B2d: WOOD AND TREE-RING STUDIES OF FOREST ADAPTATION TO CLIMATE CHANGE; IMPLICATIONS FOR WOOD PRODUCTION

Functional role of *Eucalyptus* wood in terms of drought resistance traits: trends at interspecific and intraspecific levels

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Multispecies surveys have showed that there is a weak but significant tradeoff between xylem efficiency and safety in woody species, and that there are no species occupying the spacewith high efficiency and high safety. Large vessels and tracheids result in high vulnerability to xylem cavitation (VC) due to tension. Moreover, relationships between xylem structure and function are studied mostly at the interspecific level, with few studies considering the relationships at the intraspecific level, particularly in angiosperms. Recent studies in Quercus species, finding opposite trends in wood anatomy-function relationships considering the interspecies and the intraspecific levels, raises the question about the value of multispecies studies to shed light over what is adaptive within a given species. Eucalyptus species share with Quercus a xylem anatomy composed by solitary vessels surrounded and connected to imperforate tracheary cells and parenchyma, a type of wood anatomy which is poorly understood in functional terms. Contrary to results in that genus, our results in four Eucalyptus species revealed that the trends observed between vessel size (mean and distribution) and VC are similar at the interspecific and intraspecific (*E. globulus*) levels. No tradeoff was observed between xylem efficiency and safety: the largest the vessels, the lower the VC. The amount of cells around different size-vessels could be involved in this phenomenon. Trends observed in this important forestry genus challenge what we already know about xylem anatomy and function, and may help to widen our vision about the role of wood in adaptation to drought stress.

Wood anatomical traits reveal water constraints on black spruce xylem formation in the Boreal ecosystem

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One of the most evident effects of the rapid warming occurring recently in cold and high-latitude forests is the lengthening of the growing season, with the concurrent extension of the period of wood formation. In addition, the increase of evapotranspiration demand is starting to induce drought-stress conditions. By selecting the same black spruce (*Picea mariana*) trees (20 trees in 4 sites along a latitudinal gradient in Quebec, Canada) where xylogenesis analyses were performed in the last years, we investigatedlong-term series of wood anatomical traits and compare them to previous short-term findings. Time series of wood anatomical traits were correlated to chronologies of daily temperature, VPD and precipitation during the period 1936-2010. In all sites, tracheid area correlated negatively with June-September temperature and VPD, and positively with precipitation. Meanwhile, cell-wall thickness and the number of cells per ring in the northernmost site were positively affected by spring and summer temperature. While previous monitoring studies evidenced temperature as the key climate variable influencing the timing of xylogenesis phases, our results show that water availability plays a central role in shaping xylem cell features in boreal black spruce. This stresses the importance of an integrate approach to better understand the relationships between wood formation and climate variability at both intra-annual and long (decadal) time scales. This approach will hopefully reduce the uncertainties and skewed interpretations of models on how boreal forest will perform in the future.

Impact of drought on *Eucalyptus* wood chemistry by near infrared hyperspectral imaging

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The aim is to study tree development submitted to different water and mineral constraints. The objective is to correlate spatial distribution of wood chemistry with wood density, secondary growth. We sampled wood discs from 54 trees in rainfall exclusion design with *Eucalyptus grandis* at Esalq-USP, Itatinga Station, brazil. We felled the 5 years old trees growing under different water availability. For each disk, we acquired an image with a near infrared (nir) hyperspectral camera (hsi, specim, pixel size 625 x 625µm). The challenge here was to transfer our previous nir calibrations for total extractives built with a benchtop spectrometer (vector, bruker) to a hsi camera by using standard sample set measured on the two devices. An efficient model were built for the his camera with a prediction error of 10.3% compared to the prediction error of 11.6% for our previous calibration with benchtop spectrometer. Then, based on spectra from his image, we predicted extractive contents and built images. These allow us to compare their spatial distributions according to the growth conditions. In the absence or absence of fertilization, trees with higher water stress showed a higher heterogeneous distribution, from pith to bark, for the total extractive contents and a higher average mean value. In perspective, these data will allow us to study and refine the knowledge on cambium activity according to climatic variations by crossing variability of the chemical properties, x-ray micro-density and anatomy of wood, and diameter growth rate measured by electronic dendrometers.

Spatial variation of wood density for *Eucalyptus grandis* by near infrared hyperspectral imaging combined with X-ray analysis

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