A Systematic Pipeline for Biomass Characterization Using Aligned Mechanical Stress Analysis, Polarized Raman Microspectroscopy and Scanning Electron Microscopy

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Project Goals:
Physical Characterization of plant stems and leaves.

Cellulose and hemi-cellulose present in lignocellulosic biomass can be converted to simple sugars through enzymatic hydrolysis and hence to advanced biofuels. Genetic modification of lignocellulosic biomass may enhance saccharification yields, but may weaken the plant's strength and recalcitrance to biochemical attack in nature. Any successful rational engineering approach requires an in-depth structural and chemical understanding of the consequences of biomass genetic engineering. A suite of biophysical tools were used to characterize differences in the rice mutants regarding mechanical strength, cell wall composition and fiber organization/ orientation. Tensile stress testing followed by SEM imaging of the fractured plant material revealed substantial differences in mechanical strength and elasticity for mutant plants compared to wildtype as well as for plants culturing conditions (long day versus short day), suggesting high sensitivity for this method. To address the effect of mutagenized genes on cell wall fiber organization we developed a polarized Raman microspectroscopy approach, and have found clear differences in the degree of cell wall fiber orientation between mutant and wildtype plants. We are currently evaluating the correlation of both cell wall strength and organization on the saccharification yield.

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