Biochemical and histochemical characterization of the polysaccharides present in the G-layer of wild type and AGP-modified transgenic poplars

Fernanda Guedes, Françoise F. Laurans, Carole Assor, Miyuki Takeuchi, Nathalie Boizot, Jacqueline Vigouroux, Marie-Claude Lesage Descauses, Jean-Charles Leplé, Annabelle Dejardin, Gilles G. Pilate

The XIIIth Cell Wall Meeting

Nantes

2013

Abstract Book

Nantes, France

7-12 July 2013

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Lignin as a contributor to virulence rather than defence ? — novel insights from parasitic plant haustoria

Pielach A. (a), Allison G.G. (b), Popper Z.A. (a)

(a) Botany and Plant Science and Ryan Institute for Environmental. Marine and Energy Research, School of Natural Sciences, National University of Ireland, Galway, Ireland; (b) Aberystwyth University, IBERS, Gogerddan, Aberystwyth SY23 3EE, United Kingdom.

Parasitic plants produce organs called haustoria to attach to host plants, infiltrate their vasculature and absorb nutrients. Haustoria of several parasite species attached to resistant hosts are often encapsulated by a lignified interfacial layer assumed to be the main mechanism of host defence. While the precise structure, composition and assembly of encapsulation layers are poorly characterised, interfacial lignins have frequently been suggested as a crucial component.

The interfaces of Rhinanthus minor (a hemiparasitic herb of species-rich meadows) with a grass host, Arrhenatherum elatius, and a eudicot non-host, Plantago lanceolata, were investigated using histology, immunocytochemistry and Raman spectroscopy. Lignin-like substances were present in the cell walls of haustorial interfacial parenchyma and an interfacial extramural layer, where they co-localised with xyloglucans and arabinogalactan proteins. They were also found at the contact surface of non-infective haustoria appressed to pots (lab-grown plants).

These findings suggest that at least some of the interfacial polyphenolic substances previously assumed to contribute to host defence are synthesised by and beneficial to the parasite. Consequently, reinterpretation of interfacial lignin's role in parasitic plant-host interactions is needed.

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Guedes F.T.P. (a), Laurans F. (a), Assor C. (b), Takeuchi M. (a), Boizot N. (a), Vigouroux J. (b), Lesage-Descauses M.-C. (a), Leplé J.-C. (a), Déjardin A. (a), Pilate G. (a)

(a) INRA, UR0588 Amélioration, Génétique et Physiologie Forestières, F–45075 Orléans cedex 2, France ; (b) INRA UR 1268, PVPP, rue de la Géraudière, BP 71627, 44316 Nantes, France.

In hardwood trees, tension wood formation is a remarkable adaptive mechanism that makes possible for the tree to re-orient its axes. In poplar, tension wood fibers harbor an extra cell wall layer named G-layer, responsible for the peculiar mechanical properties of tension wood. In this layer, highly crystalline cellulose is embedded in a polysaccharide matrix, whose composition may be very important for tension wood properties. Therefore, we investigated the polysaccharide distribution during G-layer differentiation. In addition to glucose, biochemical analyses of isolated G-layers reveal the presence of xylose, rhamnose, arabinose and galactose. Arabinose and galactose may be present on rhamnogalacturonan I (RGI) side chains or in specific glycosylated proteins such as arabinogalactan protein (AGP). The last possibility could be verified by a reactivity test with the Yariv reagent and using AGP specific antibodies. Using 186 specific antibodies directed against the major cell wall polysaccharides, we observed that the changes in polysaccharides localization between tension and normal wood only occurred within the G-layer, which composition varies throughout the maturation process. Most of the 30 antibodies that label exclusively the G-layer recognize AGP or RGI epitopes. These polysaccharides may be able to take a gel-like structure that potentially acts on the G-layer cellulose microfibrils to create the strong force characteristic of tension wood [1]. In order to verify this hypothesis, we produced and analyzed transgenic poplars altered for the expression of a fasciclin-like AGP. All these results will be discussed in detail in this communication.

[1] B. Clair et al. (2008) Biomacromolecules, 9, 494-498.

This project is partly funded by the French ANR Blanc Project "Stress in Trees".