U. S. FOREST SERVICE RESEARCH NOTE NE-27

1965

N

FOREST SERVICE, U.S. DEPT. OF AGRICULTURE, 102 MOTORS AVENUE, UPPER DARBY, PA.

E

WHITE PINE PRUNING AND BRANCH GROWTH

A better understanding of the growth responses of young trees to silvicultural treatments is essential for intensive management programs for juvenile stands. At the juvenile stage, the effect of silvicultural treatment on main-stem development is much greater than it would be later.

In a study conducted on the Massabesic Experimental Forest, it was learned that the growth rate of residual branches of young white pine (*Pinus strobus* L.) was not affected by pruning intensity. It was also found that, when main-stem growth rate had recovered after pruning, the cross-sectional area of branches per unit of main-stem volume still was smaller than on unpruned trees.

Barrett and Downs[1] showed how growth rate of white pine stems is affected by pruning intensity. They found that growth was reduced in proportion to the severity of the pruning, but that the growth reductions were temporary. Our study provides some of the details of the recovery process.

The Study

The study was begun in 1959 to determine how pruning influences residual branch growth. At that time a natural 12-year-old stand of white pine was thinned to spacings of either 6 or 12 feet. Twenty-seven trees averaging 9 feet tall and 1.1 inches in diameter at breast height were selected at each spacing. They were listed in order of branch area

[1]Barrett, Leonard I., and Albert A. Downs. GROWTH RESPONSE OF WHITE PINE IN THE SOUTHERN APPALACHIANS TO GREEN PRUNING. Jour. Forestry 41: 507-510, 1943.

per foot of height. Branch area is the total cross-sectional area of branches, in square inches, as measured about 1 inch from the main stem of the tree. The 27 trees in each spacing were then divided into 9 groups of 3, and the 3 trees in each group were randomly assigned among 3 pruning intensities: removal of none, one-third, or two-thirds of the branch area.

However, upon re-measurement after pruning, the pruned trees were found to fall into 3 rather distinct intensity classes in which approximately 40, 55, or 70 percent of the branch area had been removed. This happened because entire whorls of branches were either cut or left; hence some trees in the original lighter category lost more branches, and some trees in the more severe category lost fewer branches, than had been specified. These trees together made up an intermediate group in which the branch area actually removed was about 55 percent. The regrouping provided 6 trees pruned at each of the above intensities, plus 9 unpruned controls, at each spacing. The 40-, 55-, and 70-percent intensities were designated as light, moderate, and severe pruning, respectively.

Two average-size branches on each tree were selected for measurements of length and diameter. These branches were in the lowest remaining whorl on the trees originally scheduled for removal of two-thirds of the branch area. On other trees the selected branches were in the whorl that occupied a comparable position. These branches were numbered, and each was marked at the diameter measurement point.

The length and diameter of these average branches were measured in 1959, 1960, 1961, and 1962. Diameters of all other branches were measured at the same time. Main-stem diameters were also measured: at the center of the internode nearest stump height, at 3 feet above ground level, then at 4-foot intervals, and at midpoint of the shorter top section. Main-stem volume was determined from these measurements.

Results

Branch growth. — Analyses of variance were made, comparing growth in length and diameter of the selected branches of the 6 pruned trees in each pruning-intensity group with branch growth of the 9 unpruned trees in the same spacing class. No significant differences in growth of residual branches over the 3-year period were attributable to pruning. However, growth of the selected branches was somewhat greater on trees growing at the wider spacing (table 1).

Main-stem growth. — Growth rates in 1960 were reduced by pruning, roughly in accord with the amount of branch area removed. By 1962,

