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Sierra Cascade Intensive Forest Management Research Cooperative Proposal 02-02, Slow Release Fertilization Study

Principal Investigator: Ed Fredrickson

Title: Evaluating the effect of slow release fertilizers incorporated into containerized seedlings in Mediterranean climates

Year Funded: 2002

Executive Summary:

A study was initiated in 2002 to evaluate the partial contributions of fertilizer type and rate to seedling survival and growth in the field for Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*). The influence of site quality and precipitation on seedling response to incorporated slow release fertilization was also to be investigated. The stated purpose of the study was to determine appropriate fertilizer ratios and rates for typical conifer species grown in Mediterranean climates and to evaluate survival and growth responses over a range of site qualities and moisture regimes.

Three sites on Co-op members' lands were chosen for the study: Soper-Wheeler Co., Silver Butte Timber Co., and W.M. Beaty & Associates. All three sites tested Douglas-fir and ponderosa seedlings; the Soper-Wheeler site also tested sugar pine (*Pinus lambertiana*). Continuous-recording weather stations capable of recording soil and air temperature, precipitation, and soil moisture were installed at each site. All seedlings were grown in Styro-10 containers. The fertilizer used was Nutra-Cote 16-10-10 at 0, 1, 2, and 3 grams per cell.

The fall planting was done in October and November, 2003. Conditions were

cool and the ground was moist at the Silver Butte site; the soil was dry on the other two sites and it was hot and windy at the time of planting. The spring planting was done in March and early April, 2004. Planting conditions were ideal on all three sites at the time of planting. At the time of each planting, sample seedlings representing all species by landowner were taken to Redding where measurements of caliper and length were taken on 100 trees per species per landowner.

Caliper and height will be measured for all seedlings at the end of each growing season starting in fall 2004. Seedling volume will be derived from these measurements. Survival will be noted at the time of measurement. Analysis of variance (ANOVAs) of treatment means will be used to test for treatment effects and significant differences among treatments.

Survival: At the end of the fifth growing season (fall 2008), survival for all tree species was greater with the spring planting than with the fall planting on all three sites. Most differences were significant. The survival of the fall planted **Douglas-fir** on the Beaty site was so low that results could not be analysed. The fall planting treatment with the highest level of

fertilization (3 g/cell) had no survivors in any of the five replications. Two other treatments (1 and 2 g/cell) had only one survivor in the five replications. The treatment with no fertilization resulted in the best survival for the spring planted Douglas-fir seedlings on the Beaty site but the differences were not significant. There were no significant differences in fall or spring survival due to fertilization for any species on the Soper-Wheeler and Silver Butte sites. At the end of 2008, spring planted seedlings on Soper-Wheeler had a survival rate of 92 percent compared to fall planted seedlings with a rate of 34 percent. The spring planted seedlings on the Silver Butte site had a survival rate of 76 percent, the fall planted seedlings had a rate of 44 percent. The spring planted seedlings on the Beaty site had a survival rate of 65 percent.

For **sugar pine** on the Soper-Wheeler site spring planting had a survival rate of 97 per cent at the end of 2008. Fall planted seedlings had a survival rate of 90 percent.

For **ponderosa pine**, at the Beaty site, survival was 98 percent on the spring planted treatments compared with 80 percent on the fall planted ones. Silver Butte spring planted seedlings averaged a survival rate of 82 percent, the fall planted ones 74 percent. Soper-Wheeler spring planted seedlings had a survival rate of 97 percent compared to fall planted seedlings with a survival rate of 82 percent.

Growth: There were no significant differences in height, caliper, or volume of any species for any of the treatments

