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**Regulation of plant cell wall sugar deposition**

Identification of genes involved in plant cell wall polysaccharide production and restructuring

**The Science**

With the goal of ultimately engineering bioenergy crops to accumulate large amounts of easily digestible sugars, researchers from the Great Lakes Bioenergy Research Center (GLBRC) have identified a transcription factor that is highly co-expressed with the major mixed-linkage glucan (MLG) synthase gene in the model grass *Brachypodium distachyon*. Characterization of downstream genes regulated by this transcription factor provides insight into the mechanism of MLG production and restructuring, information vital to overcoming known growth defects associated with MLG synthase overexpression.

**The Impact**

Identification of genes involved in the production and restructuring of mixed-linkage glucan (MLG), an easily digestible six-carbon sugar, should lead to a better understanding of how plants store MLG in their cell walls. With such information, GLBRC researchers aim to engineer bioenergy crops like sorghum to accumulate large amounts of MLG in the stem without disrupting plant growth.

**Summary**

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* (*CSLF*) and *cellulose synthase-like H* (*CSLH*) 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. *BdXTH8* was found to preferentially interact 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.

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**Publications**

Fan, M. *et al.* “A trihelix family transcription factor is associated with key genes in mixed-linkage glucan accumulation.” *Plant Physiology* **178**, 1207-1221 (2018) [DOI: 10.1104/pp.18.00978].

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