Resource allocation, water relations and crown architecture examined at the tree and stand-level in northern conifers

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Abstract

Variation in quantity of light has driven plants to employ many strategies in order to persist in high and low light. It is also a primary driver of lower branch mortality and crown recession. Fine roots and leaves are complimentary tissues representing belowground and aboveground resource acquisition. This balance is likely to the influence forest stands as they age.

The objective of my thesis is to understand how hydraulic architecture, crown form and resource allocation are affected by shading trees of opposing shade tolerance. Four tree species were examined: *Pinus banksiana*, *Pinus contorta*, *Picea glauca* and *Picea mariana*. The following are key findings of my thesis:

- A reduced light environment alters the xylem vulnerability of shoots. Shaded shoots are not as drought resistant as those in high light. The effect of shade on hydraulic conductivity is likely tied to both the position of the shoots being examined as well as the quantity of light reduced. Evaporative demand in an understory environment is low, however, a rapid change into full light could be detrimental for shaded conifers.
- Asymmetric shading (where part of the tree crown is fully illuminated while the other part is shaded) placed less-illuminated shoots at a greater disadvantage in terms of bud expansion and growth compared with uniform shading of the entire crown. Relative reductions in TNC appear to follow similar patterns to bud expansion and growth

observations, suggesting that carbon dynamics or fluxes are playing a role in dictating physiological activity of branches. In all cases, responses to asymmetric shade were always more extreme in *Pinus contorta* compared with *Picea glauca*. This is likely due, in part, to different C storage patterns as *Pinus contorta* exhibited lower overall TNC concentrations and smaller (or non-existent) seasonal fluxes in TNC compared with *P.glauca*.

- In a *P.contorta* chronosequence, fine root surface area is the first stand parameter to level-off while wood production increases for another 30 years and leaf area to age 100. During the period of peak wood production, a number of pressures are also converging including: light asymmetry (driving crown recession), crown friction and reduced soil resources.