SOME PRELIMINARY GROWTH AND YIELD DATA FOR THINNED PSEUDOTSUGA TAXIFOLIA IN KAINGAROA FOREST

By E. Y. CUTTEN

1. *Summary*

Examination of the data from four permanent sample plots in Douglas fir, established and first thinned at ages 21 to 26 years, shows no marked response to thinning and no increase in production in six years. On the other hand, there is an appreciable increase in average tree size and improvement in stand quality.

2. *Introduction*

Four permanent sample plots were laid down in Douglas fir stands of high quality class, in Kaingaroa Forest in the Rotorua Conservancy, in 1947 and 1948. Each plot consisted of three sub-plots, given respectively a moderate and a heavy low thinning, with one left unthinned as a control. These have all been remeasured twice at three-yearly intervals.

It is now recognized that crown thinning may prove a more appropriate treatment for this species than low thinning. Consequently, a sub-plot given a heavy crown thinning, has been added to plots since established and to some of the early plots.

Additional permanent plots to the number of eleven, have been laid down, two in Kaingaroa Forest and others in forests in the Wellington, Nelson, Canterbury and Southland Conservancies, and more are projected. Only the four above have been dealt with in this paper, none of the others having yet been remeasured more than once.

It is considered too early to expect much information on response to thinning from the sample plots. The six years which have passed since the first thinning was carried out, are a brief period in the development of a species which requires a fairly long rotation. Nevertheless, the data may well be examined for a preliminary assessment of response, and an indication of the trend of yield of the thinned against the unthinned plots.

3. *Results*

The data is set out in Tables 1 - 16, which show, per acre, for each plot:

(a) The progress of stocking, and the increase in basal area, mean diameter and mean height of dominants.
(b) The volume and increment from period to period.
(c) The mean diameter and the percentage increase in volume of the 100 largest trees per acre.
(d) The volume of the thinned plots at each measurement, expressed as a percentage of the volume of the unthinned.

Comparisons of any item of the data may be made by reading vertically down the relevant column in the tables. This will give the information for the Control, Moderate Thinning and Heavy Thinning in that order.

Production to the date of the last measurement, six years from thinning, is shown in column 45 in Tables 2, 6, 10 and 14. Measured as present standing volume plus volume removed in thinning, it will be seen that production for the thinned plots is a little less in most cases than for the unthinned, and a little more for the moderate than for the heavy thinnings, taking into account initial differences in stocking (column 3).

The question arises whether the first thinnings were merchantable. The range in mean b.h. diameter of the material removed was 6.2 to 8.6 in. Under present conditions, much of this would be saleable as poles, posts and rails. For purposes of comparison of production, the assumption is made that both the material removed in first thinning in the thinned plots, and the small material in the controls, was merchantable.

Although the thinned plots have gained nothing on the unthinned in production in six years, they do exhibit a considerable improvement in stand quality. Growth is concentrated on larger and better stems. Note the increase in mean diameter (column 20, tables 1, 5, 9 and 13).

Response to thinning has been compared, by taking out the volumes and mean b.h. diameters of the one hundred largest trees per acre at each measurement (tables 3, 7, 11 and 15). Examination of the figures for percentage increase in volume, shows that there is no uniformity between treatments. For plots R.20 and R.22, the increase for the thinned sub-plots is below that for the controls for the first three year period, but above for the second. It is also above for the six year period for Plot R.20, but there is little difference for Plot R.22. For Plots R.23 and R.24, the thinned sub-plots are ahead of the controls for all periods. For all plots the mean diameters are seen to increase more rapidly for the moderately thinned plots than for the controls, and more rapidly for the heavily thinned plots than for the moderate, but not markedly so. The balance of evidence is for a moderately increased rate of growth in this superior portion of the crop for the thinned plots, a little higher for the heavy than for the moderate thinning. However, there may be a slight initial depression in volume growth, as shown in Plots R.20 and R.22. This is not evidenced in diameter growth. It will be seen that the percentage increase in volume, is appreciably less for the second three year period than for the first, for most plots, particularly for the controls. The effect on diameter growth is not so marked. This slowing up is, of course, due to reduction of root and crown space with growth.

