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SOME RECENT DEVELOPMENTS IN THE WIND RIVER DOUGLAS-FIR PLANTATION SPACING TESTS

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The effect of spacing on stand development is a subject that has been widely discussed. To test spacings ranging from 4x4 feet to 12x12 feet, a Douglas-fir plantation was established in 1925 at the Wind River Experimental Forest near Carson, Wash. This paper reports some results of a remeasurement made in 1957 (table 1) and compares these results with those of previous measurements. All measurements have been taken on one 0.4-acre plot in the 12x12 spacing and on three 0.25-acre plots in each of the other spacings. Height comparisons are based on 30 trees for each spacing.

Most of the trends evident from the 1957 remeasurement are similar to those reported previously.^{1/} Most irregularities in the trends, especially the low yields on the 8x8 spacing, are probably due to minor differences in site quality.

Effect of Spacing on Height and Diameter

Wider spacings produce taller trees (fig. 1). Average tree heights for the entire stand, the dominant and codominant stand, the 100 largest trees per acre, and the 5 largest trees per plot all

^{1/} Eversole, Kenneth R. Spacing tests in a Douglas-fir plantation. Forest Sci. 1: 14-18. 1955.

Table 1.--Live-stand statistics for 32-year-old Douglas-fir
under different spacings on the Wind River
Experimental Forest

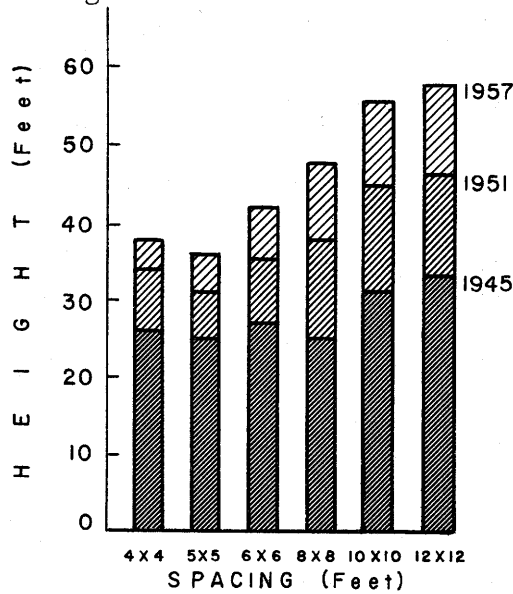
(Acre basis)

Spacing (feet)	Stand 1.6 inches d.b.h. and over					Merchantable stand ^{1/}	
	Average tree				Cubic volume	Cubic volume	International 1/4" volume
	Trees	D.b.h.	Height	Basal area			
	<u>Number</u>	<u>Inches</u>	<u>Feet</u>	<u>Sq. ft.</u>	<u>Cu. ft.</u>	<u>Cu. ft.</u>	<u>Bd. -ft.</u>
4x4	1,728	4.1	38	159.8	3,147	703	309
5x5	1,411	4.2	36	136.9	2,559	722	137
6x6	1,007	4.9	42	132.5	2,761	1,301	1,141
8x8	570	5.8	48	106.4	2,418	1,614	2,817
10x10	401	7.5	56	125.0	3,207	2,676	9,277
12x12	283	8.4	58	110.0	2,892	2,508	10,143
Natural	571	5.4	39	84.9	1,780	1,235	3,776

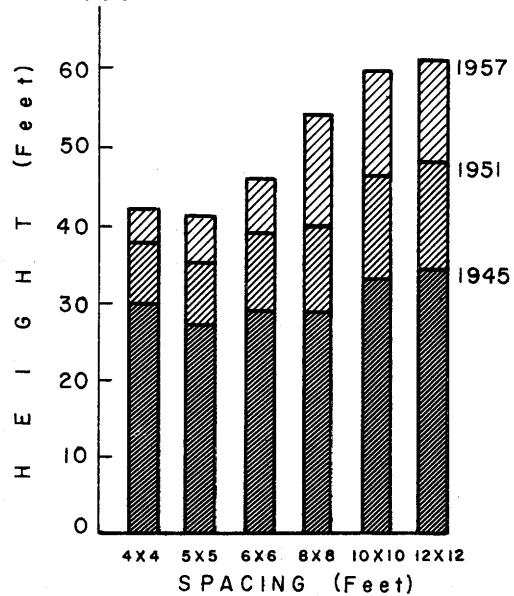
^{1/} Merchantable stand includes cubic-foot volume of trees 5.6 inches d.b.h. and over to a 4-inch top, and board-foot volume of trees 7.6 inches d.b.h. and over to a 6-inch top.

increase as spacing increases from 5x5 to 10x10 feet. The 4x4 and 5x5 spacings produce trees of nearly equal height, and the 10x10 and 12x12 spacings do likewise. There is no indication that this trend will change, as the heights on the wider spacings still tend to increase more rapidly than those on the closer spacings. Average diameters follow a similar trend, as can be seen from the distribution of trees by diameter classes (table 2).

