Abstract

Trees have the ability to perceive daily mechanical stresses related to wind and to acclimate their growth and development accordingly. Wind essentially results in organs bending, in particular in branches and stem. Previous studies have shown that growth diameter of poplar stem increased in response to bending; mimicking wind mechanical effect. This growth increment goes along with a change in the structure of the wood formed under bending stimulation. This type of reaction wood has been described for some conifers and angiosperms species, and was called "flexure wood". Until now, its anatomical characteristics have been poorly described, and the molecular actors of its formation have never been investigated. In addition, in most of these previous studies the mechanical stresses applied to the stem were bidirectional bendings with an uncontrolled intensity. Because mechanical strains constitute the physical variable perceived by the plant, it appeared necessary to carefully control the bending amplitude applied to the stem. Thanks to an original experimental setup, we applied unidirectional bendings on young poplar stems, while controlling its intensity. This study showed that the strains are perceived at a local scale and that the secondary growth response was also local, leading to stem ovalization. We also distinguished the wood formed under tension we named “Tensile Flexure Wood” from the wood formed under compression we named “Compressive Flexure Wood”. The anatomical and molecular analyzes show that the strain intensity in absolute value is not enough to explain all the answers and that the sign (tension or compression) of these strains also plays a role. In trees stimulated by more frequent unidirectional bendings, growth and cell differentiation are modulated even differently, especially in the area under compression, bringing to the stem an adaptive benefit to the following solicitations. The CLE12.2 gene, which belongs to the CLAVATA gene family involved in meristematic regulation, has been shown to be mechanosensitive. Functional analysis of the *CLE12.2* gene in transgenic plants with under- or overexpression of the gene allowed us to hypothesize that the CLE12.2 peptide is involved in the regulation of the cell-wall biosynthesis pathways. This work highlighted the complexity of the molecular mechanisms involved in wood formation and brings new knowledge for further studies on trees acclimation to wind.