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Application of Time-Domain ^{1}H-NMR for Investigating Dynamics of Vegetative Lipids in Bioenergy Crops at Different Developmental Stages

Background/Objective

Until now, sorghum grain was used to produce biodiesel while the remaining biomass was converted to other biofuels such as bioethanol, biogas, syngas, bio-char and biohydrogen. However, owing to the high biomass production per unit of cultivated land and the development of transgenic sorghum varieties with hyperaccumulation of fatty acids and triacylglycerides (TAG) in the vegetative tissues, interest in utilizing stalks and leaves to produce biodiesel is increasing. Here we successfully applied time-domain ^{1}H-NMR (TD-NMR) spectroscopy analysis to non-transgenic sorghum and lay the groundwork for non-invasive, real-time prediction of the most suitable growth stage for harvesting transgenic bioenergy crops having *in situ* vegetative lipids by correlating lipid data to the corresponding plant maturity stage for maximum free lipid fractions.

Approach

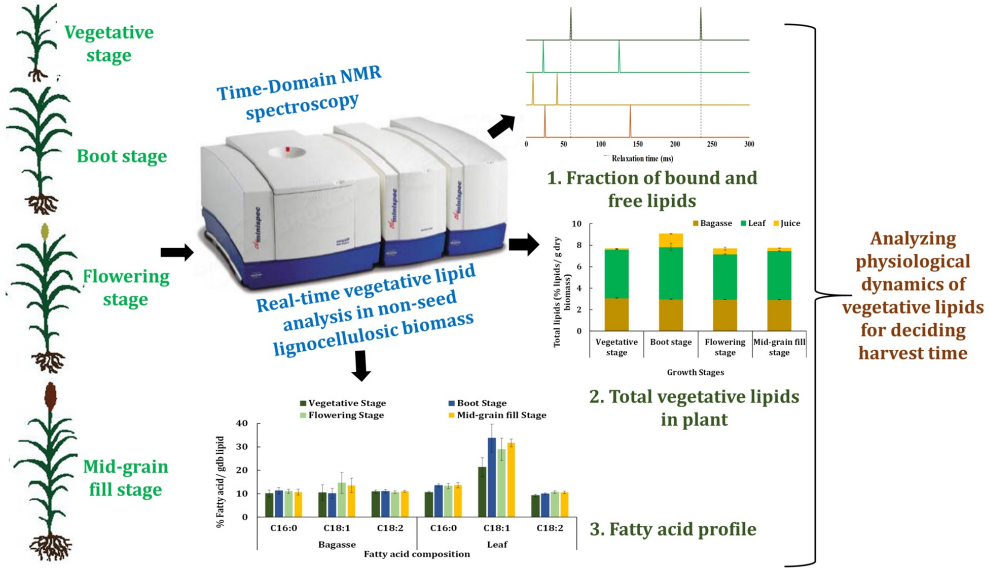
- TD-NMR spectroscopy was used to analyze total in-situ lipids and fatty acid composition of non-transgenic sweet sorghum 'Ramada' leaves and bagasse at different growth stages.
- Performed a multi-exponential analysis of TD-NMR spin-lattice (T1) relaxation spectra to understand the dynamics of the free and bound lipid fractions with plant development.

Results

- Established TD-NMR for real-time lipid screening in vegetative tissues of a wide range of transgenic and non-transgenic bioenergy crops during plant development.
- Used TD-NMR relaxometry data to understand the physiological dynamics of vegetative lipids at different developmental stages to determine appropriate harvest time.

Significance/Impacts

Proof of principle for the application of non-invasive high-throughput TD-NMR spectroscopy in deciding the ideal growth stage for harvesting transgenic bioenergy and oilseed crops.



Application of TD-NMR for analyzing dynamics of vegetative lipids at different growth stages.

Maitra, S., Singh, V. (2023) "Application of Time-Domain 1H NMR for Investigating Dynamics of Vegetative Lipids in Bioenergy Crops at Different Developmental Stages." *Industrial Biotechnology.* DOI: 10.1089/ind.2022.0039.