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Adjustments of Mechanical and Hydraulic Properties of Wood Formed under Environmental Stresses

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Abstract : Trees adjust their development to the environmental conditions they experience. Storms events of last decades showed that acclimation of trees to mechanical stresses due to wind is a very important process that allows the trees to sustain for long years. In the future, trees will experience new wind patterns, namely, more often strong winds and fewer daily moderate winds. Moreover, these patterns will go along with drought periods that may interact with the capacity of trees to adjust their growth to mechanical stresses due to wind. It is necessary to understand the mechanisms of wood functional acclimations to environmental conditions in order to predict their behaviour and in order to give foresters and breeders the relevant tools to adapt their forest management. This work aims to study how trees adjust the mechanical and hydraulic functions of their wood to environmental stresses and how this acclimation may be beneficial for the tree to resist to future stresses. In this work, young poplars were grown under controlled climatic conditions that include permanent environmental stress (daily mechanical stress of the stem by bending and/or hydric stress). Then, the properties of wood formed under these stressed conditions were characterized. First, hydraulic conductivity and sensibility to cavitation were measured at the tissue level in order to evaluate the changes in water transport capacity. Secondly, bending tests and Charpy impact tests were carried out at the millimetric scale to locally measure mechanical parameters such as elastic modulus, elastic limit or rupture energy. These experimental data allow evaluating the impacts of mechanical and water stress on the wood material. At the stem level, they will be merged in an integrative model in order to evaluate the beneficial aspect of wood acclimation for trees.

Keywords : acclimation, environmental stresses, hydraulics, mechanics, wood
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