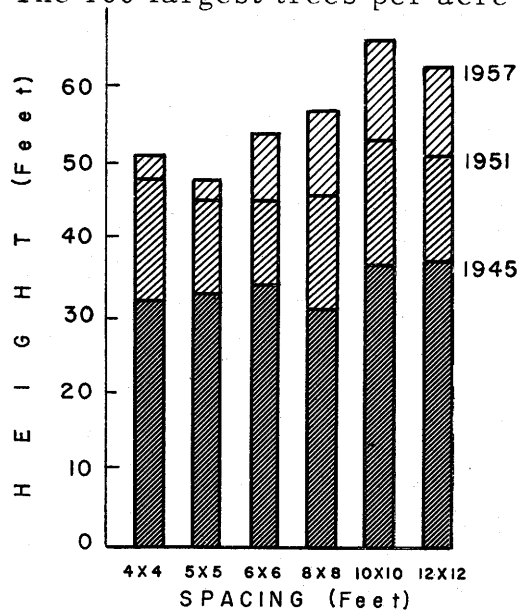
All trees 1.6" d.b.h. and larger



Dominant and codominant trees



The 100 largest trees per acre



The 5 largest trees per plot

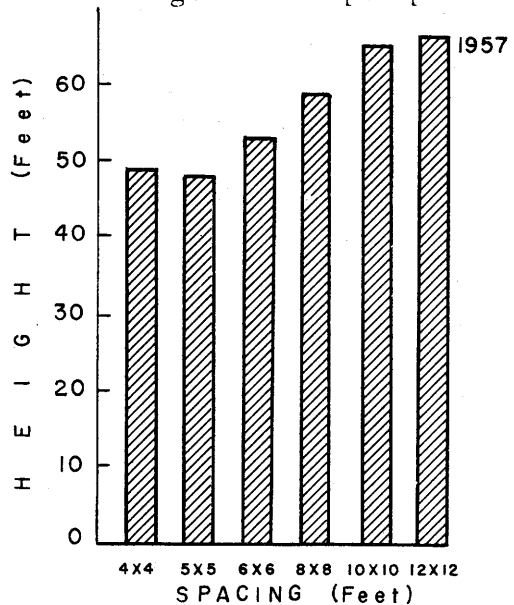


Figure 1.--Effect of spacing on height of Douglas-fir planted in 1925 at Wind River Experimental Forest. Average heights of trees 1.6 inches d.b.h. and larger, dominants and codominants, and 100 largest trees per acre are heights of the average tree within each classification, as read from height curves; that of the 5 largest trees per plot is an average of actual field measurements.

Table 2.--Stand table for Douglas-fir planted at different spacings in 1925 at Wind River Experimental Forest

(Acre basis)

D. b. h. : class : (In- ches)		Spacing and year of measurement																													
		4x4					5x5					6x6					8x8					10x10					12x12				
		1945	1951	1957	1945	1951	1957	1945	1951	1957	1945	1951	1957	1945	1951	1957	1945	1951	1957	1945	1951	1957	1945	1951	1957						
----- <u>Number</u> -----																															
1.5 and less		384	181	62	231	138	59	121	61	25	76	29	10	9	3	0	3	0	0	0	0	0	0	0	0						
2		706	415	249	507	296	197	216	138	77	140	36	28	35	11	5	13	8	0	0	0	0	0	0	0						
3		651	530	458	592	415	331	399	204	160	161	83	50	61	17	12	35	5	8	0	0	0	0	0	0						
4		365	584	453	289	494	403	348	335	254	184	148	82	113	51	22	45	28	10	0	0	0	0	0	0						
5		39	228	387	70	192	283	71	186	230	58	118	121	87	55	51	71	25	25	0	0	0	0	0	0						
6		0	66	140	3	79	148	20	142	156	19	128	106	77	104	54	76	45	17	0	0	0	0	0	0						
7		0	7	32	0	5	44	0	20	97	0	45	106	28	63	77	45	53	33	0	0	0	0	0	0						
8		0	0	8	0	0	5	0	10	23	0	20	48	4	64	61	8	56	60	0	0	0	0	0	0						
9		0	1	0	0	0	0	0	0	9	0	1	24	0	28	55	0	53	40	0	0	0	0	0	0						
10		0	0	1	0	0	0	0	0	1	0	0	5	0	10	43	0	13	55	0	0	0	0	0	0						
11		0	0	0	0	0	0	0	0	0	0	0	0	0	1	14	0	2	25	0	0	0	0	0	0						
12		0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	8	0	0	0	0	0	0						
13		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0						
Total		2,145	2,012	1,790	1,692	1,619	1,470	1,175	1,096	1,032	638	608	580	414	407	401	296	288	283	0	0	0	0	0	0	0					

