# Effect of Pruning on Growth of Western White Pine

Austin E. Helmers[1]

Pruning for production of clear lumber is being recognized more and more as a desirable silvicultural measure. The author's study on western white pine confirms earlier findings on other species that not more than one-third of the line crown should be removed in any pruning operation.

THE growth response of western white pine to artificial pruning is of importance to forest managers in the northern Rocky Mountain region because removal of branches offers a way of hastening the production of knot-free wood. Such pruning also has possibilities for getting rid of limbs bearing blister rust cankers that might invade the trunks of the trees. Hence the results, after five years, in a series of experiments which indicate how heavily western white pine can be pruned without serious injury, are of practical significance.

## Stands and Technique

In the fall of 1940 three tests were initiated to determine the height to which western white pine trees can be pruned without seriously retarding growth. The tests were located on the Kaniksu, Coeur d'Alene, and St. Joe National Forests, all in northern Idaho, in moderately open to very open stands, selected because these are the stands least capable of producing high-quality wood without artificial pruning. In numbers of trees per acre over 0.5 inch d.b.h. the stand densities were approximately 1000, 270, and 200 on the Coeur d'Alene, Kaniksu, and St. Joe tests, respectively. The trees are unevenly distributed on the three areas. The most even distribution is on the Coeur d'Alene test and the most uneven on the St. Joe test.

At the time of pruning the trees were from 20 to 30 years in age. Diameters at breast height ranged from 3 to 10 inches and total heights from 20 to 45 feet. All the tests are located on sites of good to excellent quality. The Coeur d'Alene and St. Joe tests are situated on gentle south-facing slopes and the Kaniksu test is on a flat.

Paired trees, alike with respect to d.b.h., height, and crown characteristics were selected. One tree from each pair was pruned with a pruning saw and the other left unpruned as a check. Pruning ranged in severity from 17 percent to 69 percent of the live-crown length. In all, 112 trees were included in the experiment.

Measurements of total tree height, live-crown length, height pruned, and d.b.h. were taken at the time the tests were started. Subsequently, height and d.b.h. growth have been measured annually for five years.

## Results

### Mortality

The most striking response to pruning occurred among the heavily pruned trees. During the first three years following pruning, 8 trees died among the 17 from which more than 55 percent of the live crown was removed. None of the less heavily pruned trees died. It appears that about 50 percent is the safe limit from the standpoint of causing serious mortality.

### Height and Diameter Growth

The removal of one-fifth of the live-crown length caused no appreciable reduction in rate of height growth (Fig. 1). Pruning away one-third of the live crown resulted in an average loss in annual growth of only 0.1 foot. However, greater live-crown removal resulted in seriously decreased height growth, a reduction of 36 percent resulting from pruning away three-fifths of the live-crown length. Due to the mortality among heavily pruned trees, the growth data given for higher intensities of pruning do not tell the whole story. Only the trees of exceptional vigor survived heavy pruning.

There appeared to be a slight stimulation in height growth amounting to 4 percent of unpruned tree growth during the first year following the removal of one-fifth of the live crown (Fig. 2). The stimulation was lost in the second and third years, and after the third year there was a slight decline in growth rate. However, the average differences in growth between one-fifth pruned and unpruned trees are so small as to be of no practical consequence. The safest conclusion is that removing one-fifth

[1]Silviculturist, Northern Rocky Mountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, Missoula, Mont. Affiliate member, S.A.F.

