Physiology and Growth of Redwood and Douglas-fir Planted After Variable Density Retention Outside Redwood's Range[1]

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Abstract

Reforestation following timber harvests is an important topic throughout the coast redwood (*Sequoia sempervirens* (D. Don) Endl.) range. Furthermore, as drought-induced mortality spreads across many of California's forests, it is important to understand how physiology and stand structure influence reforestation success. Finally, as climate throughout the West is projected to become hotter and drier, it is important to investigate seedling regeneration under hotter and drier conditions, particularly for species such as coast redwood that are generally restricted to mesic habitats.

To study the influences of climate and stand structure on regeneration success, we monitored physiology and aboveground growth of coast redwood and Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) seedlings during the 2015 growing season following a 2014 variable density retention harvest at the L.W. Schatz Demonstration Tree Farm in Maple Creek, California. We hypothesized that because redwood does not naturally occur this far inland, it would be more water stressed than Douglas-fir and would, as a result, grow less. We also hypothesized that seedlings planted in the moderately thinned treatment would be the least water stressed and therefore realize the most growth due to reduced competition for water and light, increased precipitation throughfall, and minimally increased evaporative loss of soil water.

We found that water stress and aboveground growth were significantly lower in redwood than in Douglas-fir. These findings suggest that greater stomatal regulation to conserve water reduces CO_2 uptake and growth in redwood when compared to Douglas-fir. Alternatively, and not mutually exclusively, redwood, a species renowned for its lignotubers and sprouting ability, may allocate more carbon belowground during seedling establishment compared to Douglas-fir. Greater belowground carbon allocation would explain our findings of decreased water stress, resulting from increased fine root production and/or mycorrhizal associations, and aboveground growth in redwood compared to Douglas-fir. We also found that seedlings of both species in our heavily thinned treatment were the least water stressed and had the highest growth compared to seedlings planted in the moderately thinned and control (not thinned) treatments.

We recommend further research on stomatal conductance and carbon allocation patterns in these two species to identify the mechanism(s) driving the decreased water stress and aboveground growth observed in this study. We also recommend heavy thinning treatments to achieve minimal water stress and maximum growth in establishing seedlings.

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