a sugar, called mixed-linkage glucan (MLG). Characterizing downstream genes regulated by this transcription factor provides insight into how plants make MLG. This information is vital to overcoming growth defects associated with engineering plants to produce large quantities of MLG.

To make fuels from grasses or other plants, scientists often focus on certain sugars, such as mixed-linkage glucan. Understanding the genes that produce and restructure such sugars should lead to a better understanding of how the bioenergy grass sorghum stores sugar in cell walls. With such information, Great Lakes Bioenergy Research Center researchers aim to engineer bioenergy crops like sorghum to accumulate large amounts of the sugar in the stem. They aim to do it without disrupting plant growth.

Mixed-linkage glucan (MLG) is an energy-rich polysaccharide found at high levels in some grass endosperm cell walls and at lower amounts in other tissues. Cellulose synthase-like F and cellulose synthase-like H genes synthesize MLG, but it is unknown if other genes participate in the production and restructuring of MLG. Working with the model grass Brachypodium distachyon, GLBRC researchers identified a trihelix family transcription factor (BdTHX1) that is highly co-expressed with the BdCSLF6 gene and which appears to help regulate MLG biosynthesis. They showed that BdTHX1 protein can bind with high affinity to BdCSLF6 as well as BdXTH8, which encodes a grass-specific endotransglucosylase, an enzyme involved in cell wall structuring.

The team found that BdXTH8 preferentially interacts with MLG and

xyloglucans, suggesting it may mediate their binding in plant tissues. In addition, B. distachyon shoots grown from cells overexpressing BdTHX1 showed abnormal growth and early death. These results indicate that the transcription factor BdTHX1 likely plays an important role in MLG biosynthesis and restructuring by regulating the expression of BdCSLF6 and BdXTH8. This knowledge will be instrumental for engineering the bioenergy grass sorghum to accumulate large amounts of MLG in its stem tissue.

More information: Mingzhu Fan et al. A Trihelix Family Transcription Factor Is Associated with Key Genes in Mixed-Linkage Glucan Accumulation, *Plant Physiology* (2018). DOI: 10.1104/pp.18.00978

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