

Growth performance of *Cedrus libani* under different climates and its potential for use in Central European forestry

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Abstract: *Cedrus libani* (Lebanon Cedar) is a frost and drought tolerant evergreen conifer, mainly distributed as pure natural stands between 800 and 2200 m a.s.l along the Taurus Mountain Range of Southern Turkey. Regarding its durability and the outstanding properties of its wood, *C. libani* constitutes a valuable tree species for Turkish forestry from the economic and ecological aspect. Recently, the discussion intensifies whether *C. libani* might be a promising candidate to substitute indigenous tree species under a changing climate in Central European forestry. The aim of this study was therefore to investigate stem growth of *C. libani* under different climate and site conditions in order to evaluate its growth potential with respect to climate change. Investigations were conducted at five different sites: four natural sites were located in the Cedar Research Forest (SW-Turkey) along an altitudinal gradient and one site comprises small stands of *C. libani* which were established in the Ecological-Botanical Gardens of the University of Bayreuth (Germany) in the early 1980's. During 2013 and 2014, stem growth was monitored with point dendrometers at hourly steps on 4 – 9 trees per site. In addition, at the German site, annual stem growth was measured by sampling tree cores and tree disks of 20 trees for the time period from 1988 until 2010. Results from dendrometer records showed an altitudinal trend with later onsets and shorter durations of tree-ring formation at higher elevations. A bimodal growth pattern with cambial rest during summer drought was absent. Tree-rings were wider in years with higher annual precipitation. Correlation analysis between daily stem radius variations extracted from dendrometer records and site-climate showed that, at all sites, vapor pressure deficit and global radiation correlated negatively with stem growth while precipitation and relative humidity correlated positively with stem growth. Analysis at the German site showed that individual growth of *C. libani* was high, reaching an average tree-ring width of 4.9 mm year⁻¹. Average annual terminal growth (0.5 m year⁻¹) of *C. libani* was similar to that of *Larix decidua*, *Picea abies* and *Pinus sylvestris* growing on similar sites, and even superior for annual stem diameter growth for the last 10 years. Overall, *C. libani* showed good growth performance with higher growth rates and wider tree-rings when competition was low, light availability was high, and soil water was continuously available throughout the year. Best growth performance was observed at the German site, mainly due to a better water supply during spring and summer, underlining the potential of *C. libani* for Central European forestry under current and future climate conditions with cold winters and prolonged droughts during summer. Further studies on *C. libani* growth should explore and test its cultivation and economic potential in silvicultural plantations under different site and climate conditions.

Keywords: Assisted migration, *Cedrus libani*, Climate change, Dendrometer, Stem growth, Tree-ring