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Searching for polysaccharides specific to tension wood fibers

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Abstract

In hardwood trees, tension wood formation is a remarkable adaptive mechanism that makes possible for the tree to reorient its axis. Tension wood differs from normal wood by anatomical, chemical and physical characteristics: it is less lignified, and contains more cellulose of higher crystallinity, with longitudinally oriented microfibrils. In poplar, tension wood fibers harbor an extra cell wall layer, named G-layer, responsible for the peculiar mechanical properties of tension wood (1). We propose that differences between tension and normal wood mechanical properties are linked to the polysaccharide composition of the G-layer. In order to investigate the nature of these links, we realized immunolocalisation studies with light microscope observation. 158 monoclonal antibodies (from CCRC, LM, JIM and MAC series) raised against various epitopes specific to different families of plant cell wall polysaccharides were tested. For each antibody tested, we analyzed where labeling was present, not only between tension and opposite wood (that is completely devoid of G-fibres), but also according to cell type, cell wall layer, and this along the gradient of xylem cell differentiation. Most antibodies directed against xyloglucans, fucosylated or not, specifically labeled the primary wall / middle lamella in both tension and opposite wood fibers. This was also the case for several antibodies specific to rhamnogalacturonans I. Some other antibodies labeled only the S2 layer, such as most antibodies directed against xylans, whereas, unexpectedly, a few other xylan-specific antibodies exhibited a wider range of labeling. None of the antibody tested was able to specifically label opposite wood cell walls. On the contrary, among all the antibodies directed against rhamnogalacturonan I or arabinogalactan epitopes that were tested, eighteen of them specifically labeled the G-layer in tension wood fibers and, for some of them, the labeling was restricted to newly formed G-layers. Overall, from the signals obtained with each of the antibody tested, differences between tension and opposite wood fibers when observed were only detected at the level of the G-layer whose composition appears to evolve throughout its maturation. Furthermore, our study strongly suggests the involvement of specific arabinogalactan-proteins and pectins during G-layer construction. Finally, we optimized a procedure for G-layer isolation in order to analyze the polysaccharide composition of purified G-layers by mass spectrometry.

In the presentation, we will discuss more in details all the results obtained using these two complementary approaches.

References

1. Bruno Clair, Tancrede Almeras, Gilles Pilate, Delphine Jullien, Junji Sugiyama and Christian Riekkel: Maturation stress generation in poplar tension wood studied by synchrotron radiation microdiffraction. *Plant Physiology*. 2011, 155 : 562-570.

Keywords

Tension wood, G-layer, poplar, polysaccharides, immunolocalization, MS analyzes