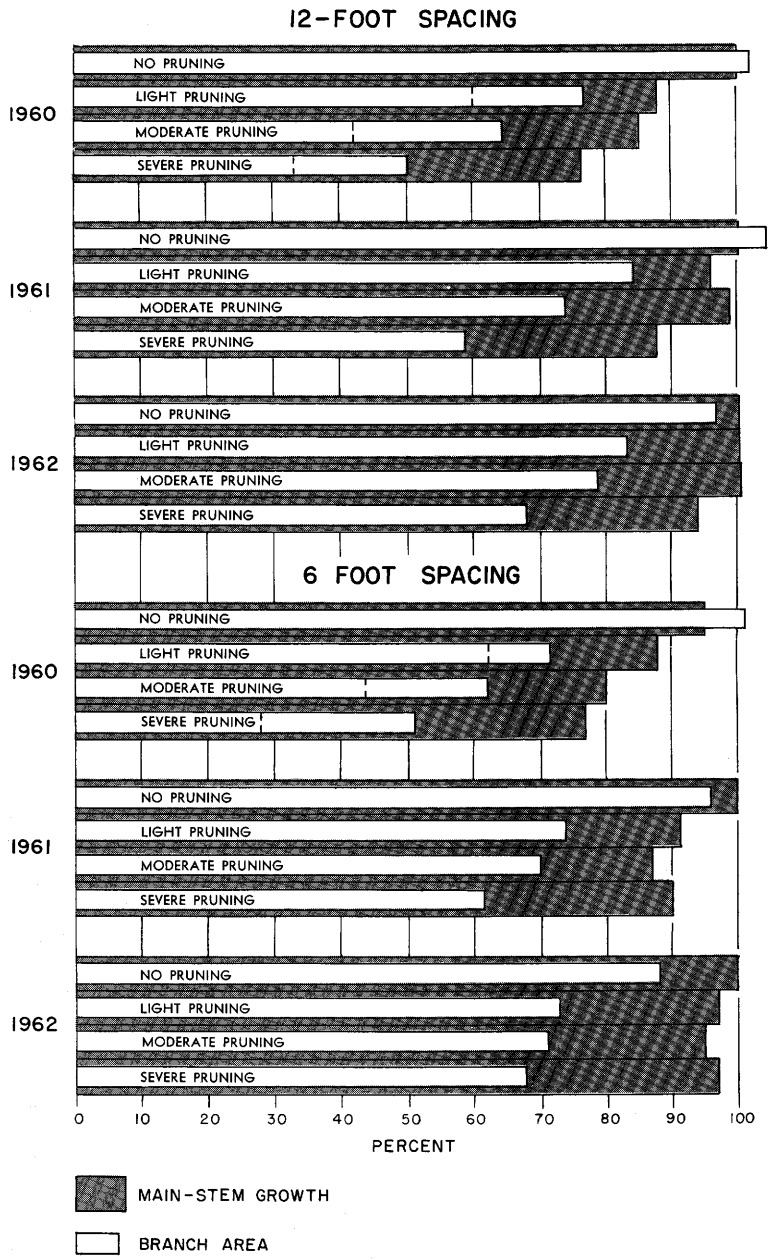

Figure 1. — Relative main-stem growth and branch area per 100 cubic inches of main-stem volume, by treatments and years. Unpruned trees at 12-foot spacing provide the standards for comparison in each year's data. Main-stem growth of these trees is assigned a value of 100 percent. Branch area/stem volume ratios are expressed in percent of the curved values shown in figure 3; hence the bars for the unpruned trees at 12-foot spacing do not read exactly 100 percent. Broken horizontal lines in the 1960 bars show values immediately after pruning in 1959.

Table 1. — Growth of selected branches

Pruning intensity[1]	Spacing	Average length		Growth	Average cross-sectional area		Growth
		1959	1962		1959	1962	
	Ft.	*In.*	*In.*	*In.*	*Sq. in.*	*Sq. in.*	*Sq. in.*
Unpruned	6	27	52	25	0.15	0.44	0.29
	12	28	59	31	.17	.52	.35
Light	6	31	56	25	.21	.44	.23
	12	29	56	27	.20	.53	.33
Moderate	6	28	52	24	.16	.41	.25
	12	27	50	23	.17	.53	.36
Severe	6	24	46	22	.14	.40	.26
	12	30	55	25	.23	.69	.46

[1]Light, moderate, and severe pruning represent removal of approximately 40, 55, and 70 percent of the branch area, respectively.

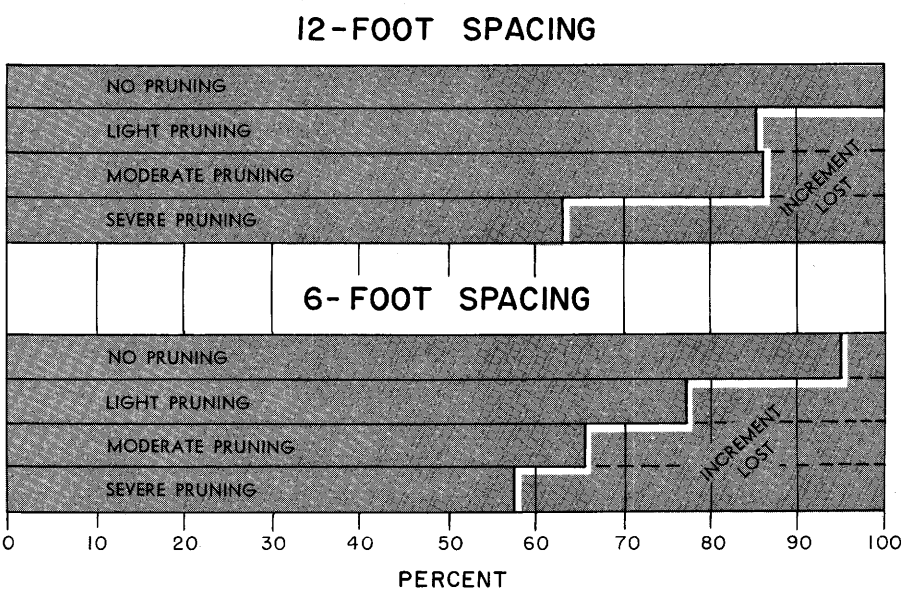

Figure 2. — Relative main-stem volumes and loss of increment at the end of 3 years. Unpruned trees at 12-foot spacing are assigned a value of 100 percent as the standard for comparison.

