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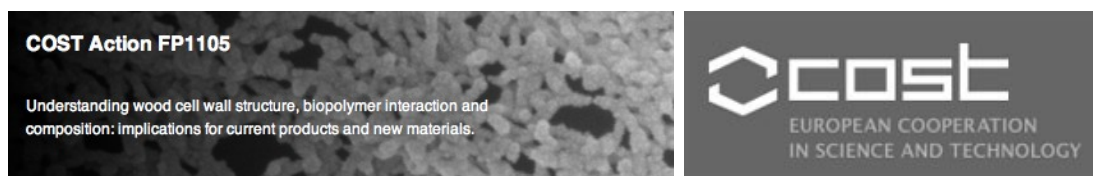
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ECTOPIC LIGNIFICATION IN THE FLAX LIGNIFIED BAST FIBER MUTANT

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ABSTRACT

Flax is a fiber crop producing highly contrasted secondary cell wall structures in the stem. Cells from the inner xylem core have heavily lignified secondary cell walls containing almost 30 % lignin whereas the thick secondary cell walls of the long bast fibers present in outer stem tissues are hypolignified and contain less than 4 % lignin (Day et al., 2005). Despite the existence of these highly contrasted secondary cell wall structures, hardly anything is known about the underlying molecular mechanisms regulating lignin biosynthesis and deposition in flax. In order to increase our knowledge about this process we have created a flax EMS mutant population (Chantreau et al., 2013)

Histochemical screening led to the identification of 93 independent M2 mutant families showing pronounced ectopic lignification in the secondary cell wall of stem bast fibers (Figure 1). We named this core collection the *Linum usitatissimum* (flax) *lbf* mutants for *lignified bast fibers*. We characterized the *lbf1* mutant and showed that the lignin content increased from 3-5% up to 17% DM in outer stem tissues containing bast fibers but was unchanged in inner stem tissues containing xylem. Whole-genome transcriptomics suggested that ectopic lignification of flax bast fibers could be caused by increased transcript accumulation of some monolignol biosynthesis genes, lignin-associated peroxidase genes, and genes involved in H₂O₂ supply. 2D NMR and immunolabelling with KM1 (Figure 2) indicated that bast fiber ectopic lignin was highly condensed and rich in G-units. The *lbf1* mutants also showed changes to other cell wall polymers as indicated by polysaccharide analysis (Figure 3), immunocytochemistry and confocal microscopy approaches. Preliminary study of the physicochemical properties showed that ectopic lignified fibers isolated from the *lbf1* mutant could sorb as much water as the non-lignified fibers from WT, indicating that fiber properties hold on complex architecture of the cell walls relying on not only polymer content but also on polymer interactions (Muraille et al., 2015).

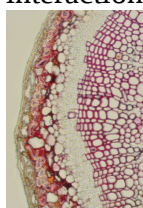


Figure 1: Phloroglucinol staining of lignin in stem tissues of wild-type and *lbf1* mutants

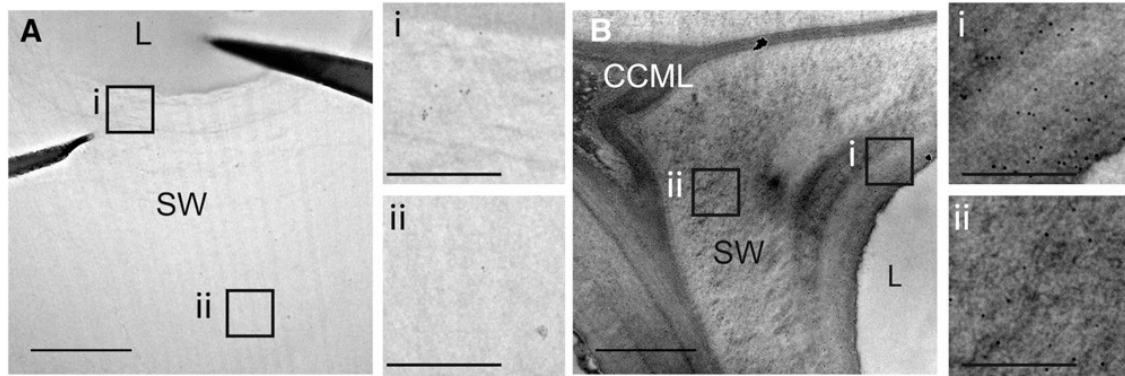


Figure 2: Immunogold silver staining of bast fibers from WT (A) and *lbf1* mutant (B) with lignin antibody KM1 . CCML, cell corner middle lamella; SW, secondary wall; L, lumen. Smaller photos (i and ii) show a zoom of the regions indicated on main photo. Bars = 1 mm (main) and 0.15 mm (small)

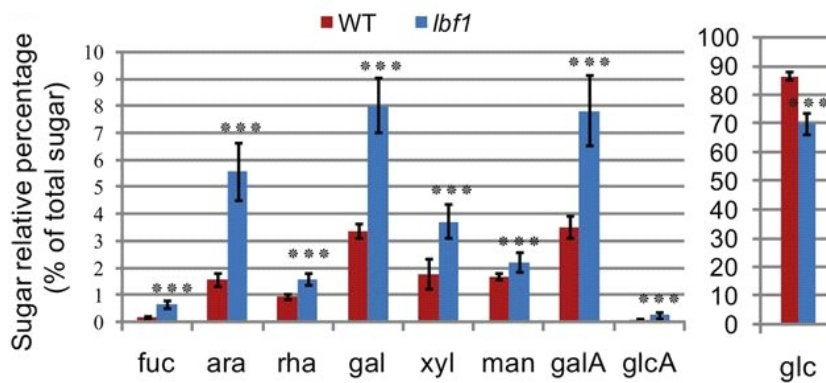


Figure 3: Relative content of different sugars in outer tissues of wild-type and *lbf1* mutants

REFERENCES

- Chantreau, M., Grec, S., Gutierrez, L., et al (2013) PT-Flax (phenotyping and TILLinG of flax): development of a flax (*Linum usitatissimum* L.) mutant population and TILLinG platform for forward and reverse genetics. *BMC Plant Biology*, 13(1), 159.
- Chantreau, M., Portelette, A., Dauwee, R. et al (2014) Ectopic lignification in the flax lignified bast fiber1 mutant stem is associated with tissue-specific modifications in gene expression and cell wall composition. *The Plant Cell*, 26: 4462–4482.
- Day, A., Ruel, K., Neutelings, G., Crônier, D., David H., Hawkins, S., Chabbert, B. (2005) Lignification in the flax stem: evidence for an unusual lignin in bast fibers *Planta*. 222: 234-245.
- Muraille, L., Pernes, M, Habrant, A., Serimaa, R., Molinari, M., Aguié-Béghin, V., Chabbert, B. (2015) Impact of lignin on water sorption properties of bioinspired self-assemblies of lignocellulosic polymers. *European Polymer Journal*, 64: 21–35.

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