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## TEN-YEAR EFFECTS FROM ROW THINNINGS IN LOBLOLLY PINE PLANTATIONS OF EASTERN MARYLAND


*Abstract.*—Four degrees of row thinning were tested in 17-year-old loblolly pine plantations of eastern Maryland. In the following 10 years diameter and basal-area growth of tagged trees increased in relation to intensity of thinning. The heavier thinnings also had the most effect in increasing live-crown lengths and ratios and in favoring crown-class position. Volume growth was high in unthinned checks, and no thinning is recommended for pulpwood rotations. Infections by *Fomes annosus* were common after thinning, especially on stumps, but had no appreciable effect on growth or mortality of residual stands.


Young stands of loblolly and pond pines on Maryland's Eastern Shore usually grow fast for the first 15 or 20 years, but then slow down as competition increases among the dominant stems. Similar decreases in growth apparently occur both in plantations and in well-stocked natural stands.

The usual practice of removing stems around selected crop trees is not always practicable for stimulating growth in these stands. But row thinnings—the cutting of all trees in selected rows through plantations or in regularly spaced lanes through natural thickets—bypass most of the difficulties of conventional thinnings. And, because cut trees lodge less and merchantable wood is removed more easily, row thinnings often provide good stumpage values in stands where conventional thinnings could only be made at a loss.

The Maryland Department of Forests and Parks and the Northeastern Forest Experiment Station began a study of row thinning in 1954. Details of the study and the first 5-year results already have been described.[1] This note summarizes the 10-year effects.

## The Study

The study was made in four similar adjoining stands of 3.0 to 5.2 acres each, all on Pocomoke sandy loam soil in the Wicomico State Forest. The four treatments were cutting (1) every other row of trees, (2) every third row, (3) every fourth row, and (4) every fifth row. A single treatment was applied in each of the four stands, and to about half of the area. The remaining half of each stand served as a check. None of the stumps was treated to reduce infection by *Fomes annosus.*

We studied treatment effects by (1) individual tree measurements and (2) stand measurements. In each stand, 20 trees of each of three crown classes (dominant, codominant, and intermediate) were selected and tagged in the check area and among the released stems of the treated area. Where every fourth or fifth row was cut, 20 additional trees were selected in each crown class from the center one or two rows that were not released. Thus, in all, 600 trees were selected and tagged, of which 512 were still living after 10 years. Measurements of tagged trees included diameter (b.h.) to the nearest 1/10 inch, total height, and length of live crown.

For stand data, five 0.5-acre plots were established, one in each treatment and one in a check area. Here all stems were tallied by 1-inch diameter classes and by species. In addition, 75 crop trees in each plot were selected, marked with paint, and tallied separately.

In 1961, Station pathologists examined all eight study areas to estimate damage caused by *Fomes annosus.* In six of the areas (three thinned and three unthinned), they made diagrams showing trees, stumps, snags, and the locations of *F. annosus* fruiting bodies.

## Mortality

Row thinning hardly affected the mortality of upper-canopy stems in the first 10 years. None of the tagged dominant or codominant trees died in the every-other-row treatment and in two of the check areas; in the

[1]Little, S., and J. J. Mohr. FIVE-YEAR EFFECTS FROM ROW THINNINGS IN LOBOLLY PINE PLANTATIONS OF EASTERN MARYLAND. U. S. Forest Serv. Res. Paper NE-12, 15 pp., illus. NE. Forest Exp. Sta., Upper Darby, Pa. 1963.

other treated and check stands the mortality of similar stems did not exceed 2.5 percent. None of the marked crop trees died in the every-other-row treatment; 4 or 5 percent died in the other treatments and in the check plot.

Row thinning did reduce the mortality of intermediate and overtopped trees. Of the tagged intermediate trees, 5 percent died in the every-other-row treatment; 15 percent in the every-third-row treatment; 35 or 50 percent in the other two treatments; and 56 percent in the check areas. In the 0.5-acre plots, mortality among the non-crop pines, which included some upper crown class trees as well as many intermediate and overtopped ones, was 36 percent in the every-other-row treatment, 48 to 57 percent in the other treatments, and 55 percent in the control.

## Diameter and Basal-Area Growth

*Tagged-tree data.*—Among the tagged trees in all crown classes, cutting every other row caused the greatest stimulation in diameter growth as compared to unthinned controls. The increased increment in the 10-year period under this treatment was 0.8 to 0.9 inch. It was 0.4 to 0.6 inch where every third row was cut, and still less, even for the outside released trees, where every fourth or every fifth row was cut (table 1).

