

Xylem anomalies assessed in a long-term white spruce provenance trial reveal maladaptations to climate

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Abstract: We studied the occurrence of four xylem anomalies in white spruce provenances representing the entire species range in a common garden site in Alberta, Canada. Frost and blue rings were only found in young trees, consistent with a greater exposure of small trees and open stands to temperature variations. Light and double rings occurred throughout the lifetime of a tree. Each of the xylem irregularities was caused by a unique set of climate factors. Provenances differed in their susceptibility to these xylem modifications. Trees from northern seed sources tend to start their growing season early and are small in stature, which makes them prone to the formation of frost rings. Since these trees end their growing season early, they are resistant to the formation of latewood anomalies. Trees from lower latitudes and maritime regions, by contrast, likely extend their period of xylogenesis longer into the late summer and fall, which makes them more susceptible to the formation of light, blue, and double rings. Since the frequency and intensity of xylem modifications was relatively low in our study, they cannot explain differences in growth and mortality. We conclude that assisted migration of white spruce seeds in Alberta is unlikely to be constrained by xylem anomalies.