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Unique capabilities of the BioXAS-Imaging beamline to investigate the distribution of elements in plants

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The distribution of elements within plant tissues can provide important information for a wide range of plant science studies, for example, functional characterization, improving nutrition or plant health, climate adaptation, or contaminants' effects and movement. Synchrotron-based X-ray fluorescence imaging surpasses other methods suitable to determine elemental and chemical species distribution in multiple aspects, such as sensitivity, resolution, tuneability, speed, and minimal sample preparation.

The BioXAS-Imaging beamline at the Canadian Light Source is a recently commissioned hard X-ray (5 - 21 keV) fluorescence imaging beamline with two spatial resolution modes currently in operation. The X-ray source of the beamline is an in-vacuum undulator providing a high spectral brilliance. The primary optics of the beamline consists of a collimating mirror, a fixed-exit double crystal monochromator, and a post-monochromator vertically focusing mirror. The macro mode can deliver a range of apertured beam sizes between 20 μm to 100 μm with photon fluxes (at 10 keV) 1.3×10^{11} ph/s and 2.0×10^{12} ph/s, respectively. An array of samples of different dimensions or a single large sample of 25 cm x 25 cm can also be accommodated. In the micro mode, the beam is focused with the Kirkpatrick-Baez (K-B) mirrors yielding 5 μm x 5 μm beam size with flux (at 10 keV) reaching 3.3×10^{11} ph/s. Bi-directional fly scanning and short dwell time enable rapid scanning in both resolution modes.

The BioXAS-Imaging beamline stands out among other synchrotron beamlines because of its capability to provide several techniques (X-ray fluorescence imaging; in situ X-ray absorption spectroscopy (u-XAS) and XAS imaging) in two resolution modes with a high-level of performance. To showcase the BioXAS-Imaging beamline's capabilities and applications in the plant science field, a few examples of recently collected data will be presented.

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