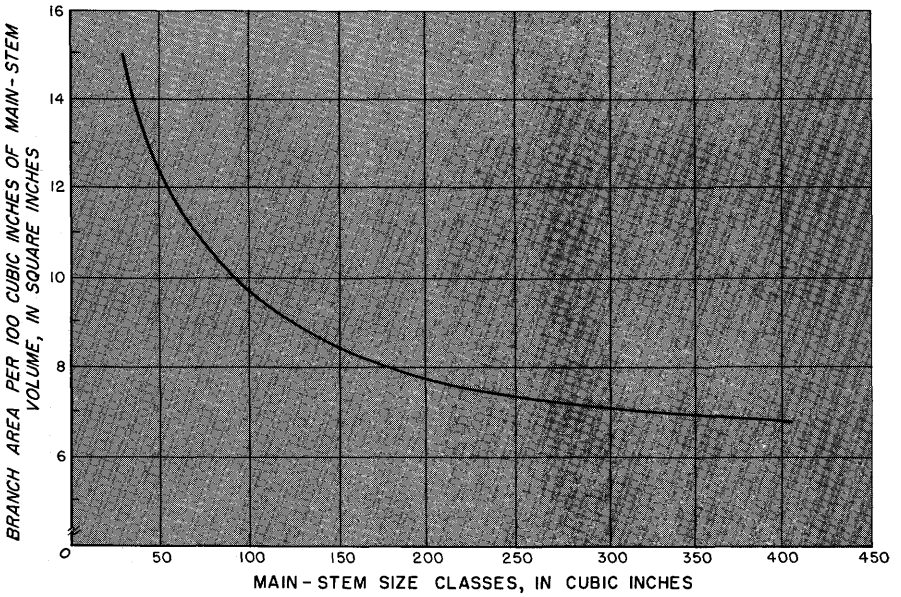

Figure 3. — Square inches of branch area per 100 cubic inches of main-stem volume, by size classes of unpruned trees growing at 12-foot spacing.

growth rates had recovered or almost recovered to the level shown by unpruned trees at 12-foot spacing; the groups that had not made complete recovery fell only slightly short of it (fig. 1). However, the data for 1961 indicate a generally slower rate of recovery among trees at the 6-foot than at the 12-foot spacing.

Although growth rates had practically recovered by 1962, a net loss in volume had resulted from the pruning, and this loss was greater at the closer spacing (fig. 2). The losses ranged from 14 to 37 percent over the 3-year period. The bar-graph data in figure 2 are based on the 3-year volume increases per unit of volume present in 1959. For unpruned trees at 12-foot spacing, which provided the base for comparison, there were 4.5 cubic inches of main-stem volume in 1962 for each cubic inch in 1959. If, for example, the lightly pruned trees at 6-foot spacing had increased at the same rate, they would have grown from 82 cubic inches in 1959 to 369 cubic inches in 1962. But they grew to only 286 cubic inches, or 78 percent of 369; hence the loss in potential volume was 22 percent.

Branch area and main-stem volume relationship. — For individual unpruned trees growing at 12-foot spacing, each year's branch-area value per 100 cubic inches of main-stem volume was plotted over total main-

stem volume. The resulting curve (fig. 3) showed a consistent relationship between main-stem volume and branch area per unit volume.

By considering these curved values as normal branch area per unit of main-stem volume, it is found that main-stem growth rate recovers while branch area is still only 70 or 80 percent of normal (fig. 1). The inference can be drawn that some portion of the branch area of unpruned trees is contributing little or nothing to main-stem growth.

The balance between amount of crown and volume of main-stem characteristic of unpruned trees is, of course, altered by pruning. Since branch growth rate after pruning remains essentially unchanged while main-stem growth rate is reduced, the growth trend in trees after pruning is toward re-establishment of the original balance between crown and stem. However, that balance is not fully regained.

— THOMAS W. McCONKEY

Research Forester
Northeastern Forest Experiment Station
Forest Service, U. S. Dept. Agriculture
Alfred, Maine

■