Effects of Thinning a 55-Year-Old Western White Pine Stand

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THE FIRST experiment in thinning western white pine (*Pinus monticola* Dougl.) was planned and established by J. A. Larson and D. R. Brewster in 1914 in a 55-year-old stand on the Priest River Experimental Forest, Idaho. It was designed to compare the effects of three thinning treatments on volume and quality growth, and on total volume production with an unthinned stand. As thinnings of saw-log material in this species are becoming salable, it is desirable to know if production can be increased by this early stand treatment and, if so, to what extent.

A forest owner or manager might hope for several benefits from thinning: first, an immediate cash income from the thinned material; second, increased total growth and production of wood during the rotation period; third, improved quality resulting in higher value at the time of harvest; and fourth, increased diameter growth, which will shorten the rotation.

Western white pine commonly occurs in various mixtures with as many as eight other species. In this stand, western larch (*Larix occidentalis* Nutt.) was the chief associate of white pine—60 percent of the dominants were larch; 30 percent were pine—with minor numbers of Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco), grand fir (*Abies grandis* [Dougl.] Lindl.), western hemlock (*Tsuga heterophylla* [Raf.] Sarg.), western redcedar (*Thuja plicata* Donn), lodgepole pine (*Pinus contorta* Dougl.), and Engelmann spruce (*Picea engelmannii* Parry). Thus the stand was typical of natural stands in the northern part of the white pine range. It was situated on a low level bench of site index 58 feet at 50 years, which is good for white pine.

Four permanent sample plots, each one-half acre in size, were established and treated as follows:

Plot 101. Left unthinned as a check area.

Plot 102. Thinned three times. The 1914 thinning removed most of the intermediate and suppressed trees and enough of the inferior dominants to provide increased growing space for the remaining trees for 10 years. The second thinning, in 1924, removed those trees needed to free the remainder for another 10 years. The third thinning, in 1934, eliminated all trees except those intended for the final crop.

Plot 103. Thinned twice, in 1914 and 1934. The result of each of these two thinnings was intended to be the same as on plot 102, but the stand was thinned in two stages instead of three.

Plot 104. One severe thinning in 1914 left only those trees that the marker felt would produce a maximum crop of saw timber at the end of the rotation.

In each of these thinnings, the cedar understory was left intact except that trees damaged during the thinning operation were removed. The primary purpose of the thinnings was to increase the growing space of selected crop trees; no conscious effort was made to alter species composition.

Measurements at 5-year intervals show the effect of these thinnings for 35 years. Tables 1 and 2 present the volume removed, mortality, and growth on the plots from 1914 through 1949.

Although the plots were generally comparable at the time of establishment, they varied somewhat in stocking. Because of this variation and the fact that no replications were installed, it is impossible to assess accurately the effects of the thinnings. However, until analyses of additional plots are available, it

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TABLE 1.—NUMBER OF TREES AND BASAL AREAS PER ACRE FOR ALL SPECIES, PRIEST RIVER 1914 THINNING PLOTS[1]

Item	Plot 101 unthinned		Plot 102 thinned three times		Plot 103 thinned twice		Plot 104 thinned once	
	No. trees	Sq. ft. basal area	No. trees	Sq. ft. basal area	No. trees	Sq. ft. basal area	No. trees	Sq. ft. basal area
Stand								
1914 before thinning	1,068	156	1,824	156	1,252	140	1,384	174
1914 removed in thinning			1,274	60	798	49	1,068	79
1914 after thinning			550	96	454	91	316	95
1924 before thinning	924	178	528	130	424	123	300	119
1924 removed in thinning			138	19				
1924 after thinning			390	111				
1934 before thinning	772	190	382	137	410	146	274	134
1934 removed in thinning			124	29	142	40		
1934 after thinning			258	108	268	106		
1949	626	221	250	151	252	143	268	166
Mortality 1914-1949	442	45	38	5	60	9	48	11
Gross annual increment 1914-1949		3.1		3.1		2.9		2.3
Net annual increment 1914-1949 (excluding mortality)		1.9		2.9		2.6		2.0
Net annual increment 1914-1949 (excluding mortality and thinnings)		1.9		—0.1		.01		—0.2
Total production		266		264		241		256

[1]Includes all trees 0.6 inch d.b.h. and larger.