To indicate the tendency of the thinned plots to regain the volume of the unthinned, tables 4, 8, 12 and 16 have been compiled.

These show the volume of the thinned as a percentage of the volume of the control at each measurement date. It will be seen that there is a constant increase.

4. *Discussion*

Plot R.20 was thinned at about the right time for its initial spacing (6 feet by 6 feet), the others (spaced at 8 feet by 8 feet) somewhat early. In deciding a thinning regime, the rate of growth which it is desired to maintain, must be considered. Recent investigation by the Forest Products Branch of the Forest Research Institute, has shown that maximum strength in Douglas fir in New Zealand is attained in trees grown at a rate of 24 rings per inch. As this is hardly an economic rate of growth, 8 to 10 rings per inch is recommended, with an absolute minimum of 6 (diameter growth 1/3rd inch per annum). These conditions are really adequately met, only in stands initially spaced at 6 feet by 6 feet or less. Examination of the tree records for Plot R.20 indicates: an average growth rate for the dominant trees since moderate thinning, of less than 1/3rd inch per annum; and an average growth rate before thinning, just over this figure.

For the other plots, initially spaced at 8 feet by 8 feet, the records indicate, for the dominant trees, an average annual growth rate exceeding 1/3rd inch, both before and after thinning. The desired figure is more closely approached by the codominants. This suggests crown thinning, removing the larger dominants and leaving the slender ones and the better codominants and subdominants. There does not appear to be any other way of limiting growth in stands spaced at 8 feet by 8 feet, to obtain the desired number of rings per inch. Crown thinning is also desirable for stands planted at 6 feet by 6 feet. Thinnings need to be repeated as soon as the rate of growth falls to a predetermined minimum. To attain these objectives, several thinnings will be required in a rotation of 80 years. The methods of controlling periodicity and degree of thinning will not be discussed in this paper.

In the samples considered, there is no increase in production in six years in the thinned plots compared with the controls. However, this is not a matter for any concern. The benefits from thining are of the future rather than the present. Tables 4, 8, 12 and 16 show that the ratio of volume of thinned to unthinned increases at each three-yearly remeasurement. Given normal conditions for growth, a higher yield must finally be obtained from the thinned plots than from the unthinned.

5. *Conclusions*

The effect on yield of Douglas fir cannot be gauged in a period of six years from first thinning. Over that period there is an improvement in stand quality with no increase in production.

To produce timber of reasonable strength, there appears to be

a case for removal in thinning, of the more vigorous trees, in favour of the less vigorous.

6. *Acknowledgements*

Grateful acknowledgement is made for assistance given by R. E. Irvine and C. R. Van der Voort in computing and checking data.

GROWTH AND YIELD

Permanent Sample Plot No. R20—Ps. taxifolia—Compt. 1123, Kaingaroa Forest

TABLE 1—Stocking and Progress of Diameter, Basal Area and Height Increment (per acre)

