

Publication

Height-related growth declines in ponderosa pine are not due to carbon limitation

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Decreased gas exchange as trees grow tall has been proposed to explain age-related growth declines in trees. We examined changes of mobile carbon stores (starch, sugars and lipids) with tree height in ponderosa pine (*Pinus ponderosa*) at two sites differing in water availability, and tested the following hypotheses: (1) carbon supply does not become increasingly limited as trees grow tall; rather, the concentration of mobile carbon compounds increases with tree height reflecting greater reductions of carbon sink activities relative to carbon assimilation; and (2) increases of stored mobile carbon compounds with tree height are greater in drier sites. Height-related growth reductions were associated with significant increases of non-structural carbohydrates (NSC) and lipid concentrations in all tissues in the upper canopy and of NSC in the bole. Lipid concentrations in the bole decreased with tree height, but such decrease is not necessarily inconsistent with non-limiting carbon supply in tall trees. Furthermore, we found stronger increases of mobile carbon stores with tree height at the dry site relative to the moist site. Our results provide first direct evidence that carbon supply does not limit growth in tall trees and that decreases of water availability might negatively impact growth processes more than net-photosynthesis.

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