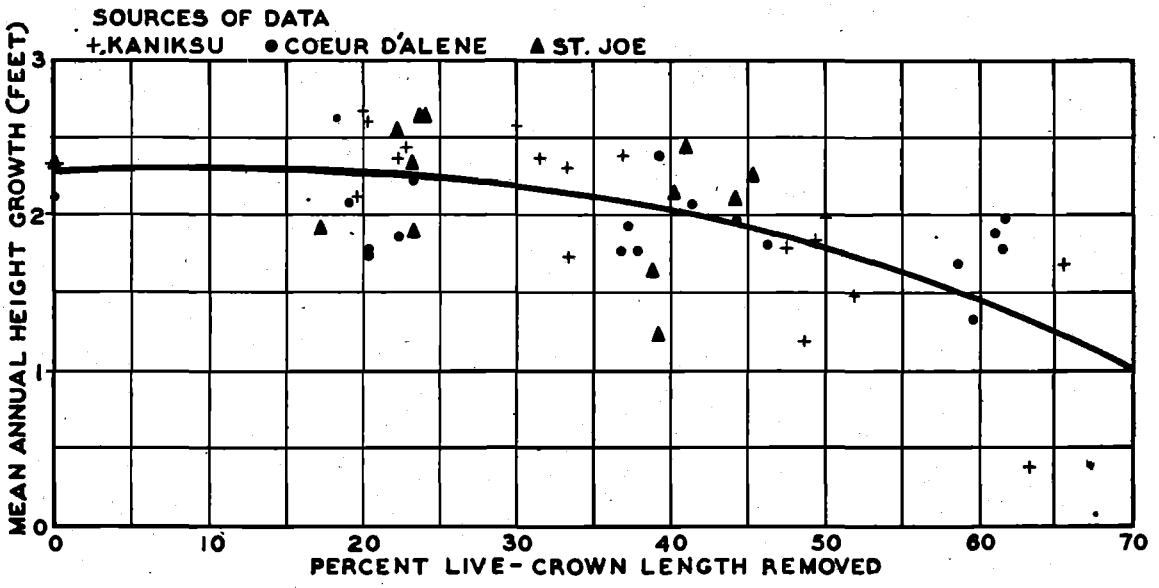


Fig. 1.—Effect of pruning on height growth of white pine during five-year period.

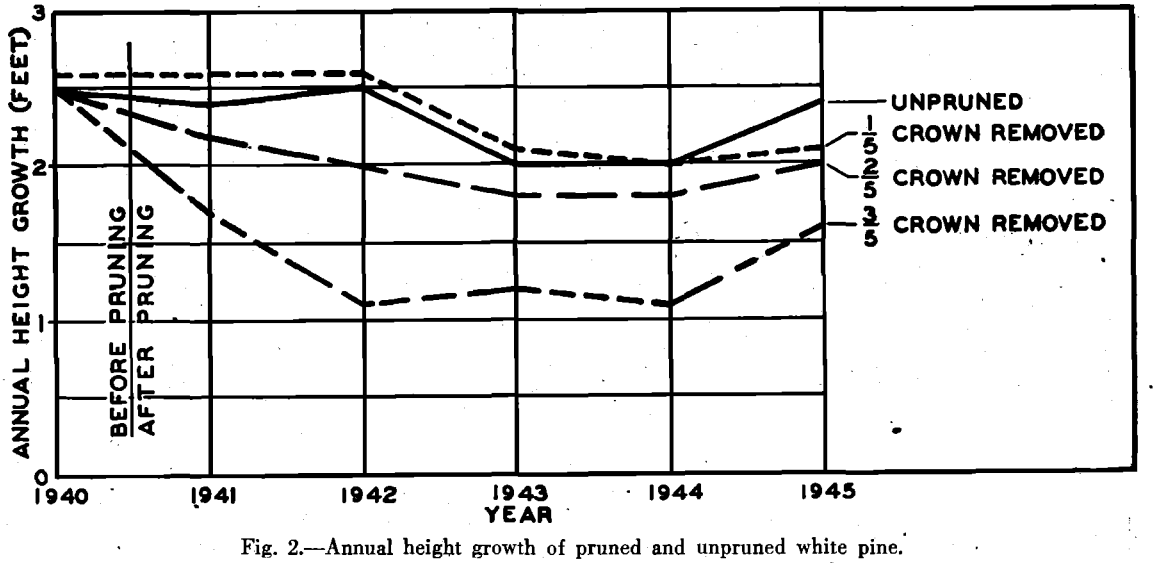


Fig. 2.—Annual height growth of pruned and unpruned white pine.

