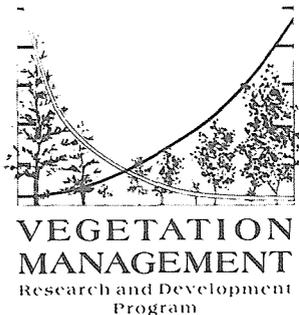




# Manual Release in an "Old" Douglas-fir Plantation Increases Diameter Growth

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Twelve-year-old Douglas-fir saplings on the Mad River Ranger District, Six Rivers National Forest, California were released by cutting competing vegetation in a 9-foot radius to test the timing and efficacy of this method in plantations older than those in which such work traditionally is done—the first 5 years. Nine years after release, the average stem diameter (3.60 inches or 9.14 cm) of released Douglas-fir saplings, taken at 12 inches (30 cm) above mean groundline, differed significantly from that of control saplings (2.98 inches or 7.57 cm) ( $p < 0.05$ ), although the average height did not differ ( $p > 0.05$ ). In spite of this finding, the stem diameter of released saplings was 40 percent less than that needed to comply with regional Forest Service growth objectives. Cost of release averaged \$428 per acre or \$1058/ha in 1978 dollars.

*Retrieval Terms:* manual release, cost, growth, Douglas-fir, northern California

The silviculturist is responsible not only for establishing conifer plantations, but also for ensuring that seedlings in them grow well. Without at least some means of controlling competing vegetation, the odds for rapid conifer growth are low. One vegetation control method is manual release, which is the physical removal of competing vegetation by grubbing, snipping, or cutting with hand tools or a chain saw.

In most instances, manual release is most successful if the vegetation to be removed is young and small and is removed when 1 or 2 years old. Manual release, in general, is least successful and is used least when the vegetation is woody shrubs, particularly old shrubs that sprout vigorously from the root crown. But whatever the vegetation, manual release is expensive.<sup>1,2</sup> Rarely has the effectiveness of manual release in plantations older than 5 years been quantified and reported.

This note reports a study in northern California that evaluates a form of manual cutting as a means of releasing 12-year-old Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) saplings from competition by a vigorous sclerophyllous shrub, and determines whether cutting reduced the shrubs enough to enable significant increases in conifer height and diameter relative to unreleased saplings. Cutting competing vegetation from a large radius around Douglas-fir saplings enabled them to outgrow untreated counterparts, at least in terms of increased diameter, after 9

years. But the cost of treating the large (9 foot or 2.8 m) radii was high (\$428 per acre or \$1058/ha) (1978 dollars).

## STUDY AND SITE CHARACTERISTICS

The study site was located on the Mad River District of the Six Rivers National Forest, 23 airline miles (37 km) south of the town of Mad River. Before clearcut harvesting in 1964, the site was forested with mostly Douglas-fir in the overstory with tanoak (*Lithocarpus densiflorus* [Hook. & Arn.] Rehd.) and a few Pacific madrone (*Arbutus menziesii* Pursh) in the understory. Occasional bigleaf maple (*Acer macrophyllum* Pursh), canyon live oak (*Quercus chrysolepis* Liebm.), and blue elder (*Sambucus cerulea* Raf.) were scattered throughout the area. This vegetation corresponds to the Douglas-fir—tanoak—Pacific madrone forest cover type (SAF 234).<sup>3</sup> Site quality is III, with height of dominant Douglas-fir averaging 96 to 114 feet (30 to 35 m) at a breast-height age of 50 years.<sup>4</sup> Site preparation by broadcast burning in fall 1965 removed nearly all the slash with minimum physical disturbance to the soil.

The predominant soil of the study area belongs to the Holland family (Ultic Haploxeralf). Such soil is formed in material that has been weathered from granitic rock. Holland soils generally are deep and well drained, with a brownish sandy loam near the surface grading to yellowish sandy clay

loam below the 5-foot (1.5-m) depth. Slopes of the study area range from 20 to 50 percent and face north to northeast. Average annual precipitation, with about half falling as snow, ranges from 65 to 75 inches (1651 to 1882 mm). Annual temperatures range from a low of 10 °F (-14 °C) to a high of 95 °F (35 °C).

After site preparation, about 1000 tanoak clumps per acre (2471/ha) remained and promptly sprouted. In this area, tanoak sprouts grow from 1.5 to 3.0 feet (0.5 to 0.9 m) tall the first growing season and average 0.5 to 1.5 feet (0.2 to 0.5 m) of height growth per year thereafter. The area was planted with bare-root Douglas-fir seedlings that were grown for 1 year in the nursery and then outplanted in spring 1966 and 1967. Consequently, the plantation was at least 12 years old when the release treatment was applied in fall 1978. The principal competitor, tanoak sprouts, numbered about 800 clumps per acre (1977/ha) and were about 9 ft (2.8 m) tall in 1978.

## METHODS

Selection of sample conifers and initial measurements began in fall 1978. About 60 Douglas-fir saplings having desirable growth and form were designated for sampling with about half being randomly selected for treatment and half for the untreated control. Diaries of personnel doing the work noted that "sample trees in released and unreleased areas were selected to be as similar as possible." A t-test of leader length in 1978, just before treatment, showed that leaders of released trees averaged 9.5 inches (24.2 cm) and those of unreleased trees averaged 12.0 inches (30.4 cm), with no significant difference occurring at the 5 percent level. Consequently, no bias was detected in tree selection.

