

Publication

Carbon limitation in trees

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1 The ongoing enrichment of the atmosphere with CO₂ raises the question of whether growth of forest trees, which represent close to 90 global biomass carbon, is still carbon limited at current concentrations of close to 370 p.p.m. As photosynthesis of C₃ plants is not CO₂ -saturated at such concentrations, enhanced 'source activity' of leaves could stimulate 'sink activity' (i.e. growth) of plants, provided other resources and developmental controls permit. I explore current levels of non-structural carbon in trees in natural forests in order to estimate the potential for a carbon-driven stimulation of growth. 2 The concentration of non-structural carbohydrates (NSC) in tree tissues is considered a measure of carbon shortage or surplus for growth. A periodic reduction of NSC pools indicates either that carbon demand exceeds con-current supply, or that both source and sink activity are low. A steady, very high NSC concentration is likely to indicate that photosynthesis fully meets, or even exceeds, that needed for growth (surplus assimilates accumulate). 3 The analysis presented here considers data for mature trees in four climatic zones: the high elevation treeline (in Mexico, the Alps and Northern Sweden), a temperate lowland forest of central Europe, Mediterranean sclerophyllous woodland and a semideciduous tropical forest in Panama. 4 In all four climatic regions, periods of reduced or zero growth show maximum C-loading of trees (source activity exceeding demand), except for dry midsummer in the Mediterranean. NSC pools are generally high throughout the year, and are not significantly affected by mass fruiting episodes. 5 It is concluded that, irrespective of the reason for its periodic cessation, growth does not seem to be limited by carbon supply. Instead, in all the cases examined, sink activity and its direct control by the environment or developmental constraints, restricts biomass production of trees under current ambient CO₂ concentrations. 6 The current carbohydrate charging of mature wild trees from the tropics to the cold limit of tree growth suggests that little (if any) leeway exists for further CO₂ -fertilization effects on growth.

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