Laser-Induced Breakdown Spectroscopy Allows Rapid Measurement of In Situ Nutrient Element Distributions in Plants and Soils

Aim

- To develop and test the applicability of a rapid *in situ* plant chemistry profiling technique to determine elemental composition in small-volume plant and soil samples obtained from a woody bioenergy crop species, *Populus trichocarpa.*

Approach

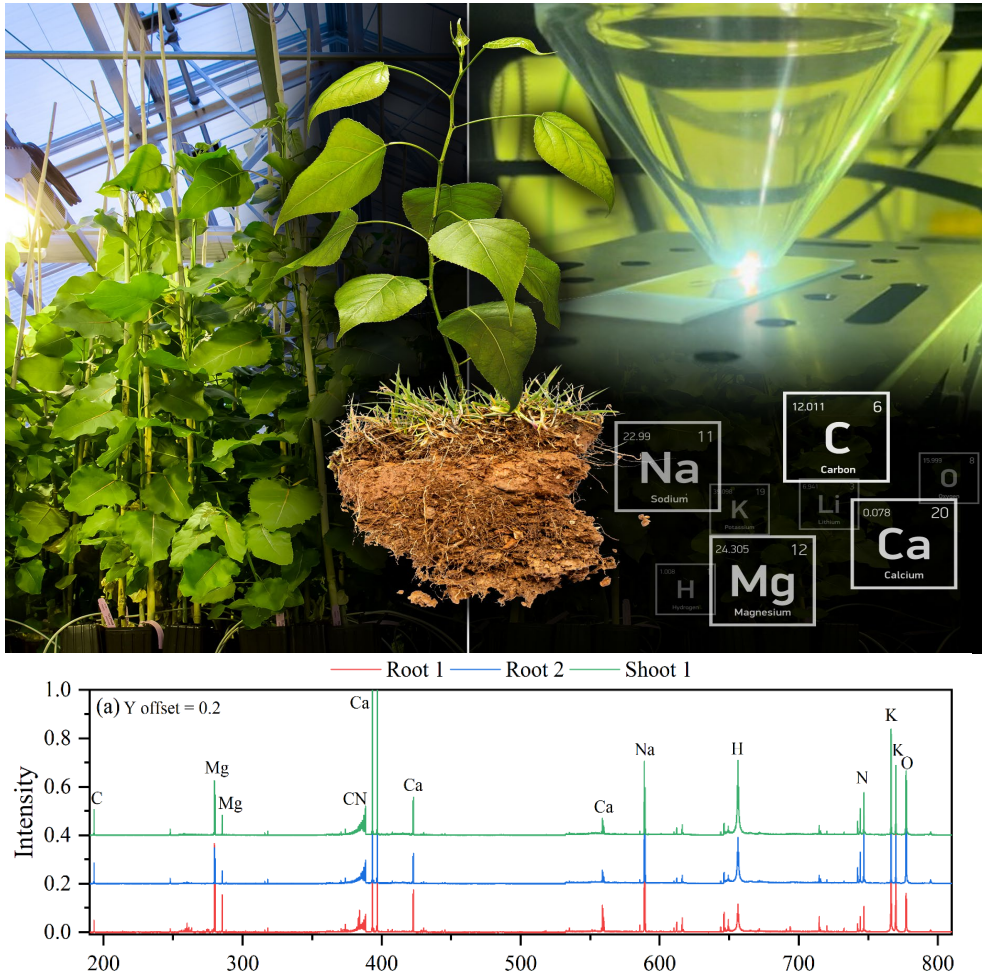
- Plant root, stem, and soil samples were tested using laser-induced breakdown spectroscopy (LIBS) to evaluate the presence and distribution of nutrient elements. Samples were tested as collected (fresh) as well as after being dried and cross sectioned in order to evaluate the effectiveness of using LIBS for *in situ* analysis on plant samples.

Results

- Qualitative amounts of elements such as H, C, N, O, Li, Na, Mg, K, Ca, Fe, Al, and Si were identified rapidly in raw samples.
- LIBS spectra has similar elemental peaks in roots and stem samples, with distinctive peaks in soil samples; this concurs with literature and validates the technique's applicability.
- Rapid, *in situ*, elemental distribution in plant and soil samples, utilizing only small sample volumes and minimal sample preparation was successfully demonstrated.

Significance

- Demonstration of a new tool to rapidly characterize carbon and other nutrient elements in plant tissues and soils. This opens avenues for accelerating our understanding of plant productivity and adaptation fundamentals, and for developing sustainable perennial bioenergy crops that are co-optimized for biomass valorization (into fuels like sustainable aviation fuel, SAF) aboveground and carbon sequestration belowground.



(Top Image) Graphical representation of LIBS analysis of elemental distribution in greenhouse plant and soil samples. (Bottom Image). Stacked normalized and averaged LIBS spectra of root and shoot samples.

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