In the unthinned and lightly thinned areas, diameter growth tended to decline during the second of the two 5-year periods. In contrast, growth

**Table 1.** — ***Average 10-year diameter growth per tree, by crown classes, according to thinning treatment***[1]

| Treatment (row cut) | Area | Dominant trees | Codominant trees | Intermediate trees |
|---|---|---|---|---|
| | | *Inches* | *Inches* | *Inches* |
| Every other row | Treated | 2.8 (1.4-1.4) | 2.4 (1.2-1.2) | 1.3 (0.6-0.7) |
| | Check | 1.9 (1.0-0.9) | 1.5 (0.9-0.6) | 0.5 (0.4-0.1) |
| Every third row | Treated | 2.6 (1.3-1.3) | 2.0 (1.0-1.0) | 1.1 (0.6-0.5) |
| | Check | 2.1 (1.1-1.0) | 1.6 (0.8-0.8) | 0.5 (0.4-0.1) |
| Every fourth row | Treated: released | 2.2 (1.2-1.0) | 1.4 (0.7-0.7) | 0.9 (0.5-0.4) |
| | Treated: unreleased[2] | 2.1 (1.0-1.1) | 1.2 (0.6-0.6) | 0.5 (0.3-0.2) |
| | Check | 1.8 (0.9-0.9) | 1.1 (0.6-0.5) | 0.2 (0.2-0.0) |
| Every fifth row | Treated: released | 2.3 (1.2-1.1) | 1.6 (0.9-0.7) | 0.5 (0.4-0.1) |
| | Treated: unreleased[2] | 2.1 (1.1-1.0) | 1.5 (0.7-0.8) | 0.4 (0.2-0.2) |
| | Check | 1.9 (1.1-0.8) | 1.3 (0.7-0.6) | 0.6 (0.4-0.2) |

[1] Limited to trees living in 1964. Values in parentheses are for the two 5-year periods, the first for 1954-59, the second for 1959-64. Crown classes are those before thinning.
[2] Trees in center of uncut strips, not usually released.

rates were maintained through the second 5 years in the two heavier treatments (table 1).

Because growth in tree diameter is reflected in proportionally much greater basal-area values, increased increment of basal area was considerably greater in the larger dominant trees than in the smaller codominants and intermediates. Where every other row had been cut, dominant, codominant, and intermediate trees gained an average of 0.292, 0.203, and 0.084 square feet of basal area respectively, or 0.111, 0.076, and 0.057 square feet more than comparable check trees. Basal-area increment was usually slightly more in the second 5 years for two groups: dominant stems in all study areas, and codominants in the two heavier thinnings.

In the strips left after cutting every fourth or fifth row, the interior unreleased trees showed little, if any, response to thinning.

*Stand data.*—Cutting every other row produced by far the greatest net gain (33 square feet) in basal area per acre, almost three times that from cutting every third row. The every fourth- or every fifth-row treatments gained only about 2.5 square feet, while the check plot lost 10 square feet from its high 1954 value of 171 square feet per acre.

When mortality and the slow growth of smaller pines are ignored, differences among treatments are much less. For example, the marked crop trees in the every-other-row treatment did grow fastest, but their gain in basal area was only 25 percent more than in the every-third-row cutting and 47 percent more than in the check. Diameter growth varied from the 2.4 inches per stem for crop trees in the heaviest thinning to 1.6 inches for those in the lightly thinned areas.

Although diameter growth of the crop trees increased with increasing intensity of thinning, the treatments had little effect on the overall average 10-year changes in diameter of all trees (except ingrowth). Four of the treatment values for average change were 1.9 or 2.0 inches; the other (every fourth row cut) was 1.6 inches. These values tended to be equalized by mortality among the smaller trees.

## Crown Lengths and Ratios

During the 10 years, live crown lengths increased more than twice as much under the heaviest thinning as in the check areas. Under the other treatments, crown lengths increased, but little more than in the controls.

| *Treatment* | *Dominants (feet)* | *Codominants (feet)* | *Intermediates (feet)* |
|---|---|---|---|
| Released: | | | |
| By cutting every other row | +11 | +8 | +5 |
| By other cuttings | + 6 | +4 | +2 |
| Unreleased: | | | |
| In cutting every fourth or fifth row | + 6 | +4 | +1 |
| In check areas | + 5 | +4 | −1 |

Crown ratios also increased only under the heaviest thinning; gains ranged from 7 percentage points for dominants to 2 points for intermediates. Under the other treatments, crown ratio changes varied from none for released dominants to a loss of 8 percentage points for intermediates in the check areas.

## Crown Class

Between 1954 and 1964 about 25 percent of the surviving trees changed crown class. The changes are summarized in table 2.

Compared to no treatment, release resulted in fewer dominants dropping to the codominant class and in more codominants moving up to a dominant position. The heavier thinnings also reduced the proportion of codominants dropping in crown class and increased the probability of intermediates becoming codominant. Any degree of release decreased the proportion of intermediates falling to an overtopped category. Crown-class changes among unreleased trees in the centers of lanes left after cutting every fourth or fifth row were similar to those observed in the check plots.

