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GUIDELINES FOR PRECOMMERCIAL THINNING OF DOUGLAS-FIR

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ABSTRACT

Production of merchantable wood in even-aged Douglas-fir stands can be increased substantially by precommercial thinning. Guidelines for, and gains from, precommercial thinning both strongly depend on the size of trees wanted at the first commercial cut; the larger this size, (1) the fewer trees should be left after precommercial thinning, (2) the greater is the maximum age or tree size at which precommercial thinning is practical, and (3) the greater is the gain in usable yield from precommercial thinning. Also, generally, the longer the time required for a stand to reach commercial size without thinning, the greater the gains from precommercial thinning. These and other considerations are discussed, and procedures are recommended.

KEYWORDS: Douglas-fir, precommercial thinning, stand improvement, stocking control, stocking density.

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INTROUCTION

Precommercial thinning is a practical means of substantially increasing the production of usable wood. The larger the trees must be to be merchantable, the greater are the gains from precommercial thinning.

This paper provides guidance on when and how to precommercially thin stands of nearly pure Douglas-fir. Relative gains from selected options are indicated; however, the complete information needed to rank management alternatives is beyond the scope of this paper. Conclusions and recommendations given are my opinions, based on observations and available data. Although I believe the recommendations are sound, I am concerned more with presenting concepts than with specific recommendations.

The first part of this paper is concerned with thinning at the "ideal" stage–– the stage at which precommercial thinning will have the greatest effect on subsequent usable production. After this, some considerations regarding stands which have passed this stage are discussed.

WHEN TO THIN

Ideally, stands should be thinned when leave trees are about 10 to 15 feet (3 to 5 m) tall and 10 to 15 years old (fig. 1). Thinning should be delayed only long enough for trees to express their growth and quality characteristics and to be above such deterrents as brush competition and animal browsing. Further delay will usually result in unnecessary loss in usable production and will often result in increased thinning costs.

A l0-year period of growth is generally sufficient to show potential growth rate, stem and branching characteristics, and susceptibility to various types of damage. On the best sites, dominant trees will average about 15 feet (5 m) tall at this age, and the stands will be ready for thinning. However, on poor sites, l0-year-old trees will be quite short and susceptible to damage; therefore, thinning on the poorest sites should be delayed to about age 15 (fig. 1). Ages and heights of trees on intermediate sites will fall between these extremes.

The longer the delay of thinning after competition among trees begins, the greater will be the unrealized usable production. First, substantial growth will be added to trees which will never be used, and therefore, less growth will be added to trees which subsequently will be used. Tree growth begins to be reduced by competition well before that competition becomes readily apparent; by the time lower branches start dying, competition is already quite substantial. Second, trees in dense stands are more susceptible to storm damage than are well-spaced trees in thinned stands, once the latter have adapted to their increased growing space. The older the stand when thinned, the longer the adaptation period.

Thinning can generally be done more cheaply and efficiently when trees are small. Excess trees can then be easily felled, with few problems. Care should be taken to cut stumps below the lowest live branch, if possible. If felling of excess trees is delayed until trees become larger, it will create a larger amount of slash, which may have to be abated, and is likely to damage residual trees and to cause "shock." Killing these larger trees with chemicals, rather than felling them, will avoid the slash and shock problems but often results in incomplete kill of unwanted trees or loss of some intended leave trees, or both.

In most situations, fill-in by natural seedlings after age 10 should be

inconsequential. The trees left after thinning will be in the period of most rapid height growth and will not give new seedlings an opportunity to become competitors. Likewise, brush encroachment generally should not be a severe problem. Where severe brush problems exist prior to thinning, chemical control of the brush should be considered.

