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Quantitative light element analysis in plant tissues using monochromatic X-ray fluorescence

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Parvinderdeep S. Kahlon[1], Pinelopi Kokkinopoulou[1], Silvia Bugallo Alfageme[1], Cheuk Ka Leong[1], Chenyu Zhang[2], Zewu Chen[3], Christa Testerink[1], Antony van der Ent[2]

[1]Laboratory of Plant Physiology, Wageningen University and Research, Wageningen, The Netherlands.;
[2]Laboratory of Genetics, Wageningen University and Research, Wageningen, The Netherlands.;
[3]Z-Spec, New York, United States of America.

Wageningen University ...

parvinderdeep.kahlon

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We use this protocol and it's working

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Abstract

This protocol is used to quantify light elements (sodium, magnesium, aluminum, silicon, phosphorus, sulfur, chlorine, potassium, and calcium) in plant tissues using monochromatic X-ray fluorescence (XRF). The method is fast, robust and enables analysis of samples as small as 1 mg without digestion or extraction. The approach provides a high-throughput, cost-effective alternative to inductively coupled plasma-mass spectrometry (ICP-MS), suitable for studying nutrient uptake and salinity responses across developmental stages.

Materials

Sample cups, rings, 4.0 µm film, dried plant material (depending on the amount of the plant material select one of the following methods).

Safety warnings

Caution: whenever opening the shutter make sure the X-ray light indication on top of the machine is always off.
Caution: Make sure the X-ray light is off, and the status of the measurement is 'finished' before opening the lid and inserting the next sample for the measurements.

Before start

Note: Avoid the move function to avoid unintentional loss of data.

Preparation of sample cups (50–200 mg sample material) Plunger method

5m

1 Place a layer of film at the top of the sample cup and secure with a ring.
Cut off the excess film with a sharp scalpel.
Place the sample cup upside down on the stage.
Add dried ground sample inside the sample cup to a 3–5 mm thickness or approximately 200 mg.
Press the plunger inside the sample cup to pack the sample.

Preparation of sample cups (1–15 mg) Embedded method

5m

2 Place a layer of film at the top of the sample cup and secure with a ring.
Cut off the excess film with a sharp scalpel.
Make sure to remove any bits and pieces of excess film, to avoid spills inside the machine.
Put the finely ground sample on top of the film.
Place a second layer of film at the top of the sample and use a second ring to embed the sample in-between the two films. Cut off the excess film.
Clean the sample cups for any sample residues to avoid any spill overs inside the machine.

XRF Elite measurement

5m

3 Switch on the machine by pressing the ‘switch on’ button for 3 s and wait for 30-60 s for initialisation.
Set-up the parameters of experiment under ‘Set-up’ on the initial screen.
Standard parameters are: 60 s test time, 30 s interval time.
Open the sample cup holder shutter and remove the stopper from front of the detector.
Clean the sample area from the dust particles.
Place the sample cup into the cup holder in instrument and close the lid.
Press the start tab on the screen for starting the measurement.

Retrieving and processing the data

2m

4 Once all the measurements are complete, export the data as follows: history/export/curve name=material selected while setting up the parameters of the experiment and export the csv file. Firmware can export up to 200 measurements in one single csv. File. If more measurements need to be exported, data can be extracted by getting single excel files and transforming them manually. That can be performed as follows: transfer/select the data you want/copy.
Note: Avoid the move function to avoid unintentional loss of data.