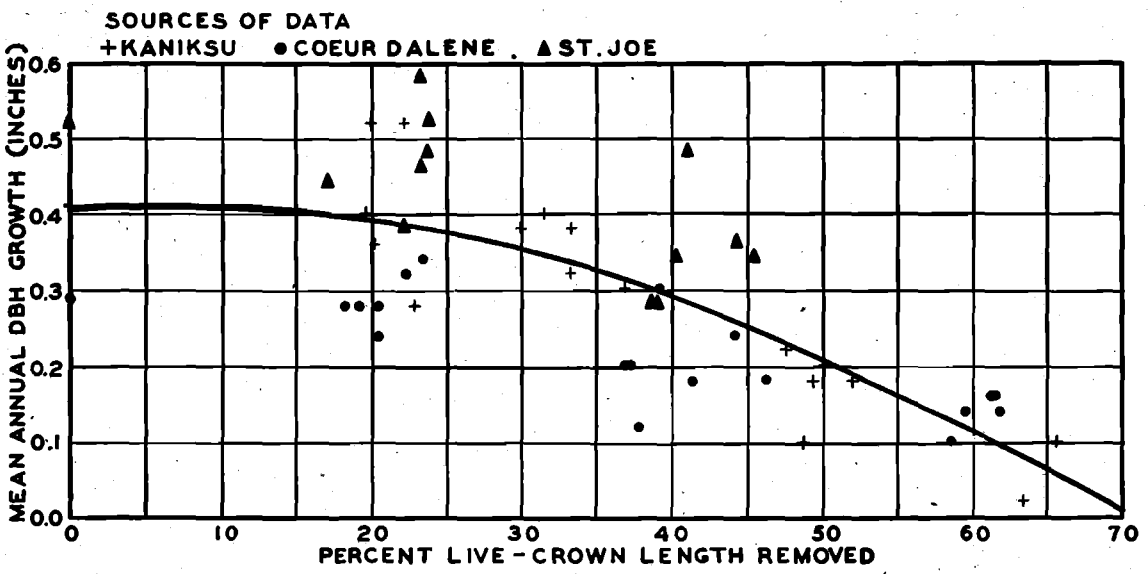


Fig. 3.—Effect of pruning on diameter growth of white pine during five-year period.

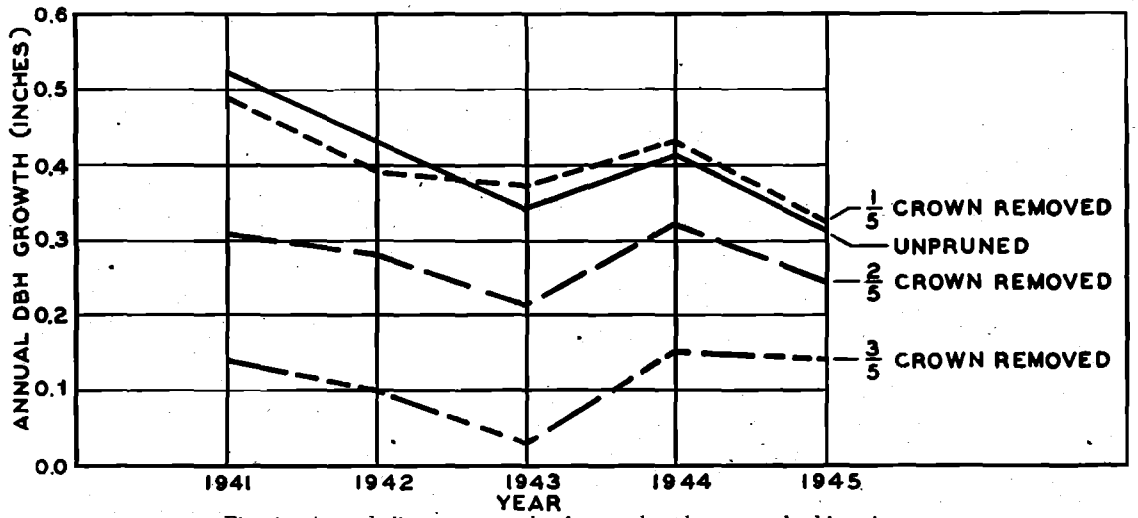


Fig. 4.—Annual diameter growth of pruned and unpruned white pine.

of the crown had little effect on height growth (Table 1).