Planted 1921 at 6 feet x 6 feet — Site Index 82*

Date Sub-plot and treatment	1947 Age: 26 STAND									1950 Age: 29 STAND									1953 Age: 32 STAND								
	Before Thinning				After Thinning			Removed		Before Thinning				After Thinning			Removed		Before Thinning				After Thinning			Removed	
	No. of stems (1)	Mean B.H.D. o.b. ins. (2)	Basal area sq. ft. (3)	Mean Dom. Ht. ft. (4)	No. of stems (5)	Mean B.H.D. o.b. ins. (6)	Basal area sq. ft. (7)	No. of stems (8)	Mean B.H.D. o.b. ins. (9)	No. of stems (10)	Mean B.H.D. o.b. ins. (11)	Basal area sq. ft. (12)	Mean Dom. Ht. ft. (13)	No. of stems (14)	Mean B.H.D. o.b. ins. (15)	Basal area sq. ft. (16)	No. of stems (17)	Mean B.H.D. o.b. ins. (18)	No. of stems (19)	Mean B.H.D. o.b. ins. (20)	Basal area sq. ft. (21)	Mean Dom. Ht. ft. (22)	No. of stems (23)	Mean B.H.D. o.b. ins. (24)	Basal area sq. ft. (25)	No. of stems (26)	Mean B.H.D. o.b. ins. (27)
C Control	766	8.2	283	70	—	—	—	—	—	694	9.0	312	80	—	—	—	—	—	664	9.7	343	84½	—	—	—	—	—
D Control	816	8.0	282	70½	—	—	—	—	—	744	8.8	313	83½	—	—	—	—	—	678	9.5	333	88½	—	—	—	—	—
E Mod. Low	822	8.0	284	67½	326	10.0	178	496	6.2	326	11.0	215	73½	—	—	—	—	—	326	11.9	252	85½	254	12.4	213	72	10.0
F Mod. Low	728	8.3	272	76	326	10.2	182	402	6.5	326	11.0	215	82½	—	—	—	—	—	326	11.9	250	89½	244	12.6	211	82	9.4
A Hvy. Low	669	8.2	273	71	176	11.3	122	493	7.5	176	12.7	154	76	—	—	—	—	—	176	14.4	199	85	—	—	—	—	—
B Hvy. Low	669	8.2	273	72	208	11.3	145	461	7.2	208	12.6	179	82	—	—	—	—	—	208	13.8	217	88	152	14.5	172	56	12.1

*Provisional Yield Table for Unthinned Douglas Fir in New Zealand, 1953. Site Index is Mean Top Height at Age 30 years.

TABLE 2—Progress of Volume Increment

(Volume to 4 inch top, inside bark—cubic feet per acre)

Date Sub-plot and treatment	1947 Age: 26 STAND				1950 Age: 29 STAND Production to Date							1953 Age: 32 STAND Production to Date						
	Before thinning cu. ft. (28)	Mean Annual Increment cu. ft. per ac. per annum (29)	After Thinning cu. ft. (30)	Removed in Thinning cu. ft. (31)	Before thinning cu. ft. (32)	Mean Annual Increment cu. ft. per ac. per annum (33)	Period Annual Increment cu. ft. per ac. per annum (34)	After Thinning cu. ft. (35)	Removed in Thinning cu. ft. (36)	Total thinnings cu. ft. (37)	Standing crop plus thinnings cu. ft. (38)	Before thinning cu. ft. (39)	Mean Annual Increment cu. ft. per ac. per annum (40)	Period Annual Increment cu. ft. per ac. per annum (41)	After Thinning cu. ft. (42)	Removed in Thinning cu. ft. (43)	Total thinnings cu. ft. (44)	Standing crop plus thinnings cu. ft. (45)
C Control	6,490	250	—	—	8,460	292	657	—	—	—	8,460	10,010	313	517	—	—	—	10,010
D Control	6,630	255	—	—	8,780	303	717	—	—	—	8,780	10,190	319	470	—	—	—	10,190
E Mod. Low	6,510	250	4,420	2,090	5,920	284	500	—	—	2,090	8,010	7,730	322	603	6,540	1,190	3,280	9,820
F Mod. Low	6,640	255	4,910	1,730	6,360	286	483	—	—	1,730	8,090	7,910	314	517	6,710	1,200	2,930	9,640
A Hvy. Low	6,500*	250	3,170	3,330	4,090	269	307	—	—	3,330	7,420	5,690	306	533	—	—	3,330	9,020
B Hvy. Low	6,500*	250	3,770	2,730	5,260	286	497	—	—	2,730	7,990	6,800	318	513	5,370	1,430	4,160	9,530

*Approx. **Note**—Replicated treatments, Sub-plots C, E, A are comparable and slightly lower site quality than D, F, B which are also comparable.

