Universität Basel

Research Project

Cold root effects on water-uptake and C-relations in temperate tree species

Project funded by own resources

Project title Cold root effects on water-uptake and C-relations in temperate tree species
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Organisation / Research unit
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Previous studies indicated that low root zone temperatures can induce drought-like water shortage in trees, with severe consequences also for their C-household. The restricted water conductivity of roots cannot be explained by the increased viscosity of water at cold temperatures alone. The very high sensitivity against non-freezing, colder root temperatures rather suggests that the water uptake of roots is likely stronger dependent on active processes (e.g. via aquaporins) than is generally assumed. Cold root temperature induced drought-like stress might thus contribute to the observed growth restriction of trees at their cold limits. In this 4-year PhD project, we will built upon recent experiments at the University of Basel to deepen our understanding of cold root zone effects on temperature trees. We will investigate seedlings of different temperate tree species at warm air temperatures and different root temperatures by means of a temperature-controlled water bath system. Water- and nitrogen-uptake, as well as carbon assimilation at different root temperatures will be quantified by pulse labelling with stable isotopes (^{2}H-H_2O and ^{15}N-NO_3enriched water, ^{13}C-CO_2 enriched air). Especially, we will address the following questions:

1. Is the water uptake capacity of tree species with low elevational distribution limits more sensitive to low root zone temperatures than in species with high elevation distribution limits?
2. Is the strong restriction of the phloem C-transport at cold root temperatures leading to accumulated non-structural carbohydrate (NSC) reserves in the aboveground tissue of tree seedlings?
3. Are trees, which are raised at colder temperatures better adapted to low root zone temperatures in terms of water-uptake and -transport, than trees raised at warmer temperatures (test for long-term acclimatization)?
4. Is the magnitude of nitrogen (N) uptake and -transport at cold root zone temperatures restricted to the same magnitude as the uptake of water?

Besides detailed physiological insights in cold soil effects on the water, carbon and nutrient household of temperate tree species, this project will provide important information for climate-growth models of trees in general, and it will contribute quantitative data for mechanistic tree species distribution models.

Keywords trees, cold, roots, temperatures, distribution, water uptake, carbon household, nitrogen uptake
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