BRC Science Highlight
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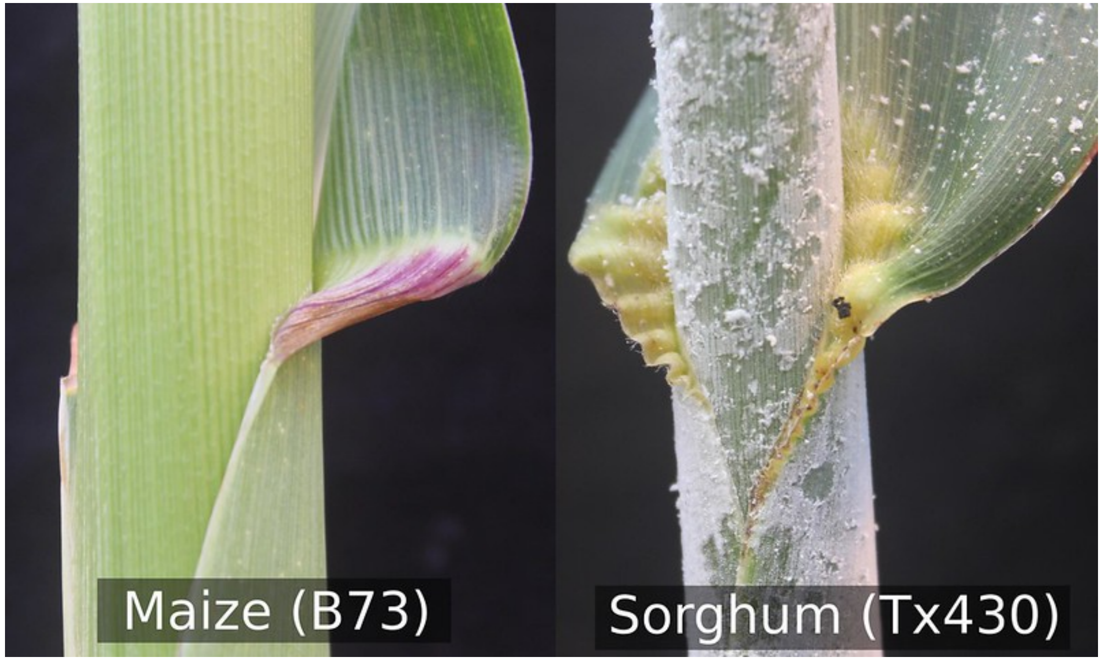
A Co-Opted Steroid Synthesis Gene, Maintained in Sorghum but Not Maize, is Associated with a Divergence in Leaf Wax Chemistry

Background/objective

Virtually all land plants are coated in a cuticle, a waxy polyester that prevents nonstomatal water loss and is important for heat and drought tolerance. Based on the importance of cuticular wax chemistry in *Sorghum bicolor* (sorghum), a drought-tolerant crop widely cultivated in hot climates, the primary objective of this study was to develop our fundamental knowledge in this area, particularly in a comparative context with its close relative *Zea mays* (maize).

Approach

This study combined detailed chemical analyses of the sorghum leaf surface, bioinformatics-guided characterization of sorghum wax synthesis genes by heterologous expression, as well as ancestral state reconstruction and a comparative genomics analysis of critical sorghum wax synthesis genes across six grass species, including sorghum and maize.



Comparison of the wax load on stems of maize (B73) and sorghum (Tx430). The high content of sorghum surface waxes contributes to the heat and drought tolerance of this CABBI feedstock. Photo credit: Yang Zhang (Schnable Lab), University of Nebraska at Lincoln

Results

- Sorghum and maize leaf waxes are similar at the juvenile stage, but after the juvenile-to-adult transition, sorghum leaf waxes are rich in triterpenoids that are absent from maize.
- Biosynthesis of the majority of sorghum leaf triterpenoids is mediated by a gene that maize and sorghum both inherited from a common ancestor but is only functionally maintained in sorghum.
- Sorghum leaf triterpenoids accumulate in a spatial pattern that can strengthen the cuticle and decrease water loss at high temperatures.

Significance

- These findings uncover a likely genetic basis for the presence and absence, respectively, of triterpenoids in the leaf waxes of sorghum and maize that could create a more heat-tolerant water barrier on the plant’s leaf surfaces.
- These results provide a fundamental understanding of sorghum leaf waxes that will inform efforts to divert surface carbon to intracellular storage for bioenergy and bioproduct innovations.

Busta, L., et al., 2021. "A Co-Opted Steroid Synthesis Gene, Maintained in Sorghum but Not Maize, is Associated with a Divergence in Leaf Wax Chemistry." PNAS, 118(12). DOI: 10.1073/pnas.2022982118