Sierra Cascade Intensive Forest Management Research Cooperative Proposal 04-01, Seedling Dormancy/Root Zone Temperature Study

Principal Investigator: Douglas F. Jacobs

Title: Interrelationship of seedling dormancy status and root zone temperature in determining new root growth capacity of northern California conifer species

Year Funded: 2004

Executive Summary:
A study was initiated in 2004 to examine how potential for new seedling root growth (i.e., extension of current roots and formation of new roots) is affected by both media temperature and changes in seedling phenology as seedlings transition through the dormancy cycle. Though it has been established that root growth of many conifer species is maximized around 20 degrees C, few studies have examined how media temperature may interact with changes in seedling dormancy status during the period from dormancy induction in the fall through dormancy release in spring. Additionally, no studies have examined either of these trends specific to seed sources in northern California. This information will be useful to help match seedling physiological status with site environmental conditions to optimize new root growth immediately following planting.

Three species were included in the experiment, each representing an important component of forest tree seedling production in California. The species were Douglas-fir (*Pseudotsuga menziesii*), consisting of a single seed source (1676 m elevation) that either did or did not receive blackout in the nursery, ponderosa pine (*Pinus ponderosa*) from two seed sources (elevations of 1067 and 1524 m), and a single seed source of California red fir (*Abies magnifica*) from an elevation of 1676 m. Douglas-fir and ponderosa pine from the 1067 m elevation were grown in Styro-8 containers and California red fir and the ponderosa pine from the 1524 m elevation were grown in Styro-15 containers.

Seedling shipments were received from Cal Forest Nursery (Etna, CA) on 7 January 2005, 7 February 2005, 25 February 2005, 23 March 2005, and 19 April 2005. On each date, seedlings of each seed source (5 treatments, 600 seedlings total) were measured for initial root volume, height, and root collar diameter. A subsample of seedlings was evaluated for numbers of new white roots. After initial measurements, seedlings were placed into a hydroponic growing system to evaluate growth potential over a four-week period.

Changes in seedling cold hardiness between January and April 2005 were assessed using the electrolyte leakage method and by determining the LT50 (lethal temperature for 50% of plant material). Seedlings were most cold-hardy in January and least cold hardy in April. Douglas-fir seedlings that received blackout treatments during nursery culture were hardier than those that did not (figure 1), as reflected by the

LT50 tests. Blackout treatments appear useful for increasing cold hardiness, and may improve seedling vigor under given environmental scenarios. Root zone temperature influenced the number and mass of new root (figure 2). Complete results are summarized in the report. Logical future research directions, including initiation of an ongoing follow-up study, are also outlined.

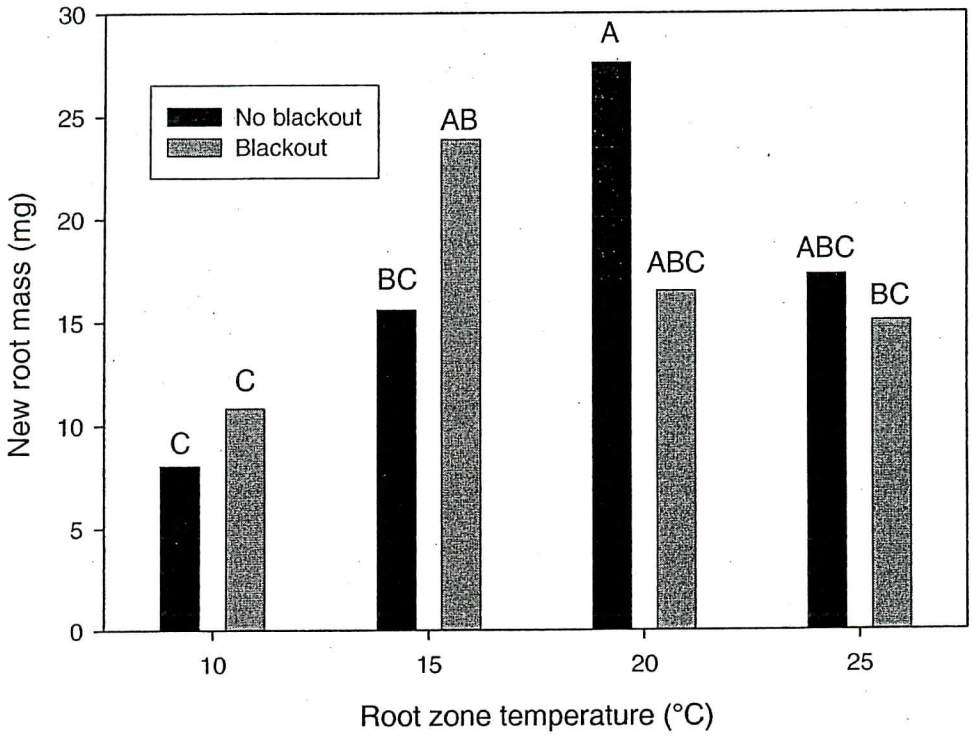

Figure 1. Investigation into the effect of interaction between blackout treatment and root zone temperature on new root mass of Douglas-fir seedlings. Bars represent means and letters represent significant differences within each graph using Tukey's HSD at α=0.05.

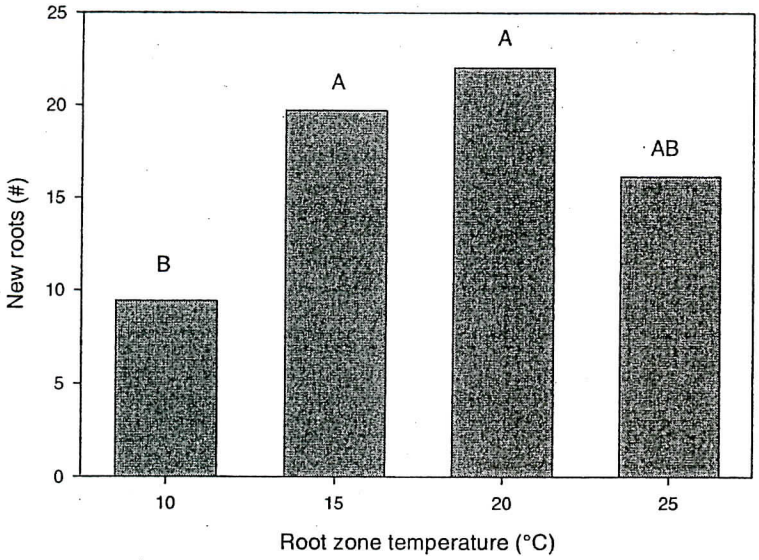

Figure 2. Number of new roots of Douglas-fir seedlings grown at different root zone temperatures. Bars represent means and letters represent significant differences within each graph using Tukey's HSD at α=0.05.