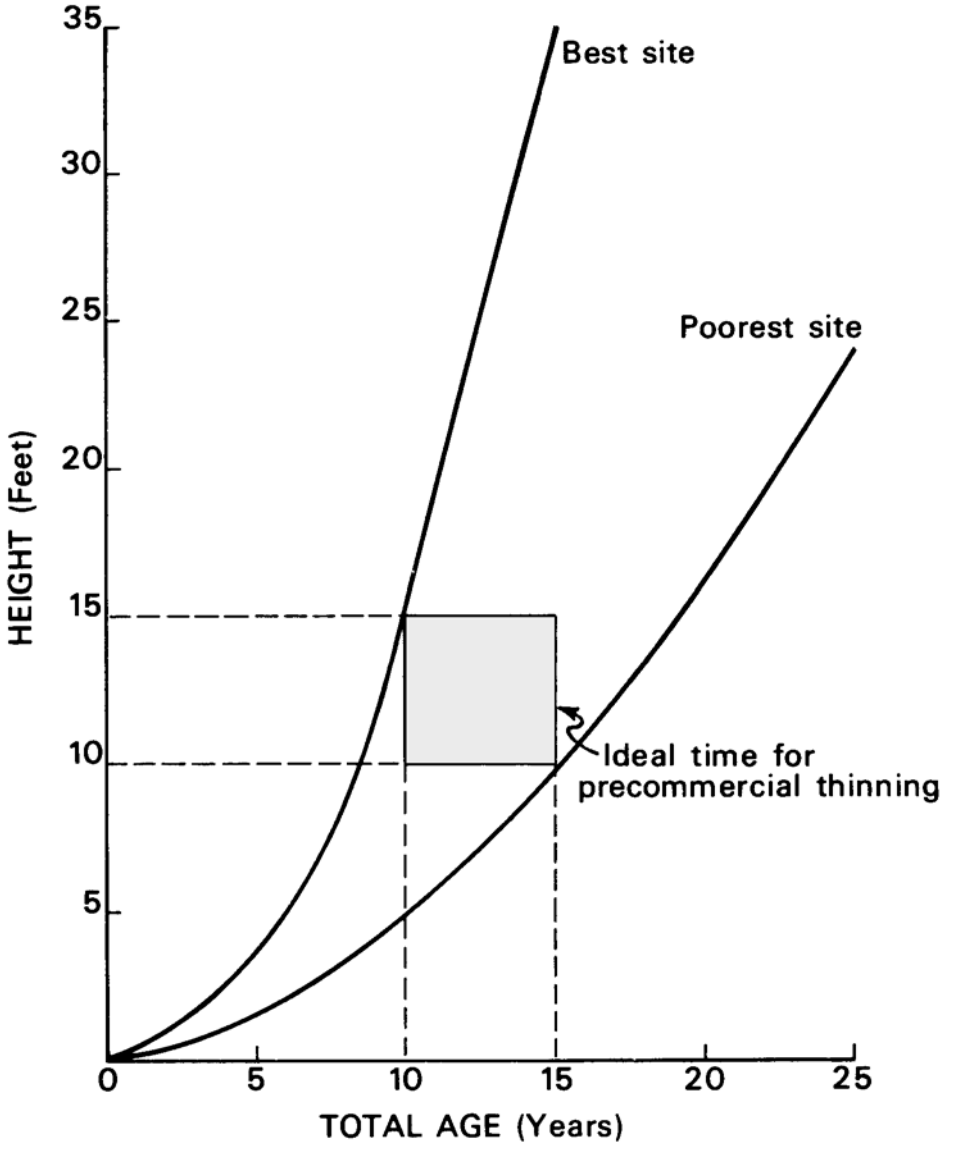

Figure 1.--*Ideal time for precommercial thinning of Douglas-fir relative to height and age of leave trees.*

SPACING OF TREES

The number of trees left after precommercial thinning should depend upon when the first *commercial* thinning will be made––in terms of tree size at that time.[1/] The larger the trees must be to support a commercial thinning, the fewer the trees left after precommercial thinning.

A guide to the desired number or spacing of trees is provided in figure 2. This format shows stocking at any point in time––n terms of stand average d.b.h. (*Dq*),[2/] number of trees, and basal area. As long as there is no mortality, the development of *a stand* with increasing age (increasing tree size) is depicted by a vertical progression upward. The "desired maximum stocking" curve shows the basal area per acre and stand average d.b.h. which stands of various densities (number and spacing of trees) can be expected to attain by the time another thinning is needed. It is applicable to all sites; only the timespan differs. The position of this curve is based on experience with experimental plots, plus a consideration of how stands develop.[3/]

Precommercially thinned stands will generally attain this level with no suppression-related mortality. Thus, the point at which desired average diameter at the time of commercial thinning intersects this "maximum" curve determines the number of trees to be left after precommercial thinning. For example, if average d.b.h. of the stand must be 8 inches (20 cm) at the time of the commercial thinning, the stand should be precommercially thinned to about 400 trees per acre (1,000 per ha). If it needs to be only 6 inches (15 cm), 610 trees per acre (1,520 per ha) should be left; if it must be 10 inches (25 cm), only 290 trees per acre (720 per ha) should be left. The average spacing of these trees is closely approximated by *D*+2 feet; where *D* is the average d.b.h. at the time of the *next* (commercial) thinning, *not* the precommercial thinning. If no commercial thinning is deemed practical, even fewer trees should be left––perhaps 150 to 200 per acre (370 to 490 per ha).