Plot: R.20

TABLE 3—Response to Thinning Measured by the Increase in Mean Diameter and the Percentage Increase in Volume of the 100 Largest trees per Acre.

Sub-plot and Treatment	Mean B.H. Diameter 1947	1950	1953	Increase 1947-50 Mean B.H. Diam.	1947-50 Volume per cent.	1950-53 Mean B.H. Diam.	1950-53 Volume per cent.	1947-53 Mean B.H. Diam.	1947-53 Volume per cent.
C. Control	12.2	13.3	14.2	1.1	33%	.9	18%	2.0	57%
E. Moderately Low	12.1	13.4	14.6	1.3	30%	1.2	34%	2.5	74%
A. Heavy Low	12.5	14.1	15.8	1.6	32%	1.7	36%	3.3	79%
D. Control	12.2	13.4	14.2	1.2	41%	.8	20%	2.0	69%
E. Moderately Low	12.4	13.6	14.8	1.2	33%	1.2	25%	2.4	66%
B. Heavy Low	12.8	14.2	15.7	1.4	36%	1.5	34%	2.9	82%

TABLE 4—Volume of Thinned Plots Expressed as a Percentage of Volume of Control

Sub-plot and Treatment	Date 1947 %	1950 %	1953 %
E. Moderately Low	68	70	77
A. Heavy Low	49	48	57
F. Moderately Low	74	72.5	78
B. Heavy Low	57	60	68

GROWTH AND YIELD

Permanent Sample Plot No. R22 Ps. taxifolia—Compt. 1145, Kaingaroa Forest

TABLE 5—Stocking and Progress of Diameter Basal Area and Height Increment (per acre)

Planted 1923 at 8 feet x 8 feet — Site Index 78

Date Sub-plot and treatment	1948 Age: 25 STAND									1951 Age: 28 STAND									1954 Age: 31 STAND								
	Before Thinning				After Thinning			Removed		Before Thinning				After Thinning			Removed		Before Thinning				After Thinning			Removed	
	No. of stems (1)	Mean B.H.D. o.b. ins. (2)	Basal area sq. ft. (3)	Mean Dom. Ht. ft. (4)	No. of stems (5)	Mean B.H.D. o.b. ins. (6)	Basal area sq. ft. (7)	No. of stems (8)	Mean B.H.D. o.b. ins. (9)	No. of stems (10)	Mean B.H.D. o.b. ins. (11)	Basal area sq. ft. (12)	Mean Dom. Ht. ft. (13)	No. of stems (14)	Mean B.H.D. o.b. ins. (15)	Basal area sq. ft. (16)	No. of stems (17)	Mean B.H.D. o.b. ins. (18)	No. of stems (19)	Mean B.H.D. o.b. ins. (20)	Basal area sq. ft. (21)	Mean Dom. Ht. ft. (22)	No. of stems (23)	Mean B.H.D. o.b. ins. (24)	Basal area sq. ft. (25)	No. of stems (26)	Mean B.H.D. o.b. ins. (27)
A Control	556	8.2	203	65½	—	—	—	—	—	524	9.3	245	73	—	—	—	—	—	502	10.1	279	80½	—	—	—	—	—
C Mod. Low	548	8.5	216	65½	250	10.2	144	298	6.6	250	11.6	184	74	—	—	—	—	—	250	12.8	226	82	—	—	—	—	—
B Hvy. Low	582	8.4	221	66	190	10.7	121	392	6.8	188	12.3	156	75	—	—	—	—	—	188	13.7	192	82	—	—	—	—	—
D Mod. Crown	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	536	9.8	282	81	302	9.5	149	234	10.2

TABLE 6—Progress of Volume Increment

(Volume to 4 inch top, inside bark—cubic feet per acre)

