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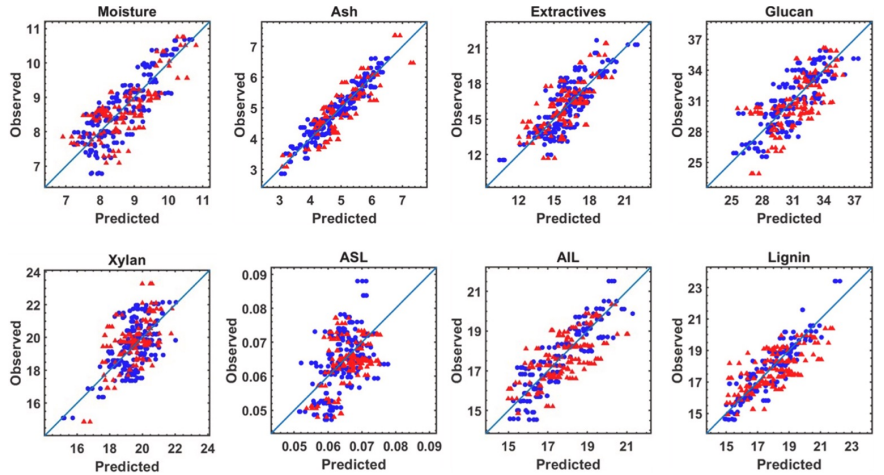
Rapid and High-Throughput Determination of Sorghum (*Sorghum bicolor*) Biomass Composition Using Near Infrared Spectroscopy and Chemometrics

Background/Objective

- Compositional characterization of biomass is vital for the biofuel industry. Traditional wet chemistry-based methods for analyzing biomass composition are laborious, time-consuming, and require extensive use of chemical reagents as well as highly skilled personnel.
- In this study, the specific objectives were to develop full spectral range partial least squares regression (PLSR) models and robust PLSR models based on selected important wavelengths for rapid and high-throughput characterization of sorghum biomass. Near-infrared (NIR) spectroscopy was used to quickly assess the composition of above-ground vegetative biomass from 113 diverse, photoperiod-sensitive, biomass-type sorghum (*Sorghum bicolor*) accessions cultivated under field conditions in central Illinois.

Approach

Biomass samples were analyzed using NIR spectra collected in the spectral range of 867–2536 nm, with their chemical compositions determined following the National Renewable Energy Laboratory (NREL) protocol. Advanced spectral pre-treatment and band selection techniques were utilized to develop calibration models using PLSR.



Prediction of sorghum biomass composition using selected bands.

Results

The prediction ability of PLSR models using selected wavelengths was better than that of PLSR models using full raw spectra. The developed PLSR models with a few selected wavelengths showed excellent model performance for moisture, ash, extractives, glucan, acid-insoluble lignin (AIL), and lignin contents. Compared to full wavelength models, the models based on a few selective wavelengths reduced RMSE by 29%, 33%, 17%, 29%, 9%, and 8% for moisture, ash, extractives, glucan, AIL, and lignin, respectively.

Significance/Impacts

This study demonstrated the potential of NIR spectroscopy as a rapid, real-time, and high-throughput analytical tool for the characterization of sorghum biomass for biofuel and biochemical production. The predictions for moisture, ash, extractives, glucan, xylan, acid-soluble lignin (ASL), AIL, and total lignin were accurate and reliable, demonstrating the capability of NIR spectroscopy to provide rapid and precise characterization of sorghum biomass.

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