This stocking guide is intended to be used for *spacing*, not for absolute number of trees per acre. Most stands contain openings not occupied by trees. Therefore, the average number of trees left per acre should generally be less than called for by the stocking guide. One should *not* maintain an overdense stand in one spot to offset the lack of trees in another. As a rough guide, the maximum number of extra trees left around an opening should be the number obtained by extending the desired spacing pattern one more space into the opening. The spacing between any two residual trees should be no less than one-half the desired average spacing (fig. 3). Thus, using these guides, we *might* compensate for holes with a width of up to twice the desired average spacing by leaving extra trees around the perimeter, provided trees are present in the right places. Any hole larger than this cannot be fully compensated for. Extra trees left to compensate for an opening should be left only around the immediate perimeter of that opening. They should *not* be crowded into other parts of the stand.

Elsewhere within the stand, an attempt should be made to maintain the

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[1/] It the stand will be carried to final harvest with no commercial thinning, then the reader should substitute "harvest" for "first commercial thinning" throughout the paper.

[2/] As used in this paper, average d.b.h. is the quadratic mean d.b.h., or d.b.h. of a tree of mean basal area.

[3/] Details and supporting evidence are on file, Forestry Sciences Laboratory, Olympia, Washington.

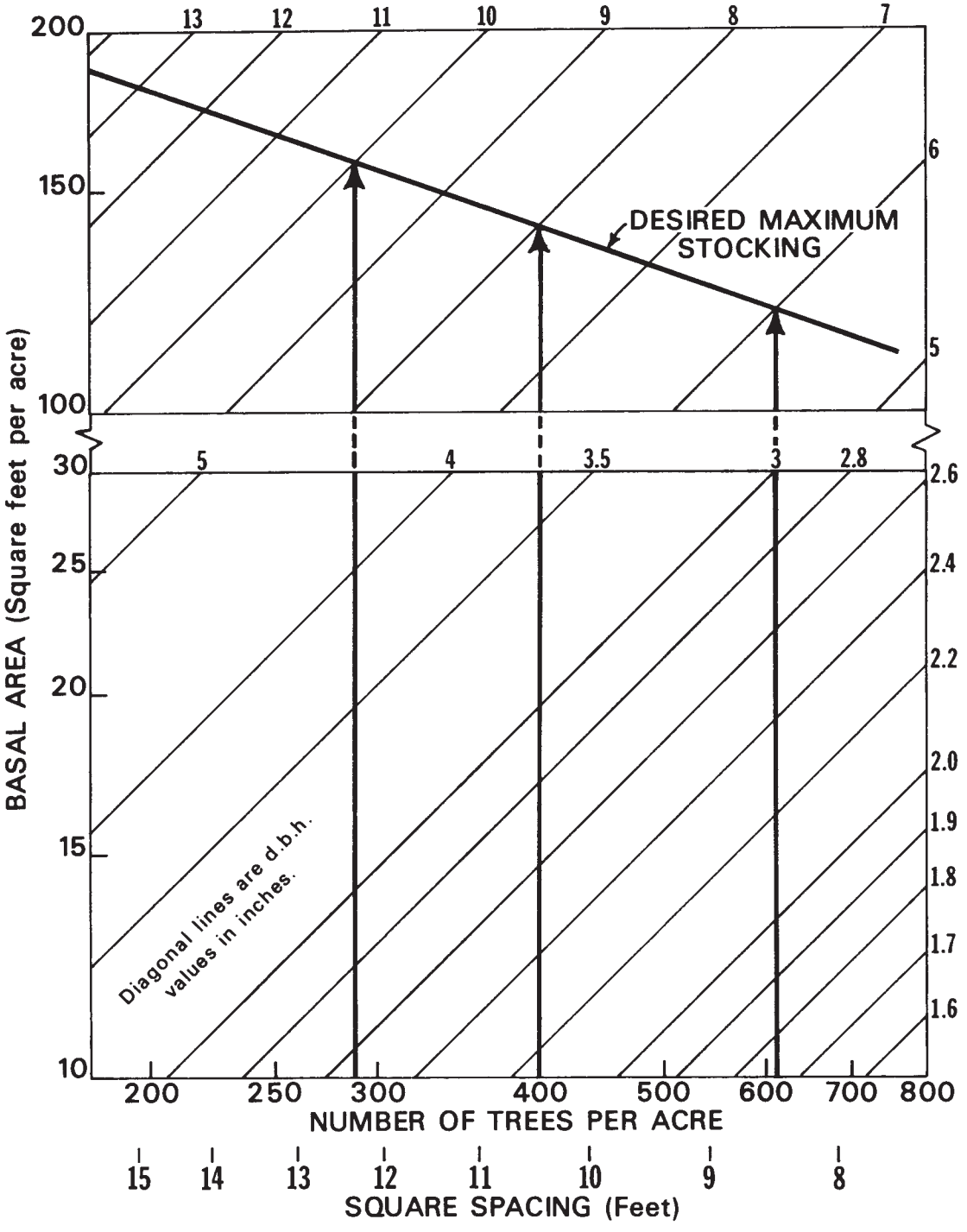

Figure 2.--*Stocking-guide for precommercial thinning of Douglas-fir (arrows show development of stands at selected spacings).*

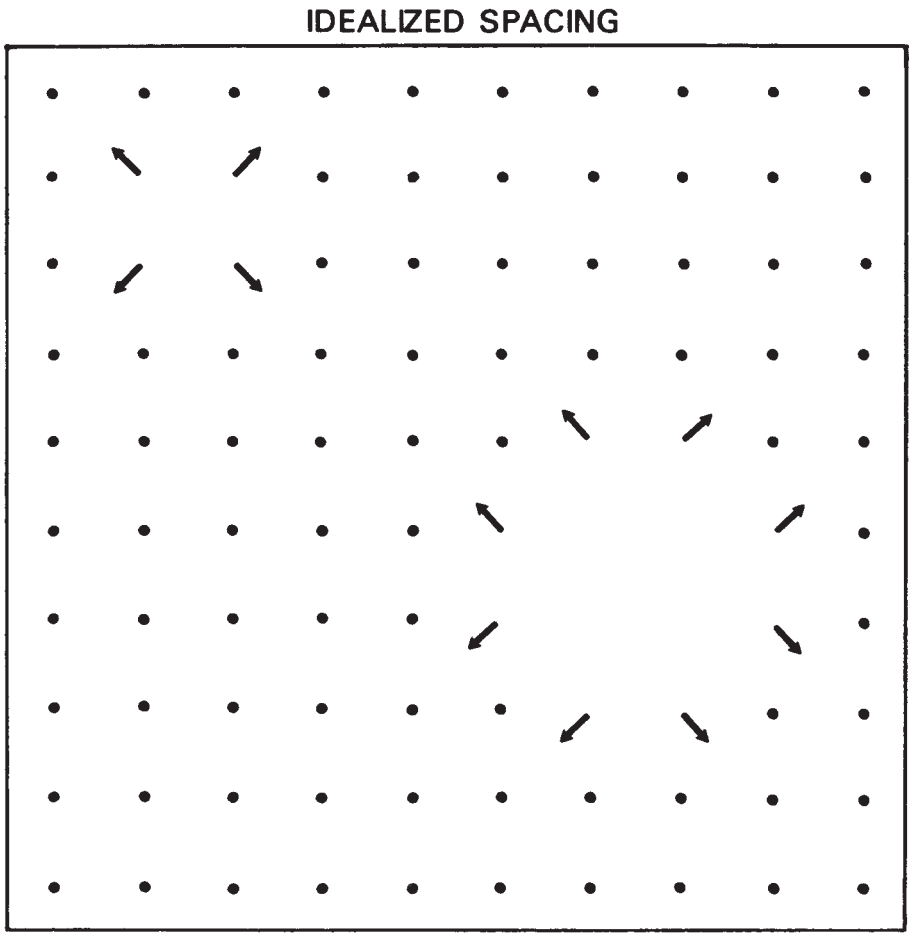

Figure 3.--*Effect of stand openings on number of leave trees per acre (arrows show where extra trees could be left on perimeter of openings).*

desired *average* spacing around each tree, as nearly as possible. Thus, crowding on one side of a tree should be compensated for by extra space on another side. This condition can, of course, seldom be achieved exactly. However, in no case should several adjacent trees be crowded. The number of trees actually left per *stocked* acre should not be more than 10 percent greater than the number called for by the guide.

