EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office via the User Portal:
https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Deadlines for submission of Experimental Reports

Experimental reports must be submitted within the period of 3 months after the end of the experiment.

Experiment Report supporting a new proposal ("relevant report")

If you are submitting a proposal for a new project, or to continue a project for which you have previously been allocated beam time, you must submit a report on each of your previous measurement(s):

- even on those carried out close to the proposal submission deadline (it can be a *"preliminary report")*,
- even for experiments whose scientific area is different form the scientific area of the new proposal,
- carried out on CRG beamlines.

You must then register the report(s) as "relevant report(s)" in the new application form for beam time.

Deadlines for submitting a report supporting a new proposal

- 1st March Proposal Round - **5th March**
- 10th September Proposal Round - **13th September**

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report in English.
- include the experiment number to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** Study of nano-plastic interaction with plants	**Experiment number**: EV347
Beamline: id19	**Date of experiment**: from: 17/11/2018 to: 19/11/2018	**Date of report**:
Shifts: 6	**Local contact(s)**: Elodie Boller, Yin Cheng	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Geraldine Sarret: ISTerre /CNRS

Denise Mitrano: EAWAG

Hiram Castillo-Michel: ESRF

Roxanne Calais: ESRF

Ana Elena Pradas del Real: IMIDRA/ESRF

Report:

Pollution with plastic debris is an environmental problem of increasing concern. Plastic debris includes tiny plastic fragments, fibers and granules. Depending on their size, they are classified as microplastics (polymer fragments <5 mm in size) and nanoplastics (<1000 nm). They are used in consumer products or formed by the breakdown of larger polymer particles. To date, most environmental studies regarding the fate and effects of micro-and nano-plastics have been focused on marine ecosystems. However, recent studies show that agricultural soils are also a major sink of plastics. Plastic waste arrives to soils mainly through the application of sewage sludge, biowaste digestates and through the use of plastic mulch films.Nanoplastics are of particular concern because a recent study showed that they can be taken up by plants with the potential to bioaccumulate and biomagnify through the food chain. However, there is still very limited information about the uptake and effects of nanoplastics on plants, the main reason is the lack of analytical methods to detect nanoplastics in complex organic matrix such us plant tissues.

In the present study, wheat plants were grown in hydroponics and exposed to Pd-doped nanoplastics at various concentrations. Plant growth and different physiological parameters were determined. Nanoplastic accumulation in plant tissues was determined based on Pd concentration by ICP-MS. Scanning electron microscopy (SEM) and micro X Ray fluorescece (μXRF) showed nanoplastic accumulated in the surface of root forming aggregates of several microns.

The pourpose of the present experiment was to perform 3D imaging at sub-micron scale using computed microtomography (μCT) available at id19 in order to: 1) study the effects of nanoplastics in root anatomy and, ii) test if phase contrast can be used to locate nanoplastic aggregates in roots.

To this end, after exposure to nanoplastics, plant roots were prepared by critical point drying. They were mounted into small plastic vials and subjected to synchrotron-computed microtomography in ID19 beamline at

the ESRF. Scans were acquired at 26.5 keVs, close to Pd K-edge (24.3 keVs). In total 4000 projections were acquired with a spatial resolution of 0.72µm and an acquisition time of 50ms each over a rotation of 360°. The images were reconstructed using the Paganin´s method applying a delta/beta ratio of 300.

A total of 42 samples were analysed including different areas of the roots, exposure conditions and replicates. Overall, the experiment was very succesfull, the quality of the obtained 3D reconstructions was very good (Figure 1). Currently, we are finalizing the segmentation of the volumes that will provide information about the density and local thicknes of cell walls and about cell volumens in the epidermis, cortex and stele of roots. We are writing the article related with these results.

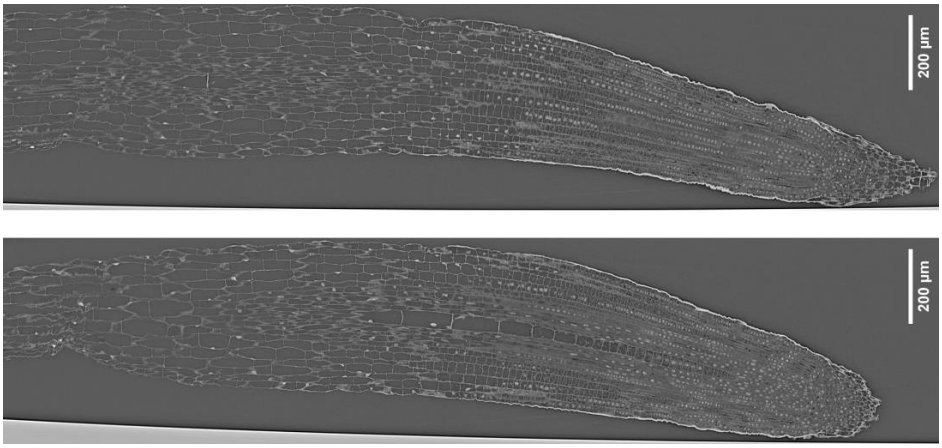

Figure 1: Example of root volumen reconstruction