Effect of Spacing on Growth and Yield

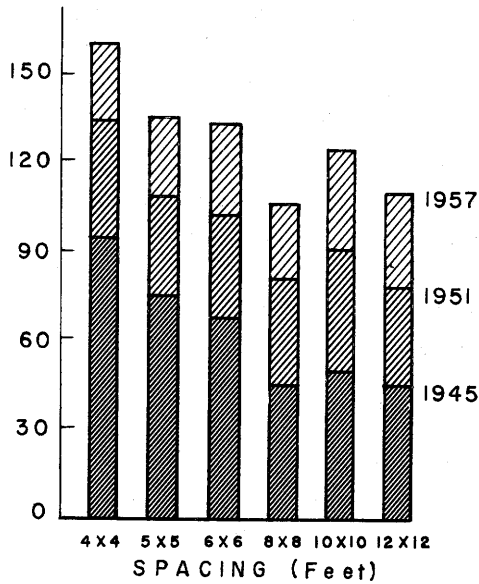
Spacing also has a marked effect on growth and yield (fig. 2). Basal area of the stand 1.6 inches d.b.h. and larger decreases with wider spacing, with little relative change having taken place from one remeasurement to another. Cubic volume on the other hand, though quite irregular, tends to be more nearly equal on all spacings. During this most recent measurement period, total cubic volume increment has been greater on the wider spacings. For the portion of the stand made up of merchantable-size trees, both cubic volume and board-foot volume increase with wider spacing. So far, this difference between spacings has increased with each measurement. However, on the 10x10 and 12x12 spacings, cubic volume increment for these trees has been nearly the same for the past two measurement periods. The portion of the total cubic volume that is merchantable at the present time increases rapidly with increasing spacing, being 87 percent on the 12x12 spacing and only 22 percent on the 4x4 spacing (fig. 3).

Conclusions

It may be concluded from the latest remeasurement that little is lost and much is gained by planting at spacings as wide as 10x10 and 12x12 feet. The superiority of these wider spacings is shown by the earlier merchantability of trees, coupled with greater height growth. The difference in merchantable volume may be reduced with time, but the wider spacings will always contain larger trees. The closer spacings are carrying an excessive number of trees, which hinder stand development.

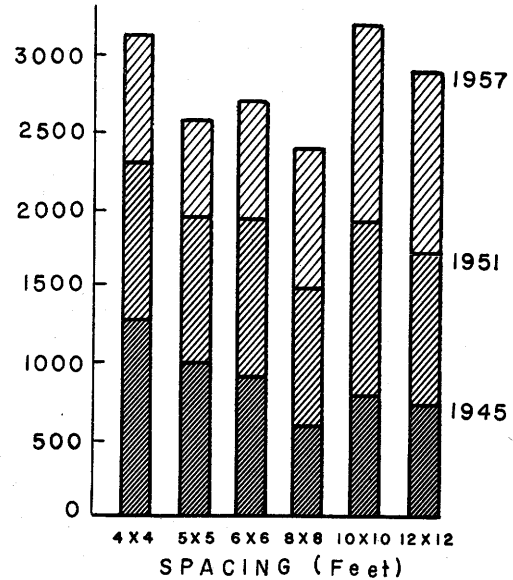
Basal area

180 SQ. FT.



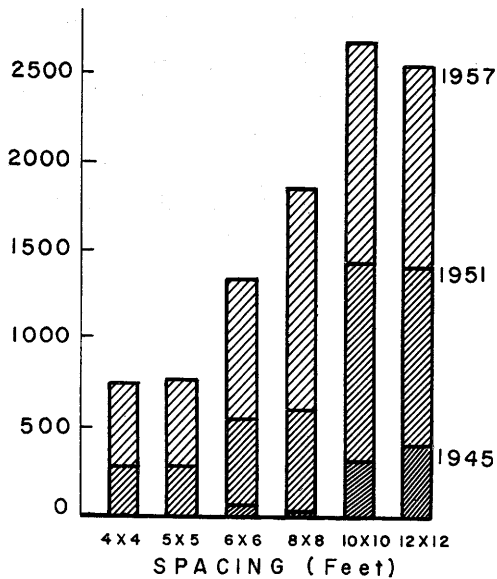
Total cubic volume

3500 CU. FT.



Merchantable cubic volume

3000 CU. FT.



International board-foot volume

12,000 BD.-FT.