**Table 2.** — *Percent of surviving 1954 trees that had changed class by 1964, by treatment and crown class*

| Change | Treatment — rows cut | | | |
|---|---|---|---|---|
| | | Fourth or fifth | | |
| | Second or third | Trees released | Trees not released | No thinning |
| | *Percent* | *Percent* | *Percent* | *Percent* |
| Dominant to codominant | 10 | 5 | 18 | 20 |
| Codominant to dominant | 18 | 25 | 5 | 8 |
| Codominant to intermediate | 2 | 15 | 20 | 19 |
| Codominant to overtopped | 0 | 2 | 2 | 0 |
| Intermediate to codominant | 19 | 8 | 0 | 3 |
| Intermediate to overtopped | 12 | 17 | 45 | 34 |

## Volume and Volume Growth

During the 10 years, the volume of the *check* stand increased by 13.3 cords per acre, which was more net growth than in the three lighter thinning treatments. The every-other-row treatment had the greatest net growth per acre, 14.9 cords, and also the greatest 5-year growth, 8.4 cords between 1959 and 1964. However, total stand volume was still far below that of the *unthinned* stand (28 versus 44 cords per acre).

The percent of growth on residual volume also was the highest in the every-other-row treatment—114 percent. Other values were 66 percent in the every-third-row treatment, 47 and 49 percent in the other two treatments, and 43 percent in the check.

The peak in cordwood growth apparently had already occurred in the unthinned stand. Its mean annual net growth was 1.8 cords per acre in the first 17 years, 1.7 cords in 22 years, and 1.6 cords in 27 years. These figures indicate that such stands, if grown for pulpwood alone, should be managed on a 20- to 25-year rotation.

Row thinning cannot be recommended in such a short rotation. Unless the thinning is very heavy, subsequent net growth in cords will be less in thinned stands than in unthinned. Furthermore, yield in the final cut of thinned stands will be markedly less, and rotation yields (that from thinning plus the final cut) will usually be less than in unthinned stands.

For landowners managing for sawtimber and piling, thinning may be beneficial—partly by increasing growth of the final crop trees and partly by providing income through salvaging fiber for pulpwood. In our unthinned stand, 406 trees containing 9 cords of pulpwood per acre died between 1954 and 1964. We estimate that 250 more stems containing 20 cords per acre may die by the time the stand is 50 years old. In such stands, removal of every third row at 17 years and a stemwise thinning 10 to 13 years later would harvest many of these trees before they die. Together the cuts might produce 20 to 22 cords per acre, the second thinning yielding somewhat more than the first.

## Infections by *Fomes annosus*

In 1961 fruiting bodies of *Fomes annosus* were found on many of the stumps and dead trees or snags, and on some living trees in the thinned plots. In the check plots fruiting bodies were found only on an occasional snag (table 3).

Infection was detected in 64 and 66 percent of the stumps (from cutting live trees) in the every-third- and every-fourth-row treatments,

Table 3.—*Incidence of 1961 fruiting of Fomes annosus in three plots thinned in 1954 and in the companion unthinned checks*

| Fruiting medium | Treatment: Every other row | Every third row | Every fourth row | No cutting |
|---|---|---|---|---|
| | *Percent* | *Percent* | *Percent* | *Percent* |
| Stumps from cut live trees | 33 | 64 | 66 | — |
| Stumps from cut dead trees | 7 | 22 | — | — |
| Living trees | 6 | 28 | 20 | 0 |
| Standing dead trees[1] | 9 | 62 | 70 | 0 |
| Snags[1] | 15 | 66 | 55 | 1 |
| Dead-and-down stems[1] | 16 | 29 | 30 | 0 |

[1]Standing dead trees are trees that had died recently and still retained most of their small twigs and branches. Snags were trees that had been dead for some time, but in some cases still had up to half of their branches. Stubs broken off 2 feet or more above ground were included as snags. Dead-and-down stems were those broken off near the ground, the remaining bole usually in an advanced stage of rot.

but in only half as many stumps in the every-other-row treatment. There is no logical explanation for this difference. Production and survival of *annosus* spores are supposedly less in late July when the two lighter cuttings were made than at the time of the every-other-row cutting in October to early January. No intensive examination was made in the every-fifth-row treatment.

Although, in the thinned area, many living trees without evident fruiting bodies presumably were infected by 1961, the 1954-1964 data do not indicate that the infections appreciably affected mortality or growth. As shown in table 1, diameter growth in thinned areas almost always exceeded the growth of comparable stems in unthinned areas, and the growth responses to degrees of thinning varied in a seemingly normal way.

The only noticeable effect to date from *annosus* infections has been the death of occasional small clumps of trees. Such mortality has occurred both in the study areas and in other thinned plantations. Although typical loblolly plantations in eastern Maryland undoubtedly are highly susceptible to *annosus* infection, the damage appears to be low on the more productive sites in the first 10 years after thinning—even where no control measures have been applied.

As yet, the effect of these infections over a piling-and-sawtimber rotation is not known. But in the absence of more definite information, stump treatments such as Driver described[2] would seem advisable when doing

[2]Driver, Charles H. THE OCCURRENCE AND CONTROL OF ANNOSUS ROOT-ROT IN SOUTHERN PINE PLANTATIONS. Internat. Paper Co., Southlands Exp. Forest, Forest Res. Note 23. 7 pp., illus. 1965.

any row or stemwise thinning in plantations to be managed for these products. These stump treatments are especially important on the lighter, sandier soils where *annosus* damage seems more severe than on Pocomoke or similar soils.

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