Manipulating phloem transport affects wood formation but not local nonstructural carbon reserves in an evergreen conifer

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Abstract

How variations in carbon supply affect wood formation remains poorly understood in particular in mature forest trees. To elucidate how carbon supply affects carbon allocation and wood formation, we attempted to manipulate carbon supply to the cambial region by phloem girdling and compression during the mid- and late-growing season and measured effects on structural development, CO_2 efflux, and nonstructural carbon reserves in stems of mature white pines. Wood formation and stem CO_2 efflux varied with location relative to treatment (i.e., above or below the restriction). We observed up to twice as many tracheids formed above versus below the treatment after the phloem transport manipulation, whereas cell-wall area decreased only slightly below the treatments, and cell size did not change relative to the control. Nonstructural carbon reserves in the xylem, needles, and roots were largely unaffected by the treatments. Our results suggest that low and high carbon supply affects wood formation, primarily through a strong effect on cell proliferation, and respiration, but local nonstructural carbon concentrations appear to be maintained homeostatically. This contrasts with reports of a decoupling of source activity and wood formation at the whole-tree or ecosystem level, highlighting the need to better understand organ-specific responses, within-tree feedbacks, as well as phenological and ontological effects on sink-source dynamics.

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