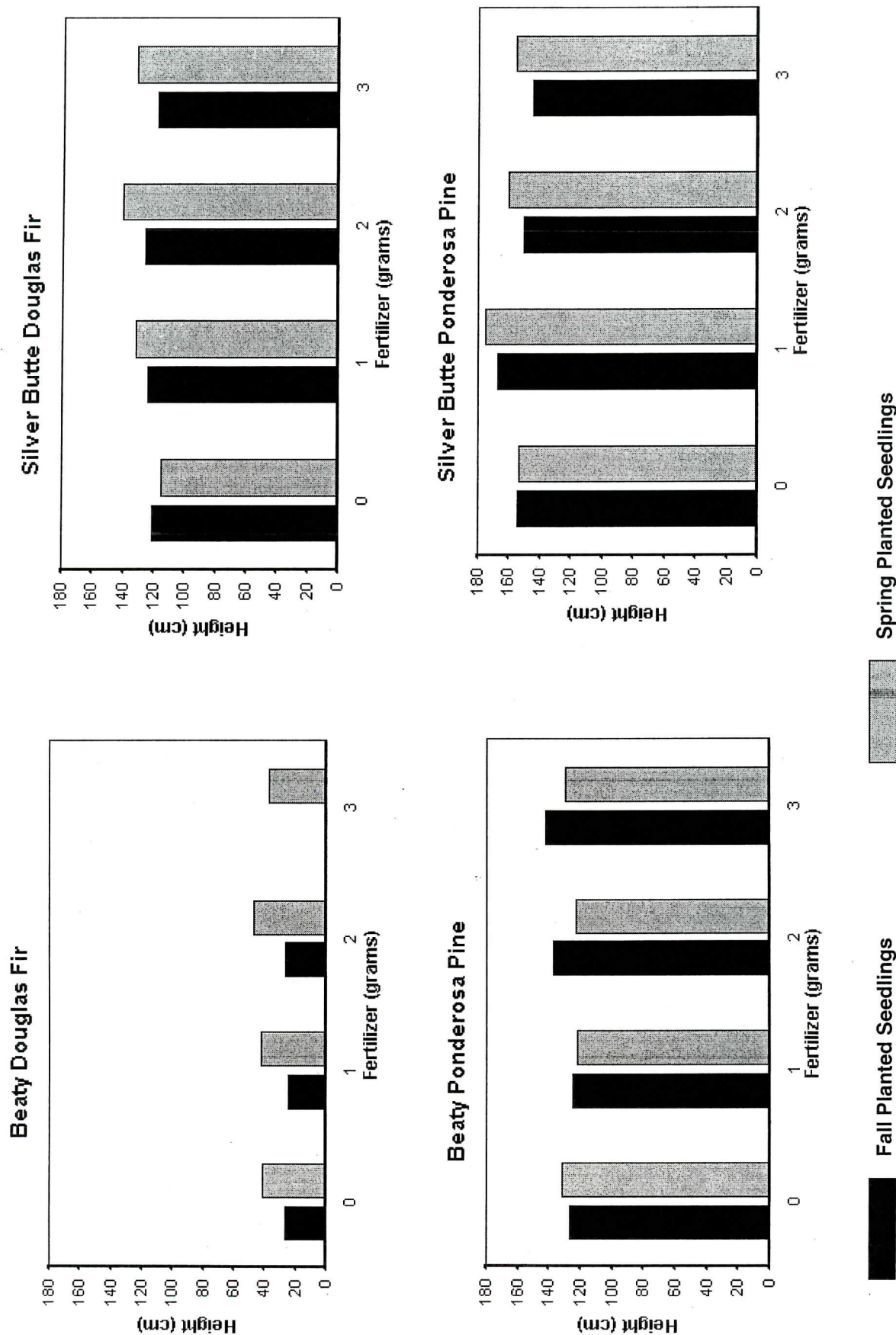
on the Beaty and Silver Butte sites (Figure 1). For **Douglas-fir** at the Soper-Wheeler site, spring-planted seedlings with the highest fertilization rate (3 g/cell) were significantly taller than seedlings planted in the fall with the lowest fertilization rate (Figure 2). This same spring planted treatment also resulted in significantly larger values in caliper and volume as compared to the two fall treatments with the two lowest rates of fertilization (0 and 1 g/cell).

For **ponderosa pine**, there were no significant differences in height between any of the treatments on the Soper-Wheeler site. But the spring treatment with the highest fertilization rate (3 g/cell) resulted in seedlings with significantly higher values for caliper and volume when compared to seedlings planted in the fall with the second lowest fertilization rate (1g/cell).

For **sugar pine**, on the Soper-Wheeler site the second lowest fertilization rate (1 g/cell) in the spring planted treatment resulted in seedlings with significantly higher values in height, caliper, and volume than seedlings planted in the fall with the second lowest fertilization rate (1 g/cell).