The spacing recommended in this guide is expected to allow all trees to reach merchantable size; the minimum merchantable size is assumed to be about 25 percent smaller than the specified average diameter of the stand (*Dq*). It is further expected that when the desired *Dq* is reached, most trees will still be growing well and will respond well to release. With more trees than this, growth of individual trees begins to be seriously retarded before trees become large enough to support commercial thinning, and some trees will die. The first commercial thinning will remove up to one-third of the trees, with average d.b.h. of cut trees about equal to average d.b.h. of the entire stand.

SELECTION OF LEAVE TREES

Precommercial thinning at the ideal stage should strive for uniform size of trees as well as spacing. One should attempt to leave trees having diameters within ± 25 percent of the average for all leave trees within that portion of the stand. Thus, if average d.b.h. of all leave trees is 2.0 inches (5.1 cm), the maximum range should be about 1.5 to 2.5 inches (3.8-6.4 cm). If smaller trees are left, they would generally be crowded out of the stand. On the other hand, if larger trees are left, they tend to grow at an excessive rate and adversely affect their neighbors.

There is some question regarding the need to cut very small understory trees. In some instances, they could be left and would soon be crowded out of the stand. However, if they have good root systems, they could grow quite rapidly and become competitors. As a general rule, it is best to remove all unwanted trees.

STANDS PAST THE IDEAL STAGE

Gains in usable yield from precommercial thinning are greatest if thinning is done at the ideal stage, and stands at that stage generally should not be bypassed in favor of thinning otherwise comparable stands which have passed that stage.[4/] However, there are still opportunities for substantial gains from precommercial thinning of somewhat older stands, although a marginal point is soon reached, beyond which precommercial thinning is no longer practical. This point will vary with site quality, stand structure, expected markets for small trees, management objectives, and type of ownership.

A primary gain from precommercial thinning is a shortening of the time a stand must be carried before it can be commercially thinned. Generally, the longer the time required for trees to reach commercial size without thinning, the greater the gain from precommercial thinning. Thus, the larger the trees must be to support a commercial thinning, the greater the gain. Likewise, up to a point, the more slowly the trees are growing, the greater is the gain.

If precommercial thinning is delayed, trees will be substantially older when they reach the desired size for commercial thinning. First, leave trees will be smaller at the time of precommercial thinning than they would be at that age if the stand had been thinned earlier. Second, they will continue to grow more slowly for the next few years than they would if the stand had been thinned earlier. I am reluctant to give specific estimates but have done so for the purpose of illustrating a *concept*. These estimates are based on the assumption that the stands, before thinning, are "normal."[5/] Obviously, the ages for both unmanaged stands and stands receiving precommercial thinning will vary somewhat with initial stand density, among other factors.

Estimated gains in time are shown for three commercial thinning options: thin when *average* d.b.h. of merchantable trees is (I) 8 inches (20.3 cm), (II) 9 inches (22.9 cm), or (III) 10 inches (25.4 cm) (table 1). If *minimum* merchantable size is 25 percent smaller than

[4/] Gains in undiscounted dollar's, and likely even in discounted dollars, will also be greatest with early precommercial thinning.

[5/] Normal by site and age, according to Richard E. McArdie, Walter H. Meyer, and Donald Bruce, The yield of Douglas-fir in the Pacific Northwest, U.S. Department of Agriculture Technical Bulletin 201 (revised 1961), table 2. (Reprinted by Oregon State University Book Stores, Inc., Corvallis, Oregon, 1971.)