Date Sub-plot and treatment	1948 Age: 25 STAND				1951 Age: 28 STAND / Production to Date							1954 Age: 31 STAND / Production to Date						
	Before thinning cu. ft. (28)	Mean Annual Increment cu. ft. per ac. per annum (29)	After Thinning cu. ft. (30)	Removed in Thinning cu. ft. (31)	Before thinning cu. ft. (32)	Mean Annual Increment cu. ft. per ac. per annum (33)	Period Annual Increment cu. ft. per ac. per annum (34)	After Thinning cu. ft. (35)	Removed in Thinning cu. ft. (36)	Total thinnings cu. ft. (37)	Standing crop plus thinnings cu. ft. (38)	Before thinning cu. ft. (39)	Mean Annual Increment cu. ft. per ac. per annum (40)	Period Annual Increment cu. ft. per ac. per annum (41)	After Thinning cu. ft. (42)	Removed in Thinning cu. ft. (43)	Total thinnings cu. ft. (44)	Standing crop plus thinnings cu. ft. (45)
A Control	4,600	184	—	—	6,460	231	620	—	—	—	6,460	8,040	259	527	—	—	—	8,540
C Mod. Low	4,850	194	3,400	1,450	5,150	242	583	—	—	1,450	6,600	6,930	282	593	—	—	1,450	8,380
B Hvy. Low	4,960	198	2,890	2,070	4,470	243	527	—	—	2,070	6,540	5,960	275	497	—	—	2,070	8,030
D Mod. Crown	—	—	—	—	—	—	—	—	—	—	—	8,010	259	—	4,170	3,840	3,840	8,010

*Established 1954

Plot: R.22

TABLE 7—Response to Thinning Measured by the Increase in Mean Diameter and the Percentage Increase in Volume of the 100 Largest trees per Acre.

Sub-plot and Treatment	Mean B.H. Diameter			Increase 1948-51		Increase 1951-54		Increase 1948-54	
	1948	1951	1954	Mean B.H. Diam.	Volume per cent.	Mean B.H. Diam.	Volume per cent.	Mean B.H. Diam.	Volume per cent.
A. Control	11.7	13.1	14.4	1.4	56%	1.3	30%	2.7	103%
C. Moderately Low	12.1	13.6	15.2	1.5	45%	1.6	37%	3.1	99%
B. Heavy Low	12.0	13.7	15.2	1.7	45%	1.5	37%	3.2	99%

TABLE 8—Volume of Thinned Plots Expressed as a Percentage of Volume of Control

Sub-plot and Treatment	Date 1948 %	1951 %	1954 %
C. Moderately Low	74	80	86
B. Heavy Low	63	69	74

GROWTH AND YIELD

Permanent Sample Plot No. R23 Ps. taxifolia Compt. 1153, Kaingaroa Forest

TABLE 9—Stocking and Progress of Diameter, Basal Area and Height Increment (per acre)

Planted 1925 at 8 feet x 8 feet — Site Index 83

Date Sub-plot and treatment	1948 Age: 23 STAND									1951 Age: 26 STAND									1954 Age: 29 STAND								
	Before Thinning				After Thinning			Removed		Before Thinning				After Thinning			Removed		Before Thinning				After Thinning			Removed	
	No. of stems (1)	Mean B.H.D. o.b. ins. (2)	Basal area sq. ft. (3)	Mean Dom. Ht. ft. (4)	No. of stems (5)	Mean B.H.D. o.b. ins. (6)	Basal area sq. ft. (7)	No. of stems (8)	Mean B.H.D. o.b. ins. (9)	No. of stems (10)	Mean B.H.D. o.b. ins. (11)	Basal area sq. ft. (12)	Mean Dom. Ht. ft. (13)	No. of stems (14)	Mean B.H.D. o.b. ins. (15)	Basal area sq. ft. (16)	No. of stems (17)	Mean B.H.D. o.b. ins. (18)	No. of stems (19)	Mean B.H.D. o.b. ins. (20)	Basal area sq. ft. (21)	Mean Dom. Ht. ft. (22)	No. of stems (23)	Mean B.H.D. o.b. ins. (24)	Basal area sq. ft. (25)	No. of stems (26)	Mean B.H.D. o.b. ins. (27)
C Control	480	9.6	241	63	—	—	—	—	—	470	10.5	282	72	—	—	—	—	—	460	11.2	314	80	—	—	—	—	—
B Mod. Low	444	9.9	239	65	256	11.1	171	188	8.1	256	12.3	209	74½	—	—	—	—	—	254	13.6	255	83	—	—	—	—	—
A Heavy Low	482	9.8	248	66	198	11.3	134	284	8.6	198	12.7	175	73	—	—	—	—	—	198	14.2	220	83	—	—	—	—	—