TABLE 2.—CUBIC- AND BOARD-FOOT VOLUMES PER ACRE FOR ALL SPECIES, PRIEST RIVER 1914 THINNING PLOTS[1]

Item	Plot 101 unthinned		Plot 102 thinned three times		Plot 103 thinned twice		Plot 104 thinned once	
	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet
Stand								
1914 before thinning	3,431	4,414	3,063	2,530	2,970	2,512	3,872	4,648
1914 removed in thinning			929	516	834	702	1,489	1,200
1914 after thinning			2,134	2,014	2,136	1,810	2,383	3,448
1924 before thinning	4,753	8,650	3,497	6,056	3,372	5,000	3,527	7,822
1924 removed in thinning			400	98				
1924 after thinning			3,097	5,958				
1934 before thinning	5,750	12,874	4,260	11,214	4,529	10,280	4,372	12,672
1934 removed in thinning			773	640	1,112	1,184		
1934 after thinning			3,487	10,574	3,417	9,096		
1949	7,613	22,892	5,625	21,532	5,187	18,538	5,978	21,450
Mortality 1914-1949	1,043	2,514	108	70	221	258	270	290
Gross annual increment 1914-1949	149	600	136	581	125	519	110	523
Net annual increment 1914-1949 (excluding mortality)	119	528	133	579	119	512	103	514
Net annual increment 1914-1949 (excluding mortality and thinnings)	119	528	73	543	63	458	60	480
Total production	8,656	25,406	7,835	22,856	7,354	20,680	7,737	22,940

[1]Cubic-foot volumes include all trees 0.6 inch d.b.h. and larger. Board-foot volumes were computed from total height volume tables based on the Scribner Decimal C log rule. Minimum diameters used in computing board-foot volumes were 7.6 inches for white pine and 9.6 inches for other species.

is believed this information will serve as a useful guide in thinning white pine stands.

Effects of Thinning

In this test, the thinning treatments failed to increase the gross volume production above that of the unthinned stand (Table 2). The volume of standing timber 35 years after thinning was greater on the check plot than on any of the thinned plots. Also the total volume of wood produced in 90 years was greater on the check plot. However, a much larger share of the production has been lost through mortality on the check plot. If mortality is deducted from the gross growth, plot 102, which was thinned three times, shows an annual increment of 133 cubic feet compared to 119 feet on the check plot, 119 feet on plot 103, and 103 feet on plot 104. Therefore, if the material removed were merchantable, conservative thinning would enable the forest owner to receive an immediate income from the land by harvesting potential mortality and at the same time increase the total yield.

At present, thinned material, except that of saw-log size, is seldom merchantable and therefore is lost just as mortality is lost. If both mortality and the thinnings are deducted from the gross growth, the net board-foot increment shows an advantage for the stand thinned three times, but the net cubic-foot increment is greatest on the unthinned plot. The difference between board-foot and cubic-foot increment leads to the conclusion that growth on the thinned plot was made on fewer but larger trees whereas growth on the check plot was divided among numerous small trees. This is a distinct and important advantage of thinnings.

Since the material removed in low thinning is generally unmerchantable and the volume production following thinning is no greater than in unthinned stands, any benefits derived from such thinnings must come from improved quality of the final product or from a shortened rotation. One way in which thinning can enhance the value of a stand is through improving the species composition so that growth is concentrated on stems of the most valuable species. Improved composition is especially important when the difference in value between species is as large as it is in the white pine type. Although no special effort was made in this test to improve species composition, all the treatments did increase the proportion of high-value white pine in the stand (Table 3). The repeated light thinnings, which increased the proportion of white pine by 20 percent, proved more effective than the single heavy thinning, which resulted in only an 8-percent increase. The proportion of white pine in the unthinned stand remained nearly constant during the 35-year period.

The actual growth and production of white pine following thinning is probably more meaningful than the proportional composition of the stand by species (Table 4). Plot 102, thinned three times, has shown a net annual growth of 407 board feet of white pine per acre, or 158 feet more than the check plot. The net periodic annual white pine cubic-foot growth on plot 102 was 64 cubic feet, or 12 cubic feet greater per acre than that on the check plot. Neither of the other two thinned plots equalled the growth of the check plot. The in-

TABLE 3.—EFFECT OF THINNING ON STAND COMPOSITION

Plot	Proportion of white pine cubic-foot volume in total stand: 1914 Before thinning	1949	Increase
	Percent	*Percent*	*Percent*
101	40.9	42.5	1.6
102	41.4	62.7	21.3
103	26.1	45.6	19.5
104	27.3	35.1	7.8