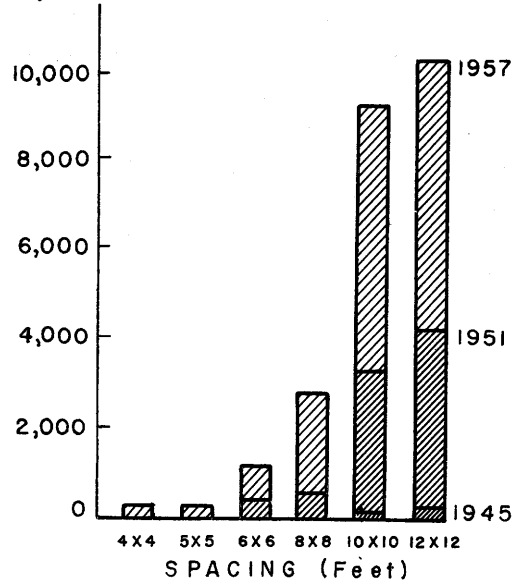
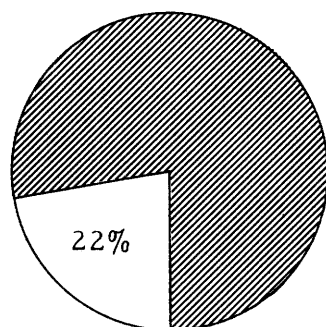
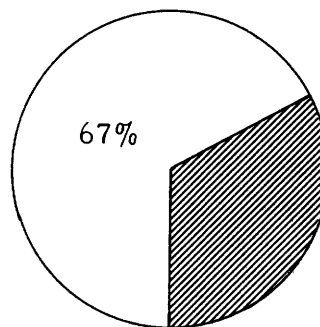


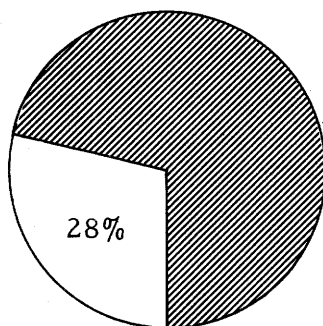
Figure 2. -- Effect of spacing on per-acre yields of Douglas-fir planted in 1925 at Wind River Experimental Forest. Basal area and total cubic volume include all trees 1.6 inches d.b.h. and larger, merchantable cubic volume includes all trees 5.6 inches d.b.h. and larger to a 4-inch top, and International board-foot volume includes all trees 7.6 inches d.b.h. and larger to a 6-inch top.



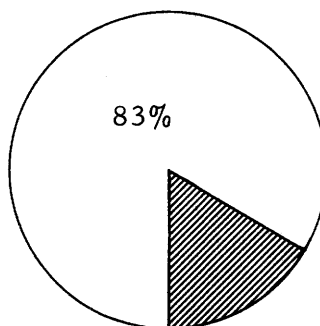
4x4 feet



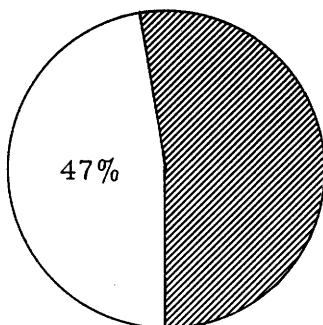
8x8 feet



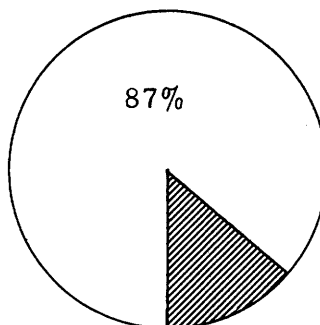
5x5 feet



10x10 feet



6x6 feet



12x12 feet



Merchantable



Unmerchantable

Figure 3.--Effect of spacing on proportion of merchantable to total cubic volume for 32-year-old Douglas-fir at Wind River Experimental Forest. Merchantable cubic volume includes trees 5.6 inches d.b.h. and larger to a 4-inch top. Total cubic volume includes the entire stem of all trees 1.6 inches d.b.h. and larger.