TABLE 10—Progress of Volume Increment

(Volume to 4 inch top, inside bark—cubic feet per acre)

Date Sub-plot and treatment	1948 Age: 23 STAND				1951 Age: 26 STAND			Production to Date			1954 Age: 29 STAND			Production to Date		
	Before thinning cu. ft. (28)	Mean Annual Increment cu. ft. per ac. per annum (29)	After Thinning cu. ft. (30)	Removed in Thinning cu. ft. (31)	Before thinning cu. ft. (32)	Mean Annual Increment cu. ft. per ac. per annum (33)	Period Annual Increment cu. ft. per ac. per annum (34)	After Thinning cu. ft. (35)	Removed in Thinning cu. ft. (36)	Total thinnings cu. ft. (37)	Standing crop plus thinnings cu. ft. (38)	Before thinning cu. ft. (39)	Mean Annual Increment cu. ft. per ac. per annum (40)	Period Annual Increment cu. ft. per ac. per annum (41)	After Thinning cu. ft. (42)	Removed in Thinning cu. ft. (43)	Total thinnings cu. ft. (44)	Standing crop plus thinnings cu. ft. (45)
C Control	5,360	233	—	—	7,600	292	747	—	—	—	7,600	9,630	332	677	—	—	—	9,630
B Mod. Low	5,390	234	3,990	1,400	5,950	290	635	—	—	1,400	7,350	7,790	330	613	—	—	1,400	9,190
A Heavy Low	5,550	241	3,150	2,400	5,080	299	643	—	—	2,400	7,480	6,760	337	560	—	—	2,400	9,160

Plot: R.23

TABLE 11—Response to Thinning Measured by the Increase in Mean Diameter and the Percentage Increase in Volume of the 100 Largest trees per Acre

Sub-plot and Treatment	Mean B.H. Diameter			Increase					
				1948-51		1951-54		1948-54	
	1948	1951	1954	Mean B.H. Diam.	Volume per cent.	Mean B.H. Diam.	Volume per cent.	Mean B.H. Diam.	Volume per cent.
C. Control	12.4	13.3	14.6	0.9	46%	1.3	23%	2.2	79%
B. Moderately Low	12.7	14.0	15.6	1.3	50%	1.6	26%	2.9	90%
A. Heavy Low	12.4	13.9	15.6	1.5	59%	1.7	27%	3.2	102%

TABLE 12—Volume of Thinned Plots Expressed as a Percentage of Volume of Control

Sub-plot and Treatment	Date		
	1948 %	1951 %	1954 %
B. Moderately Low	74	78	81
A. Heavy Low	59	67	70

GROWTH AND YIELD

Permanent Sample Plot No. R24 Ps. taxifolia—Compt. 1238, Kaingaroa Forest

TABLE 13—Stocking and Progress of Diameter, Basal Area and Height Increment (per acre)