TABLE 4.—CUBIC- AND BOARD-FOOT VOLUMES PER ACRE FOR WHITE PINE ONLY, PRIEST RIVER 1914 THINNING PLOTS[1]

Item	Plot 101 unthinned		Plot 102 thinned three times		Plot 103 thinned twice		Plot 104 thinned once	
	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet
Stand								
1914 before thinning	1,402	2,350	1,268	1,350	775	734	1,058	1,288
1914 removed in thinning			291	104	185	158	400	174
1914 after thinning			977	1,246	590	576	658	1,114
1924 before thinning	2,113	4,510	1,745	4,138	1,101	1,926	1,072	2,600
1924 removed in thinning			126	0				
1924 after thinning			1,619	4,138				
1934 before thinning	2,598	7,302	2,345	7,910	1,613	4,632	1,370	4,524
1934 removed in thinning			276	192	178	148		
1934 after thinning			2,069	7,718	1,435	4,484		
1949	3,232	11,080	3,520	15,598	2,366	9,318	2,096	8,408
Mortality 1914-1949	691	2,018	66	70	100	258	94	70
Gross annual increment 1914-1949	72	307	86	418	59	261	44	210
Net annual increment 1914-1949 (excluding mortality)	52	249	84	416	56	254	41	208
Net annual increment 1914-1949 (excluding mortality and thinnings)	52	249	64	407	45	245	30	203
Total production	3,923	13,098	4,279	15,964	2,829	9,882	2,590	8,652

[1]Cubic-foot volumes include trees 0.6 inch d.b.h. and larger. Board foot volumes were computed from total height volume tables based on the Scribner Decimal C log rule. Board-foot volumes include trees 7.6 inches d.b.h. and larger.

creased production of white pine resulting from thinning may be important to a forest owner who must grow as much high-value white pine per acre as possible to offset an investment in blister rust control.

One outstanding benefit from thinning is increased diameter growth which shortens the rotation. All the treatments in this test stimulated the diameter growth of trees in the dominant and codominant crown classes at the time of thinning (Table 5).

Increased diameter growth following thinning has not been sufficient, however, to change the diameter distribution pattern to a marked degree. This is illustrated in Table 6, which shows numbers of trees 10 inches and larger within diameter classes. The data show little difference between the number and distribution of merchantable sized trees on the four plots 35 years after thinning. This distribution is largely influenced by their arrangement in 1914 when plots 101 and 104 contained more large trees than the other two plots. Nevertheless, thinning has not greatly altered that distribution.

Conclusions

Results of this single test provide some useful information on thinning western white pine, but they are not conclusive.

The thinnings had little effect on total volume production but enhanced the value of the stand by increasing the proportion of high-value white pine in it. They stimulated diameter growth of dominant and codominant stems but not at a rate that resulted in an appreciably greater number of larger diameter trees than on the check plot.

Because white pine was exceeded initially by other species, it is possible that an early weeding to correct composition followed by frequent thinnings would prove more beneficial eventually. Analyses of data from other plots, established later than those described above, will complement these results and provide additional information for the management of young white pine stands.

TABLE 5.—DIAMETER GROWTH OF DOMINANT AND CODOMINANT TREES FOLLOWING THINNING

Plot	Western white pine Average d.b.h. 1914	1949	D.b.h. growth	Western larch Average d.b.h. 1914	1949	D.b.h. growth
	Inches					
101	7.6	11.0	3.4	7.9	10.5	2.6
102	7.2	12.5	5.3	7.6	11.4	3.8
103	7.2	12.4	5.2	8.3	12.2	3.9
104	7.8	12.0	4.2	9.2	12.0	2.8

TABLE 6.—DIAMETER DISTRIBUTION OF TREES 10 INCHES D.B.H. AND LARGER ON THINNED AND UNTHINNED PLOTS

D.b.h. class	1914 Unthinned	Thinned three times	Thinned twice	Thinned once	1949 Unthinned	Thinned three times	Thinned twice	Thinned once
	Trees per acre							
10	16	10	12	32	54	28	16	32
11	16	4	12	24	36	24	32	24
12	10	4	4	12	16	38	30	30
13	2		2	4	26	28	12	20
14		2	2	4	12	6	22	16
15		2			10	4	6	10
16					6	2	2	12
17	2				4	2	2	4
18					2	4	4	
19						4		
20								
21					2			
22								
23								
Total	46	22	32	76	168	140	126	148