Understand the Nanoarchitecture of Native and Engineered Plant Cell Wall via Multi-dimensional Solid-state NMR

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Project Goals: Develop the fundamental understanding of cell wall biology and develop tools to facilitate bioenergy crop improvement.

Abstract: Lignocellulosic biomass will be a major sustainable feedstock for the burgeoning bioeconomy. Understanding the biosynthesis and nanoarchitecture of the plant cell wall is important foundational knowledge to enable predictive cell wall engineering. Multi-dimensional solid-state NMR spectroscopy facilitates the detailed structural elucidation of intact wild-type and engineered plant cell walls, which allows us to better understand the impact of genetical modification on the native plant cell wall architecture and refine our genetical models of the plant cell wall. Here, we present our recent findings in wild type sorghum secondary cell walls. With 2D INADEQUATE experiments, we demonstrate that, unlike dicot and softwood plant cell walls, most grass cell wall xylan is in the three-fold screw conformation. Also, we use PDSD experiments to show that three-fold screw xylan is responsible for the most of the cellulose-xylan interactions via amorphous cellulose. Additionally, we determine that sorghum secondary walls have approximately three fold more amorphous cellulose compared to Arabidopsis, a model dicot plant. We propose a model of grass secondary cell wall with a new configuration of cellulose-xylan interaction, which will provide insights for future sorghum engineering strategies.

References/Publications

1. Gao, Y., Lipton, A.S., Wittmer, Y. *et al.* A grass-specific cellulose–xylan interaction dominates in sorghum secondary cell walls. *Nat Commun* **11,** 6081 (2020). https://doi.org/10.1038/s41467-020-19837-z

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