First maps of nutrients in ectomycorrhizal roots

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Introduction

Ectomycorrhizal symbiosis is well known for its positive effect on P and K nutrition of the host plant. However, there is no data available regarding the distribution of P and K in ectomycorrhizal vs non mycorrhizal roots. In this work, we used the Synchrotron facility and the LUCIA beamline to map P and K in roots of Pinus pinaster, whether or not associated with the ectomycorrhizal basidiomycete Hebeloma cylindrosporum.

Material and Methods:

Plants were grown for 2 months in rhizoboxes with a thin layer of soil. Non mycorrhizal short roots and ECM ones were collected and immediately embedded in a cryoprotectant and stored in liquid N₂. The roots were cut with a cryomicrotome to get sections of 20 μm depth.

The sections were excited at 3 keV with a monochromatic beam LUCIA Beamline. The maps were obtained using the flyscan software. The data were extracted using an home-made program. Finally, Image J was used to convert the maps in grey levels and to draw quantitative profiles.

Results:

Figure 2 (non mycorrhizal roots – NM) and 3 (Mycorrhizal roots- M) A shows the maps with P in blue and K in red. Whatever the M status, P maps reveal the nuclei belonging probably to the host plant. K is more regular although it seems more abundant in the central cylinder. A higher concentration of P in nuclei is also revealed in P maps (Fig 2B, 3B). In the profiles given in C, D and E, it is possible to distinguish P from the cytosol, the vacuole (less concentrated) and the nuclei (peak of black pixels). It was not yet possible to attribute cellular compartments to K.

Conclusions:

These first results show that it is possible to map the elements such as P and K on cryofixed and cryocut root sections. The next steps of the analysis will be (i) to use standards to calculate the concentrations in elements, (ii) for P to extract the pixels corresponding to the nuclei, (iii) to compare the concentrations of element in given root compartments between NM and M roots. This should enable us to unravel the mechanisms of nutrient transfer between fungal and host cells in the Hartig net of ectomycorrhizal roots.