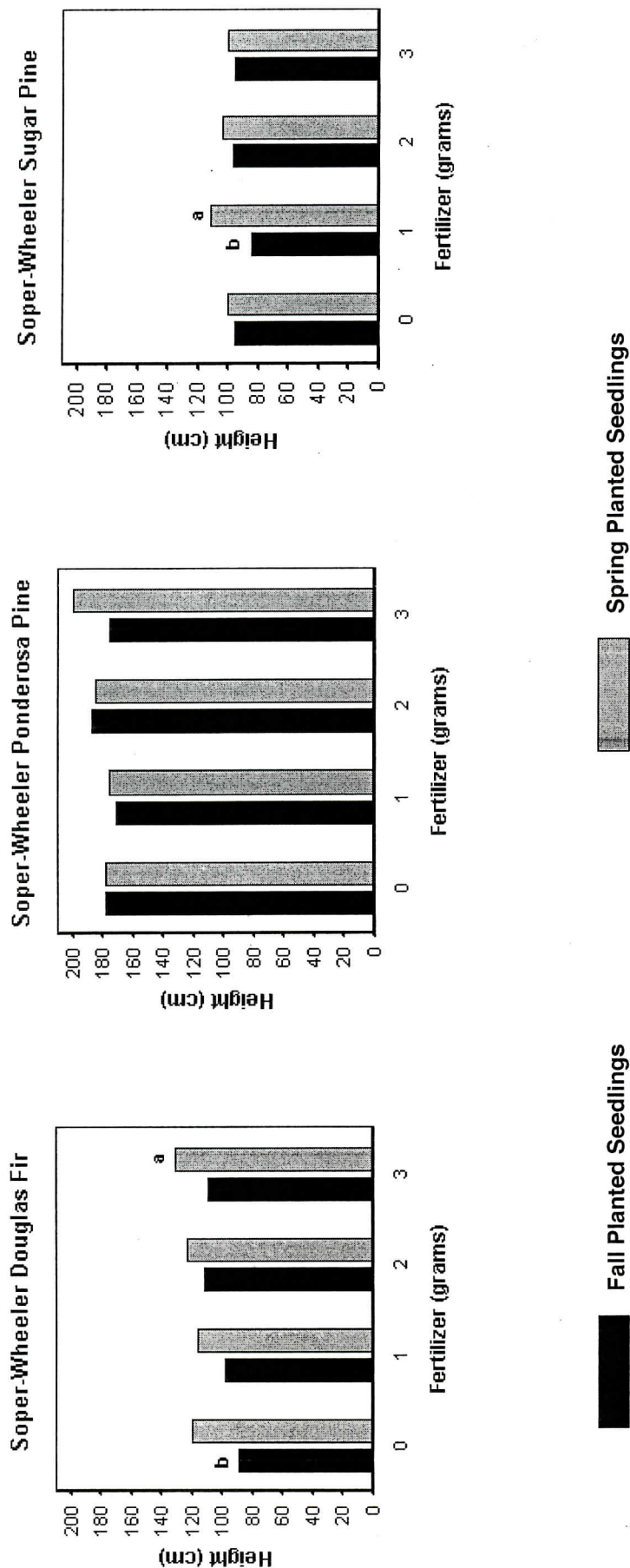
Weather stations were established at all three sites at the time of the first planting in 2003. Continuous readings of soil temperature, air temperature, soil moisture, and total precipitation were recorded through the fall 2008 season. The weather stations were removed following the completion of the conifer measurements in the fall of 2008.

Figure 1 : Height of seedlings for Slow Release Study by fertilizer rate and time of planting, Fall 2008
Beaty and Silver Butte sites



For each fertilizer rate, site, and planting time combination, treatment means with the same letter do not differ statistically at the 0.05 level. Means with no letters do not differ.

Figure 2 : Height of seedlings for Slow Release Study by fertilizer rate and time of planting, Fall 2008
Soper-Wheeler Site



For each fertilizer rate, site, and planting time combination, treatment means with the same letter do not differ statistically at the 0.05 level.
Means with no letters do not differ.