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Risk assessment: How do urban tree species respond to drought? Analyzing tree growth in relation to the surrounding urban environment

A. Moser, T. Rötzer, H. Pretzsch

Chair for Forest Growth and Yield Science, School of Life Sciences Weihenstephan,
Technische Universität München, Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, Germany

Abstract

The urban environment is characterized by various stresses, e. g. limited soil volume, restricted water availability, or heat stress which denote huge challenges for tree growth and vitality. In particular, water deficits and high temperatures can cause immense drought stress to urban trees, resulting in reduced growth and die-off. Climate change with a higher frequency of extreme weather events will lead to even more restricting growth conditions for trees in cities. Drought-tolerant species are expected to be resilient to these conditions and are therefore advantageous over other, more vulnerable species. However, the drought tolerance of urban trees in relation to their specific growth conditions is poorly researched. This study aimed to analyze the annual growth and drought tolerance of two common urban tree species, small-leaved lime (*Tilia cordata* Mill.) and black locust (*Robinia pseudoacacia* L.), in two cities in southern Germany in relation to their urban growing conditions. Marked growth reductions during drought periods and subsequent fast recovery were found for *R. pseudoacacia*, whereas *T. cordata* exhibited continued less growth after a drought event, although these results were highly specific to the analyzed city. We further show that individual tree characteristics and environmental conditions significantly influence the growth of urban trees. Openness and other aspects of the surrounding environment (climatic water balance and distance to trees and buildings), tree size, and tree species significantly affect urban tree growth and can increase the drought stress of urban trees. Planting of tree species well adapted to their urban environment ensures healthy trees which provide ecosystem services for a high quality of human life in cities.