Table 1.--*Estimated gain in age of Douglas-fir at which first commercial thinning can be made, for selected conditions*

Precommercial thinning (PCT) options and treatments	Site				
	I	II	III	IV	V
	- - - - - - - - *Gain in years*[1/] - - - - - - - -				
Option I (400 8-inch trees):					
Ideal PCT time[2/]	4	5	6	10	16
PCT at age 20	--	--	--	6	11
PCT at 30 feet	2	3	3	5	2
Option II (335 9-inch trees):					
Ideal PCT time[2/]	6	7	9	13	21
PCT at age 20	--	--	--	9	16
PCT at 30 feet	4	5	5	8	7
Option III (290 10-inch trees):					
Ideal PCT time[2/]	7	9	11	16	26
PCT at age 20	--	--	--	11	21
PCT at 30 feet	5	6	7	11	12

[1/] Age without precommercial thinning minus age with precommercial thinning.
[2/] When leave trees are 10-15 feet tall and 10-15 years old.

these stand averages--i.e., 6.0, 6.75, and 7.5 inches (15.2, 17.1, and 19.0 cm), the corresponding numbers of merchantable trees for each of the three options will be about 400, 335, and 290 per acre (990, 830, and 720 per ha), respectively. For precommercially thinned stands, this is the total number of trees in the stand. For unmanaged stands, many additional trees will die without reaching merchantable size. For each option, gains with (1) precommercial thinning at the ideal time and (2) precommercial thinning when leave trees are 30 feet (9.1 m) tall are shown; for sites where trees are more than 20 years old when they reach a height of 30 feet (fig. 4), precommercial thinning at age 20 is also included. Stand ages associated with these gains are shown in table 2.

Gains from delayed precommercial thinning in stands where leave trees are up to 30 feet (9 m) tall or 20 years old, whichever comes sooner, are still substantial, although much less than gains from earlier thinning. Gains from thinning after about age 20 decline very rapidly. This is the approximate age at which current annual height growth culminates. The differences in gains for the three commercial thinning options are due to differences in merchantability standards. If smaller trees could be used, then gains from precommercial thinning would be less than in option I.