Manual release, entirely by chain saw, consisted of cutting all vegetation in a 5-foot (1.5-m) radius outward from the lowest (and widest) branches of each Douglas-fir sapling. Vegetation growing under the branches also was cut. Because sapling branch width ranged from 3 to 5 feet (0.9 to 1.5 m) and averaged about 4 feet (1.2 m), the treated radius amounted to about 9 feet (2.8 m). Sprouts of tanoak, madrone, and all other vegetation were cut to about 10 inches (25.4 cm) above the ground, or lower

if the lowest Douglas-fir branch was less than 10 inches from the ground.

Douglas-fir saplings selected for sampling were tagged and measured for height and stem caliper in fall 1978 and measured again in fall 1987. In 1978, about 50 percent of the saplings were at least as tall as the hardwood sprouts. Some saplings were suppressed by nearby shrubs, whereas others were only slightly affected because the shrubs were farther away.

The experimental design was randomized with two-way treatment structure. The confidence interval for the difference between the two treatments—designated as  $(\bar{D} \pm w)$ , in which  $\bar{D}$  equals the difference between treatment means, and  $w$  equals the half-width of the confidence interval—was calculated from an analysis of variance model. The confidence interval is used to present the best information available on the range of values within which the expected difference is estimated (with 95 percent confidence) to lie. The manual release treatment and untreated control were replicated four times. Douglas-fir saplings were last measured in summer 1987, the ninth growing season after treatment. Sampling intensity was 26 and 23 released and unreleased trees, respectively.

Production data were recorded as a basis for determining the cost of manual release in this type and age of vegetation.

## RESULTS AND DISCUSSION

Diary records, while not quantitative, are helpful in describing early differences among treated and untreated Douglas-fir saplings. After one growing season, released saplings appeared green and healthy although leader growth was not as large as that of untreated saplings. After four growing seasons, stem caliper 1 inch (2.5 cm) above mean ground line was larger for released saplings—apparently the result of buttressing.

According to diary entries, cut and uncut tanoak sprout clumps grew equally well after two growing seasons. Total height differed, but leader growth was similar. Apparently, the capability of the sprout clumps to grow was not impaired by cutting. After three growing seasons, the cut sprout clumps were not as tall as released Douglas-fir saplings; after four seasons,

Table 1—Mean stem height and diameter of released and unreleased Douglas-fir saplings near Mad River, California, 1987

Treatment	Mean stem height	Mean stem diameter
	<i>ft</i>	<i>inches</i>
Released	22.5a <sup>1</sup>	3.60a
Unreleased	20.2a	2.98b
Standard error	0.8	0.09
$\bar{D} \pm w^2$	2.30 ± 1.62	0.62 ± 0.31

<sup>1</sup>Values in each column followed by the same letter do not differ statistically at the 0.05 level.

<sup>2</sup>Difference between means + or - half-width of the confidence interval.

average sprout height of tanoak was slightly higher than that of the average Douglas-fir sapling; and after five seasons, the sprouts were unquestionably taller. Average height of cut and uncut tanoak sprouts in fall 1987 was 20.9 feet (6.4 m) (standard error 1.6 feet or 0.5 m).

In 1987, or nine seasons after treatment, height of released Douglas-fir trees did not differ statistically ( $p > 0.05$ ) from that of unreleased trees (table 1). Average stem diameter at 12 inches (30 cm) above mean groundline was 3.60 inches (9.14 cm) and 2.98 (7.57 cm), respectively, for released and unreleased trees, with the difference being statistically significant ( $p < 0.05$ ). However, a breast-height stem diameter of at least 5.0 inches (13 cm) and a height of 25 feet (7.6 m) would be needed to comply with USDA Forest Service regional timber management growth objectives for a plantation of this age on a site of this quality.<sup>5</sup>

Petersen and Newton<sup>6</sup> evaluated the release of 10-year-old Douglas-fir saplings from snowbrush (*Ceanothus velutinus* Dougl. ex Hook.) in the Cascade Mountains of Oregon. Both species were equal in height and over 6 feet (2 m) tall. The release treatment was one application of cutting the snowbrush in a wide radius (26 feet or 8 m) around each tree with a chain saw. Four years after cutting, diameter and height of Douglas-fir did not differ significantly from the control at the 5 percent level. The authors<sup>6</sup> concluded that trees which have grown with shrubs and forbs for as long as 10 years will have little early response to release from snowbrush by such a treatment.

A better approach to release is to control

the competing vegetation as early as possible and hence minimize its effect on the growth of the Douglas-fir seedlings.<sup>6,7</sup> Several shrub-free trees at Mad River averaged at least 8 inches (20 cm) in breast-height diameter, 42 feet (13 m) in height, and appeared to be growing at or near the potential of the site.<sup>8</sup>

The cost of cutting (chain saw) a 9-foot (2.8 m) radius around the Douglas-fir saplings ranged from \$375 to \$512 per acre (\$927 to \$1265/ha) in 1978 dollars, with an average of \$428 per acre (\$1058/ha).

## CONCLUSIONS

Silviculturists cannot always release each planted acre from competing vegetation promptly, because of too many acres (after a wildfire, for example), not enough money, unavailability of herbicides, or lack of bidders on release contracts. In such instances, the hardwoods and shrubs often sprout, grow large and tall, and soon dominate the plantation. Results from this study show that cutting older hardwood sprouts from a large radius around Douglas-fir saplings enables them to grow better, at least in diameter, than unreleased counter-

parts. This finding is important because it gives silviculturists a treatment that is an advantage, albeit a small one, over doing nothing. But the treatment is costly, both in dollars spent and growth forgone.

## END NOTES AND REFERENCES

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