Theme 5: Forests, Soil and Water Interactions

205 - Phloem function and dysfunction under drought

KG I - 1098 (Uni Freiburg)

IUFRO17-314 **Potassium nutrition and water availability affect phloem transport of photosynthetic carbon in eucalypt trees**

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Abstract: Potassium fertilisation strongly affects growth and carbon partitioning of eucalypt on tropical soil. In addition, potassium fertilization could be of great interest in mitigating the adverse consequences of drought in planted forests, as foliar K concentrations influence osmotic adjustment, stomatal regulation and phloem loading. But little is known about the effect of potassium nutrition on phloem transport and on the interaction between K nutrition and water availability.
In situ 13C pulse labelling was conducted on tropical eucalypt trees grown in a trial plantation with plots in which 37% of throughfall were excluded using home-made transparent gutters (-W) or not (+W) and plots that received 0.45 mol K m-2 (+K) or not (-K). Three trees were labelled in each of the four treatments (+K+W, +K-W, -K+W and -K-W), for one hour by injecting pure 13CO2 in a whole crown chamber. We estimated the velocity of carbon transfer in the trunk by comparing time lags between the uptake of 13CO2 and its recovery in trunk CO2 efflux recorded by off axis integrated cavity output spectroscopy in two chambers per tree, one just under the crown and one at the base of the trunk.
The velocity of carbon transfer in the trunk was twice as high in +K trees as in -K trees, with no significant effect of throughfall exclusion except for one tree exposed to a more pronounced water stress. Our results suggest that besides reductions in photosynthetic C supply and in C demand by sink organs, the lower velocity under K deficiency is due to a lower cross section area of the sieve tubes, while an increase in phloem sap viscosity is more likely limiting phloem transport under drought.

phloem, drought, Eucalyptus grandis, fertilization

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IUFRO17-1830 **Tree response to drought under changing climate regimes: mitigation or amelioration?**

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Abstract: A climate change treatment chamber experiment was conducted to assess how an important European tree species, *Populus tremula*, coped with a combination of elevated [CO_2] and temperature and how drought additionally affected growth performance. We grew 1-year potted *P. tremula* trees under ambient control conditions (400 ppm CO_2 and ambient temperature) and under predicted climate change conditions (700 ppm CO_2 and ambient +3°C). Half the trees in both treatment chambers were watered to a soil water content near field capacity, and half to about 70 % of this value. Both tree water and carbon relations were investigated. Sap flow and stem diameter changes were continuously measured with plant sensors. Vulnerability to drought-induced cavitation was examined with the acoustic emission technique. Treatment effects on phloem transport were investigated with positron emission tomography (PET), a medical technique that enables *in-vivo* and non-invasive measurement of sugar transport after labelling with radioactive $^{11}CO_2$. The plant-PET scans were used to develop mechanistic understanding on phloem transport speed and sugar exchange among treatments. This multidisciplinary approach is needed to understand the complex responses of trees under changing climate regimes, because surprisingly we observed that the drought-stressed trees under elevated conditions grew best.

water-carbon relations under a changing climate

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IUFRO17-1008 **Phloem sap as a diagnostic assessment of plant water and nutritional status**

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Abstract: Developing tools for the rapid assessment of plant health is of considerable interest for maximising growth and productivity of forest systems. Phloem is the central conduit for long distance transport and signalling in plants and offers great promise in reflecting plant scale resource limitations. Changes in the abundance of solutes and isotopes in phloem sap are sensitive to environmental cues. With a focus on both water and nutrient availability, we outline temporally and spatially integrative tools for the rapid assessment of plant water and nutritional status.

Phloem, isotope, nutrient, Eucalyptus

BOOK OF ABSTRACTS

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