ATR-FTIR imaging: phenotyping at the cell wall level in poplar wood

Clément Cuello, Paul Marchand, Françoise Laurans, Camille Grand-Perret, Véronique Laine-Prade, Gilles Pilate, Annabelle Dejardin

ATR-FTIR imaging: phenotyping at the cell wall level in poplar wood

Clement Cuello*[1,2], Paul Marchand[1], Françoise Laurans[1,3], Camille Grand-Perret[1], Véronique Lainé-Prade[1,3], Gilles Pilate[1], and Annabelle Déjardin[1]

[1]UMR Biologie intégrée pour la valorisation de la diversité des arbres et de la forêt – Institut national de la recherche agronomique (INRA), Office National des Forêts - ONF (FRANCE) – France

[2]Ecole Doctorale "Santé, Sciences Biologiques et Chimie du Vivant" – Université d'Orléans : ED549 SSBCV – France

[3]Plateforme régionale Génobois – Institut national de la recherche agronomique (INRA) – France

Résumé

Trees are able to grow high and to live old thanks to the remarkable properties of their wood. As a matter of a fact, wood delivers three major functions: (1) water conduction from roots to crown, (2) support of the ever-increasing mass of the growing tree and (3) storage of temporary reserves, important for tree growth over the years. In angiosperm trees, different wood cell types are affected to each of these functions. Fibers are involved in tree mechanical support, vessels in water conduction and parenchyma rays in starch and/or lipid storage during the resting period. In addition, these cell types have distinct developmental programs. While fibers and vessels are early-dying cells, parenchyma rays stay alive longer. Therefore wood is a complex patchwork of cells and its structure results from the three-dimensional assembly of the cell walls of dead fibers and vessels, interconnected with still living parenchyma rays. This great complexity stands as an obstacle when studying wood formation and the construction of wood properties. However, this can be circumvented thanks to the development of cell-specific approaches. We developed a non-destructive method based on ATR-FTIR imaging on poplar wood sections. This technology enables to collect IR-absorbance spectra from small areas of cross-sections, which makes possible to differentiate between wood cell-types or even between the different cell wall layers from a single fiber. We first demonstrated that spectra taken from fiber cell walls on cross-sections differed from spectra obtained from wood powder. We also showed that ATR-FTIR imaging is able to discriminate the cell walls of fibers, vessels and rays. These findings are in accordance with other studies, but with an improved spatial resolution. ATR-FTIR microspectroscopy is thus a promising tool to finely characterize the cell wall of different wood cell types. This work has been supported by the OPeNSPeNU project.

*Intervenant