

Thinning Nine-Year-Old Douglas Fir by Spacing and Dominance Methods

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THINNING VERY early in the life of a Douglas-fir forest can increase growth on individual trees and reduce the time required to grow them to merchantable size. These important findings came from a study started in 1920 to seek a good silvicultural method of thinning. A dense sapling stand of nine-year-old Douglas fir on site IV on the Wind River Experimental Forest in southwestern Washington was used for the test. The thinning was first described by Meyer (1931). Measurements made in 1952 show that the effects of an early thinning are lasting and beneficial to the stand.

One area had been thinned to as near an 8 by 8 foot spacing as was possible, regardless of the crown classes of the trees left. In this treatment, the tree closest to the desired spacing was left, even though it was an intermediate or suppressed tree rather than a dominant or codominant. This treatment is hereafter called "space thinning."

The second area was thinned to as near an 8 by 8 foot spacing as possible, but only the dominant tree nearest each 8-foot point was left. Even though the stand was only nine years old, some degree of dominance was already expressed. This treatment is hereafter called "dominance thinning."

The stand used for this study became established naturally in the spring of 1911. In 1920, before thinning, the area supported an average of 4,448

TABLE 1. STAND STATISTICS AT TIME OF THINNING (1920), STAND AGE NINE YEARS
(*acre basis*)

Treatment	Before thinning			After thinning		
	Number stems	Average height (feet)	Average diameter at 1 foot (inches)	Number stems	Average height (feet)	Average diameter at 1 foot (inches)
Space thinning	6,133	4.5	0.52	635	6.3	1.04
Dominance thinning	2,702	6.6	1.27	678	8.5	1.74
No thinning	4,509	6.0	1.03	4,509	6.0	1.03

saplings per acre. Average height was 5.4 feet, and average diameter a foot above the ground was 0.8 inch. The data come from two thinned plots that are $\frac{3}{4}$ -acre in size, and an unthinned plot of half an acre, which was left between them as a check. Both the thinned and unthinned areas extended beyond their plot boundaries to provide a buffer or isolation strip. Stand conditions before thinning and immediately after thinning are shown in Table 1.

Stand Development

By 1952, the average tree in each of the thinned stands was 7.8 inches d.b.h. (diameter breast high), compared with 5.1 inches d.b.h. in the unthinned stand (Table 2). Average height for all trees in the space thinning is 67 feet, and for the dominance thinning, 69 feet, compared with only 54 feet for the unthinned stand.

Apparently, the taller trees have resulted from the wider spacing in the thinned stands. The inherent productive capacity of the three plots is not noticeably different since they are adjacent to each other on similar topography. In the dominance thinning, trees are well spaced for growth (Fig. 1). In



Figure 1. Thinned stand where only dominants were left. Average d.b.h. is 7.8 inches. Average height is 69 feet, and age is 42 years. Compare with unthinned stand in Figure 2.



Figure 2. Unthinned stand. Note tangle of small saplings and bent trees. Average d.b.h. is 5.1 inches. Average height is 54 feet, and age is 42 years.

the unthinned stands, trees tend to occur in groups, and very small saplings still remain alive (Fig. 2).

Cubic-foot volume is greatest (6,298) in the dominance thinning (Table 2). The volume is practically equal in the space thinning and the unthinned area: 5,154 and 5,295 cubic feet, respectively. It is significant that the volume in the thinned stands is contained in 60 per cent fewer trees than in the unthinned.

TABLE 2. BASIC STATISTICS 1952, STAND AGE 42 YEARS
(acre basis)

Treatment	Number stems	Basal area (sq.ft.)	Average d.b.h. (inches)	Average height (feet)	Volume		
					Cubic ¹ (cu. ft.)	Inter. ² (bd. ft.)	Scribner ³ (bd. ft.)
Space thinning	506	170	7.8	67	5,154	23,655	2,176
Dominance thinning	623	204	7.8	69	6,298	27,851	2,749
No thinning	1,428	202	5.1	54	5,295	11,094	171

¹ Trees 1.5 inches d.b.h. and larger, including stump and top.

² Trees 6.6 inches d.b.h. and larger to a 5-inch top, International rule.

³ Trees 11.6 inches d.b.h. and larger to an 8-inch top, Scribner rule.

Board-foot volume for the thinned stands is more than twice that of the unthinned, measured in terms of the International $\frac{1}{8}$ -inch rule.

Increment

From 1920 through 1934, the unthinned stand showed more periodic annual increment by cubic volume than either of the thinned plots (Table 3). From 1934 to 1952, however, both thinned plots have shown more periodic annual increment than the unthinned in all measures of volume. Mortality and crowding apparently began to reduce the increment rate in the unthinned stand about 1934 when the stand was 24 years old.

Space thinning has had a more lasting effect on periodic annual increment even though dominance thinning held the lead during the first 20 years after thinning. Dominant trees, growing more vigorously before thinning, responded more quickly to release and made greater periodic annual increment for the period 1925-1945 in all units of growth measurement. Where spacing alone was the thinning guide, release trees responded a little more slowly, which tended to make the effect last longer. Since 1945, space thinning has had greater increment in all measures except Scribner volume.