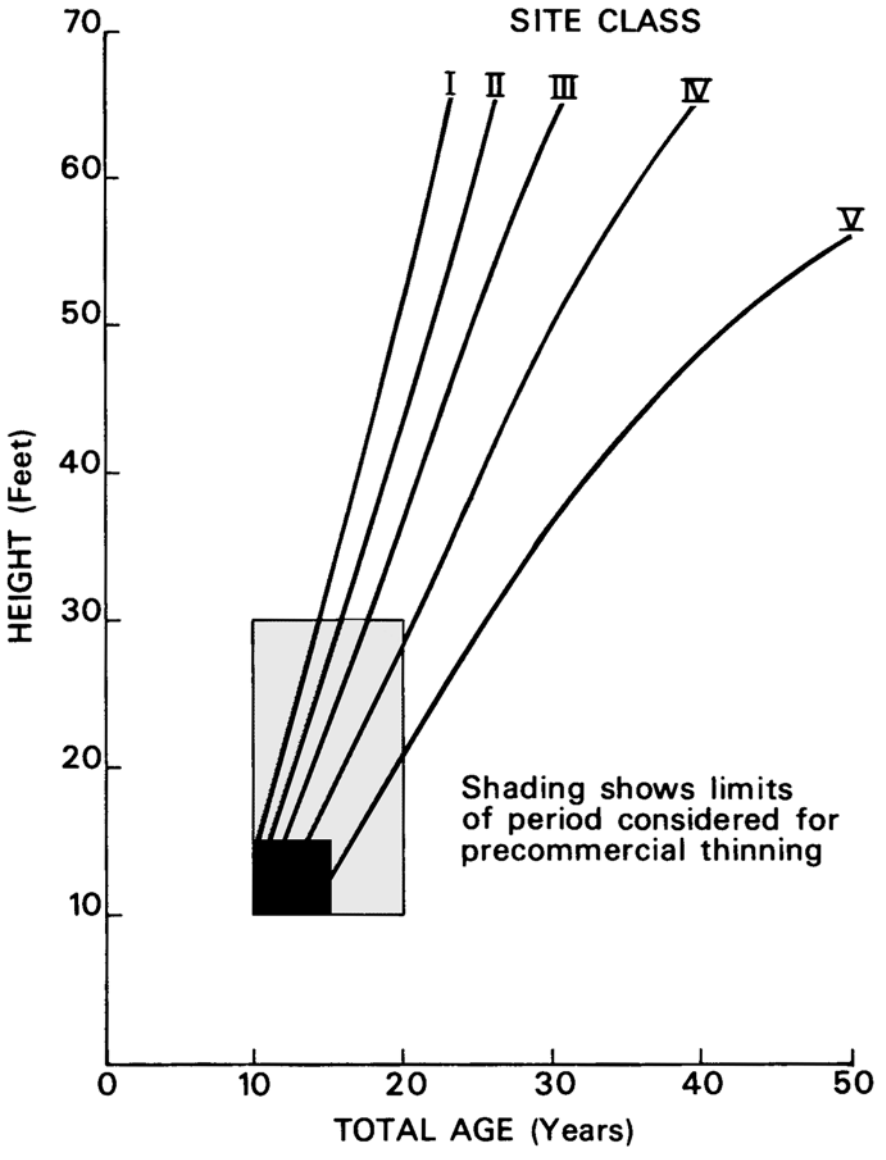

Figure 4.--*Relationship between age and height of dominant and codominant Douglas-fir trees, by site class.*

On the other hand, if commercial thinning required larger trees than in option III, gains from precommercial thinning would be even greater. Where delayed precommercial thinning might not be justified if 6-inch (15-cm) trees are considered merchantable, it might be justified if trees must have a d.b.h. of 8 inches (20 cm) or larger to be merchantable.

Percentage gains in mean annual increment (m.a.i.) of usable volume due to precommercial thinning are closely related to these gains in time and age at

Table 2.--*Estimated ages of Douglas-fir at first commercial thinning, for selected conditions*

Precommercial thinning (PCT) options and treatments	Site				
	I	II	III	IV	V
	Age (years)				
Option I (400 8-inch trees):					
Unmanaged	27	31	36	47	66
Ideal PCT time	23	26	30	37	50
PCT at age 20	--	--	--	41	55
PCT at 30 feet	25	28	33	42	64
Option II (335 9-inch trees):					
Unmanaged	30	35	41	53	76
Ideal PCT time	24	28	32	40	55
PCT at age 20	--	--	--	44	60
PCT at 30 feet	26	30	36	45	69
Option III (290 10-inch trees):					
Unmanaged	32	38	45	59	86
Ideal PCT time	25	29	34	43	60
PCT at age 20	--	--	--	48	65
PCT at 30 feet	27	32	38	48	74

first commercial thinning; the ratio of percentage-gain to years-gained tends to increase with age at first commercial thinning.[6/] Thus, for any of these commercial thinning options, percentage gains from precommercial thinning within the above limits increase markedly with decreasing site quality. The resulting absolute gains in usable m.a.i. also increase with decreasing site quality--at least through site IV; gains on site V may be about equal to those on site IV.

If precommercial thinning is not done until leave trees are about 30 feet (9 m) tall, it will not be practical to create as uniform a stand as could be done with earlier thinning. Dominant and codominant trees will then have an average d.b.h. of about 4 inches (10 cm) or more, and some will be more than 25 percent larger than this average. When these trees are close to merchantable size, they should generally be retained in the stand until at least the first commercial thinning, unless they are wolf-trees.

[6/] This conclusion has been derived from both theoretical considerations and *preliminary* estimates of yields attainable with thinning.

CONCLUSION

Ideally, precommercial thinning should be done when leave trees are about 10 to 15 feet (3 to 5 m) tall and 10 to 15 years old. The spacing of residual trees should depend on how large the trees will be when the first commercial thinning will be made; the larger the trees at that time, the fewer should be left, as per the stocking guide. The thinning should create a uniform tree size.

If this ideal stage has passed, there are still worthwhile opportunities for precommercial thinning; but gains will be less. Gains from precommercial thinning in stands where leave trees are up to 20 years old or 30 feet (9 m) tall, whichever comes first, can still be quite substantial. The maximum age or tree size at which precommercial thinning is practical depends on several factors. Probably the most critical of these is the size that trees must attain before a commercial thinning will be made.

The need for precommercial thinning is greatest on poor-quality sites, where it may make the difference in whether or not a crop of merchantable trees is produced within an economic time frame. On better sites, a satisfactory crop can be produced without precommercial thinning.

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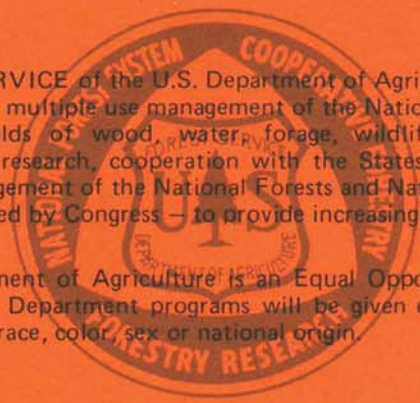

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