Table 1.—Comparison of Annual Height Growth of Pruned Trees with Unpruned Trees

| Proportion of live crown removed | Height growth by years | | | | | |
|---|---|---|---|---|---|---|
| | 1940[1] | 1941 | 1942 | 1943 | 1944 | 1945 |
| | *Percent* | | | | | |
| None | 100 | 100 | 100 | 100 | 100 | 100 |
| One-fifth | 104 | 108 | 104 | 105 | 100 | 88 |
| Two-fifths | 100 | 92 | 80 | 90 | 90 | 83 |
| Three-fifths | 100 | 71 | 44 | 60 | 55 | 67 |

[1]Before pruning

The rates of height growth of trees pruned two-fifths definitely declined. The greatest reductions occurred during the first two years. There was some recovery by the end of five years. The losses in height growth from three-fifths pruning were even more pronounced.

Diameter growth fell off more rapidly than height growth as a result of pruning (Fig. 3). Removal of one-fifth of the crown caused an average reduction in diameter growth of 5 percent during the 5-year period as compared with no appreciable loss in height growth. Pruning away three-fifths of the crown caused a 73-percent drop in growth among the trees that survived this severe treatment in contrast to a decline in height growth of 36 percent.

The diameter growth rates of trees pruned one-fifth appeared to have recovered fully before the end of the 5-year period (Fig. 4). The more heavily pruned trees have recovered somewhat but after five years they are still lagging behind the unpruned trees (Table 2).

Table 2.—Comparison of Annual Diameter Growth of Pruned Trees with Unpruned Trees

| Proportion of live crown removed | Diameter growth by years | | | | |
|---|---|---|---|---|---|
| | 1941 | 1942 | 1943 | 1944 | 1945 |
| | *Percent* | | | | |
| None | 100 | 100 | 100 | 100 | 100 |
| One-fifth | 94 | 91 | 109 | 105 | 103 |
| Two-fifths | 60 | 65 | 62 | 78 | 77 |
| Three-fifths | 27 | 23 | 9 | 37 | 45 |

The evidence from these experiments indicates that only about one-third of the live crown can be removed without substantially lowering the rates of growth, both in diameter and in height. This conclusion is in agreement with the work of various writers in the United States (*1, 2, 3, 4, 5, 6*) and in Europe (*7*), that from one-fourth to one-third of the live crown can be safely removed from other tree species.

### RELATIONSHIP TO STAND DENSITY

It was observed that with a given intensity of pruning, the resulting loss in growth rate was greatest in the most open stand and least in the densest stand.[2] The same response was observed in the mortality that occurred during the first three years after pruning. In the densest stand, none of the trees with over 55 percent of their live-crown length removed died. But in the stand of intermediate density three out of five, and in the most open stand five out of six of the trees so heavily pruned died. This response is in harmony with the belief that the more heavily shaded lower limbs on trees growing in closed stands contribute less to the nutrition of the trees than the lower limbs on open-grown trees.

### LITERATURE CITED


1. **Barrett, Leonard I. and Albert A. Downs. 1943.** Growth response of white pine in the southern Appalachians to green pruning. Jour. Forestry 41: 507-10.
2. **Bull, H. 1943.** Pruning practices in open-grown longleaf pine in relation to growth. Jour. Forestry 41:174-79.
3. **Cline, A. C. and E. D. Fletcher. 1928.** Pruning for profit as applied to eastern white pine. A joint study by the Harvard Forest, Petersham, Mass. and the Massachusetts Forestry Association, 3 Joy St., Boston, Mass. 24 pp.
4. **Hawley, R. C. and R. T. Clapp. 1935.** Artificial pruning in coniferous plantations. Yale Univ. School For., Bul. 39, 36 pp.
5. ——— **and H. J. Lutz. 1943.** Establishment, development, and management of conifer plantations in the Eli Whitney Forest, New Haven, Connecticut. Yale Univ. School For., Bul. 53, 81 pp.
6. **Hicock, H. W. 1931.** Pruning in young plantations. Jour. Forestry 29:541-43.
7. **Mayer-Wegelin, H. 1936.** Astung. M. and H. Schaper, Hanover, Germany. (Trans. 264, Div. Silvics, U. S. Forest Service) C. P. de Blumenthal (1936).


[2]From the standpoint of density, the term that expresses the most distinctive character of the stands is "live-crown ratio", the percent ratio of live-crown length to total tree height, as used by Hawley and Lutz (5). Average live-crown ratios of dominant and codominant white pine in the three stands are 86 percent (moderately open stand) on the Coeur d'Alene, 95 percent (open stand) on the Kaniksu, and 99 percent (very open stand) on the St. Joe tests.