Rapid Screening of Poplar Leaves for Aromatic Metabolites

Background

- Current extraction-GC/MS analysis methods for characterization of secondary metabolites in poplar leaves require intensive and laborious sample preparation and data analysis processes.
- High-throughput methods are needed for compositional characterization of sustainable, bioenergy-relevant feedstocks such as poplar for population-scale studies and to inform breeding and engineering strategies. Monitoring metabolites in poplar leaves is essential for understanding genetics, plant physiology, and stress response associated with sustainable feedstock production.

Approach

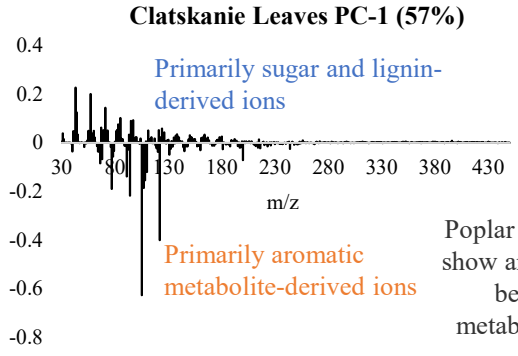
- Poplar leaves were sampled from trees at two common garden sites, one with irrigated and one with drought stress, and subsequently extracted; extracts were then derivatized and analyzed by GC/MS for aromatic metabolites.
- Partial Least Squares Regression models were built using GC/MS data to predict the sum of extractable aromatic metabolites present in poplar leaves by the more rapid high throughput pyrolysis-Molecular Beam Mass Spectrometry (Py-MBMS); simplified ion summation methods were also employed to estimate aromatic metabolite trends in poplar leaves when *a priori* GC/MS data is not available for model construction.

Results

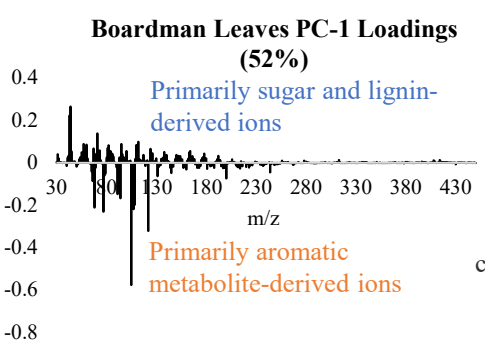
- Py-MBMS spectral variance across the sites shows similar patterns originating from variation in aromatic metabolites. Trends in aromatic metabolite abundances did not vary significantly across genotypes grown in both drought and irrigated plots.
- Site-specific PLS models successfully predicted the sum of aromatic metabolites in poplar leaves.
- An ion summation method can be used to track trends in metabolite abundances across sites without PLS models.

Significance

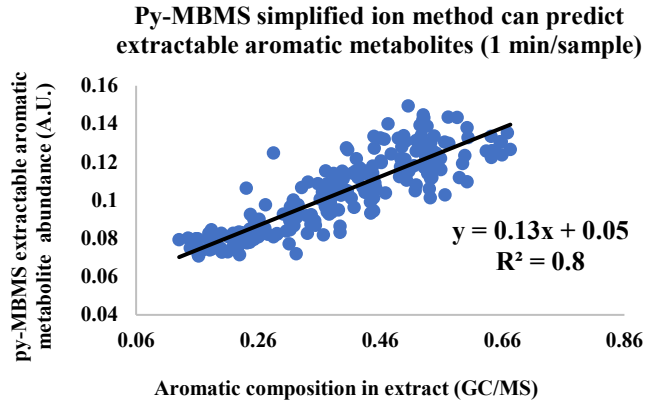
- High throughput py-MBMS can be used to rapidly screen leaves for aromatic metabolite content without any sample preparation beyond cryomilling. This method can be implemented for down-selection of samples needed for deeper metabolomics analyses or to quickly inform genetic or environmental impacts on poplar physiology. Aromatic metabolites are important for lignin biosynthesis and for plant defense.



Poplar leaves in Clatskanie show antithetic relationship between aromatic metabolites and cell wall polymers.



Poplar leaves from Boardman show similar compositional variance to those from Clatskanie.



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