Planted 1927 at 8 feet x 8 feet — Site Index 80

Date Sub-plot and treatment	1948 Age: 21 STAND									1951 Age: 24 STAND									1954 Age: 27 STAND								
	Before Thinning				After Thinning			Removed		Before Thinning				After Thinning			Removed		Before Thinning				After Thinning			Removed	
	No. of stems (1)	Mean B.H.D. o.b. ins. (2)	Basal area sq. ft. (3)	Mean Dom. Ht. ft. (4)	No. of stems (5)	Mean B.H.D. o.b. ins. (6)	Basal area sq. ft. (7)	No. of stems (8)	Mean B.H.D. o.b. ins. (9)	No. of stems (10)	Mean B.H.D. o.b. ins. (11)	Basal area sq. ft. (12)	Mean Dom. Ht. ft. (13)	No. of stems (14)	Mean B.H.D. o.b. ins. (15)	Basal area sq. ft. (16)	No. of stems (17)	Mean B.H.D. o.b. ins. (18)	No. of stems (19)	Mean B.H.D. o.b. ins. (20)	Basal area sq. ft. (21)	Mean Dom. Ht. ft. (22)	No. of stems (23)	Mean B.H.D. o.b. ins. (24)	Basal area sq. ft. (25)	No. of stems (26)	Mean B.H.D. o.b. ins. (27)
B Control	420	9.0	187	55	—	—	—	—	—	412	10.0	244	66	—	—	—	—	—	396	10.9	255	73	—	—	—	—	—
C Mod. Low	444	8.3	168	57½	260	9.5	127	184	6.5	260	10.9	167	67	—	—	—	—	—	260	12.0	203	73	—	—	—	—	—
D Hvy. Low	456	8.9	197	58	220	10.3	127	236	7.4	220	11.5	159	63½	—	—	—	—	—	220	12.9	199	75	—	—	—	—	—

TABLE 14—Progress of Volume Increment

(Volume to 4 inch top, inside bark—cubic feet per acre)

Date Sub-plot and treatment	1948 Age: 21 STAND				1951 Age: 24 STAND						Production to Date	1954 Age: 27 STAND						Production to Date
	Before thinning cu. ft. (28)	Mean Annual Increment cu. ft. per ac. per annum (29)	After Thinning cu. ft. (30)	Removed in Thinning cu. ft. (31)	Before thinning cu. ft. (32)	Mean Annual Increment cu. ft. per ac. per annum (33)	Period Annual Increment cu. ft. per ac. per annum (34)	After Thinning cu. ft. (35)	Removed in Thinning cu. ft. (36)	Total thinnings cu. ft. (37)	Standing crop plus thinnings cu. ft. (38)	Before thinning cu. ft. (39)	Mean Annual Increment cu. ft. per ac. per annum (40)	Period Annual Increment cu. ft. per ac. per annum (41)	After Thinning cu. ft. (42)	Removed in Thinning cu. ft. (43)	Total thinnings cu. ft. (44)	Standing crop plus thinnings cu. ft. (45)
B Control	3,820	210	—	—	5,760	294	590	—	—	—	5,760	6,860	269	363	—	—	—	6,860
C Mod. Low	3,390	191	2,710	680	4,360	238	523	—	—	680	5,040	5,530	260	390	—	—	680	6,210
D Hvy. Low	3,900	225	2,610	1,290	4,280	268	483	—	—	1,290	5,570	5,480	291	397	—	—	1,290	6,770

Plot: R.24

TABLE 15—Response to Thinning Measured by the Increase in Mean Diameter and the Percentage Increase in Volume of the 100 Largest trees per Acre

Sub-plot and Tratment	Mean B.H. Diameter			Increase					
				1948-51		1951-54		1948-54	
	1948	1951	1954	Mean B.H. Diam.	Volume per cent.	Mean B.H. Diam.	Volume per cent.	Mean B.H. Diam.	Volume per cent.
B. Control	11.4	12.8	13.9	1.4	48%	1.1	23%	2.5	82%
C. Moderately Low	11.0	12.6	13.9	1.6	54%	1.3	27%	2.9	94%
D. Heavy Low	11.6	13.0	14.4	1.4	47%	1.4	29%	2.8	90%

TABLE 16—Volume of Thinned Plots Expressed as a Percentage of Volume of Control

Sub-plot and Treatment	Date		
	1948 %	1951 %	1954 %
C. Moderately Low	71	76	81
D. Heavy Low	68	74	80