TABLE 3. PERIODIC ANNUAL NET INCREMENT
(acre basis)

Treatment	Growth period	Basal area (sq. ft.)	Volume		
			Cubic ¹ (cu. ft.)	Intern. ² (bd. ft.)	Scribner ³ (bd. ft.)
Space thinning	1920-25	2.4	---	---	---
	1925-34	4.4	93	49	---
	1934-45	7.2	239	1,029	---
	1945-52	4.6	230	1,609	272
Dominance thinning	1920-25	4.8	---	---	---
	1925-34	5.9	172	162	---
	1934-45	7.5	288	1,431	---
	1945-52	4.4	214	1,488	344
No thinning	1920-25	6.4	---	---	---
	1925-34	5.2	194	12	---
	1934-45	5.7	189	422	---
	1945-52	3.0	183	844	21

¹ Trees 1.5 inches d.b.h. and larger, including stump and top.

² Trees 6.6 inches d.b.h. and larger to a 5-inch top, International rule.

³ Trees 11.6 inches d.b.h. and larger to an 8-inch top, Scribner rule.

Mortality

Mortality has been much higher in the unthinned stand by all units of measurement and for all remeasurement periods. The space thinning had more mortality than the dominance thinning. This difference occurred because dominants are the most vigorous trees. Periodic annual mortality between 1945 and 1952 was 50 cubic feet per acre for the unthinned stand, compared with 16 cubic feet for the space thinning, and 11 cubic feet for the dominance thinning.

Comparison of the 100 Largest Trees per Acre

Average diameter of the 100 largest trees (Table 4) is decidedly larger for the thinned stands, 10.9 and 11.0 inches compared with 8.8 inches in the unthinned stand. Volumes of the 100 largest trees are also greater in the thinned areas by all units of measurement. A comparison on this basis is especially valuable because the 100 largest trees will probably form a major part of the final timber crop, and the data are not influenced by the smaller trees, many of which will be lost before they reach saw-timber size. Diameter growth of the large trees is also greater in the thinned stands. During the most recent measurement period, advantage was still with the dominance thinning; however, the space thinning is slowly catching up. If this trend continues, the effect of early thinning may extend well beyond 30 years.

TABLE 4. COMPARISON OF THE 100 LARGEST TREES PER ACRE, 1945 AND 1952

Treatment	Year	Basal area	Volume			Diameter of average tree
			Cubic ¹	Inter. ²	Scribner ³	
		(sq. ft.)	(cu. ft.)	(bd. ft.)	(bd. ft.)	(inches)
Space thinning	1945	47.0	1,301	6,259		9.3
	1952	64.4	2,133	11,952	2,176	10.9
Dominance thinning	1945	51.3	1,529	7,786		9.7
	1952	66.4	2,235	12,716	2,749	11.0
No thinning	1945	32.1	845	3,849		7.7
	1952	42.0	1,274	6,324	171	8.8

¹ Trees 1.5 inches d.b.h. and larger, including stump and top.

² Trees 6.6 inches d.b.h. and larger to a 5-inch top, International rule.

³ Trees 11.6 inches d.b.h. and larger to an 8-inch top, Scribner rule.

Comparison with Normal Stand

In number of trees, the unthinned stand exceeded yield-table values, but the thinned stands were far below normal (Table 5).¹ In board-foot volume, both types of thinning exceed the unthinned stand. Dominance thinning shows the

¹ Data shown in Table 5 are actual values expressed as a per cent of normal yield-table values for site index 100 feet, age 42 years. Table 2 of U.S. Dept. of Agr. Tech Bul. 201 was used as the normal.

highest per cent of normal in all measures of volume. The extremely high per cent of normal for board-foot volume is attributed to the thinning treatment, which gives individual trees more room to grow and fosters development of larger trees.

TABLE 5. RELATIVE PRODUCTIVITY OF STUDY PLOTS, 1952, SHOWN AS PERCENTAGE OF NORMAL YIELD

Treatment	Number stems	Basal area	Volume	
			Cubic	Board feet (Intern.)
	—	—	—	—
			per cent	
Space thinning	49	115	159	302
Dominance thinning	61	138	195	355
No thinning	139	137	164	141

¹ Trees 1.5 inches d.b.h. and larger, including stump and top.

² Trees 6.6 inches d.b.h. and larger to a 5-inch top, International rule.

³ Trees 11.6 inches d.b.h. and larger to an 8-inch top, Scribner rule.

Summary and Conclusions

Early thinning in nine-year-old Douglas fir produced a stand of taller, larger trees than no thinning, and reduced the time required for stands to reach merchantable size. Thinning did not appreciably influence total cubic volume at the age of 42 years. There was some evidence that thinning for dominance is superior to thinning for spacing. The trees in the thinned stands were taller than those in the unthinned stand, indicating that height growth was noticeably affected by tree density. When trees as young as 10 to 15 years old are used for Christmas trees, thinning dense sapling stands of this age may be economically practical.

Literature Cited

Meyer, W. H. 1931. Thinning experiments in young Douglas fir. Jour. Agr. Res., 43(6): 537-546.

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