

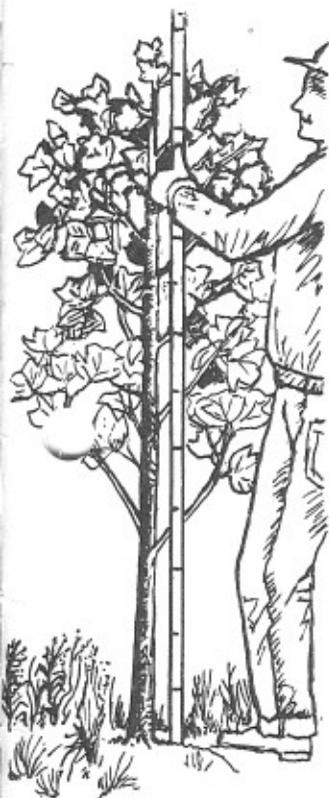
OCCASIONAL REPORT 60

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# LOBLOLLY PINE RELEASE STUDY

REPORT NUMBER

1



Virginia Division of Forestry



Department of Conservation and Economic Development

RESULTS OF A LOBLOLLY PINE RELEASE STUDY  
RELEASE REPORT NUMBER 1

by

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ABSTRACT

Six plots were closely paired at age 9 for stocking of both planted loblolly pine and competing hardwoods. One plot of each of the three pairs was released by chopping down all hardwoods. Hardwood competition varied considerably among the three pairs of plots, even though total numbers and basal area of hardwoods were similar.

The plots were measured annually through age 23, and response to release varied greatly among the three pairs of plots. At age 23 there was 69 percent more volume (in standard cords) on the released plot of one pair, and 4 percent less volume on the released plot of another pair. The hardwood data collected at age 9 and 23 did not account for this great variation in response.

INTRODUCTION

This is the first of a series of Occasional Reports, that we will publish over the next five years or so, that will report the results of studies in which loblolly pine seedlings were released from hardwood competition. The area on which this study was installed is stand number 1 of the Booker 18 management unit on the Cumberland State Forest in the Central Piedmont. This area supported a stand of hardwoods before it was harvested in 1958. It was prepared for planting by bulldozing lightly, so that little topsoil was removed. Stumps were not pushed out of the ground. Loblolly pine seedlings were planted during the late winter of 1959 at a spacing of 9 feet between rows and approximately 6 feet within rows.

INSTALLATION OF STUDY

In November 1967, after the 9th growing season, three pairs of 1/10 acre plots were installed (see Figure 1). Each pair was carefully matched for number of loblolly pine seedlings, loblolly pine basal area, and hardwood basal area. All loblolly pines were measured to the nearest .1 inch DBH, and tallied in order by row, so that individual pines could be tracked by row and position in the row in all subsequent measurements. Plots were .8 chain wide and 1.25 chains long, and contained six rows. Total tree heights were measured on all of the loblolly seedlings in every other row, and crown class was tallied for every seedling. All hardwoods greater than .5 inch DBH were tallied by 1 inch classes on each plot. Hardwoods that were less than .5 inch DBH were below the live crowns of the pines. Table 1 presents the summaries of these measurements for each pair of plots.

Table 1. Numbers of stems over .5 inch DBH and basal area per acre of loblolly pines and hardwoods, also average DBH and height of dominants and codominants for loblolly; at age 9.

| DBH        | Plot 1 (released) and 2 (check) |       |                     |       |
|------------|---------------------------------|-------|---------------------|-------|
|            | Number of Loblolly              |       | Number of Hardwoods |       |
|            | Released                        | Check | Released            | Check |
| 1          | 50                              | 90    | 1,680               | 1,490 |
| 2          | 60                              | 70    | 510                 | 540   |
| 3          | 60                              | 90    | 40                  | 90    |
| 4          | 130                             | 110   | 10                  | 10    |
| 5          | 40                              | 20    |                     |       |
| 6          | 10                              | 10    |                     |       |
| Totals     | 350                             | 390   | 2,240               | 2,130 |
| Basal Area | 22.7                            | 20.7  | 23.1                | 25.2  |
| Mean DBH   | 3.16                            | 2.79  |                     |       |
| D & CD Ht  | 22.6                            | 22.7  |                     |       |

| DBH        | Plot 3 (released) and 4 (check) |       |                     |       |
|------------|---------------------------------|-------|---------------------|-------|
|            | Number of Loblolly              |       | Number of Hardwoods |       |
|            | Released                        | Check | Released            | Check |
| 1          | 40                              | 40    | 2,160               | 1,830 |
| 2          | 40                              | 20    | 300                 | 300   |
| 3          | 110                             | 60    | 20                  | 40    |
| 4          | 160                             | 180   | 10                  |       |
| 5          | 100                             | 130   |                     |       |
| 6          | 20                              |       |                     |       |
| Totals     | 470                             | 430   | 2,490               | 2,170 |
| Basal Area | 38.7                            | 36.2  | 20.2                | 18.5  |
| Mean DBH   | 3.63                            | 3.75  |                     |       |
| D & CD Ht. | 25.3                            | 24.5  |                     |       |

| DBH        | Plot 5 (released) and 6 (check) |       |                     |       |
|------------|---------------------------------|-------|---------------------|-------|
|            | Number of Loblolly              |       | Number of Hardwoods |       |
|            | Released                        | Check | Released            | Check |
| 1          | 10                              | 20    | 1,890               | 2,050 |
| 2          | 20                              | 50    | 230                 | 220   |
| 3          | 80                              | 70    | 30                  | 30    |
| 4          | 260                             | 190   | 20                  | 10    |
| 5          | 90                              | 160   |                     |       |
| 6          | 30                              | 10    |                     |       |
| Totals     | 490                             | 500   | 2,170               | 2,310 |
| Basal Area | 45.1                            | 46.1  | 18.5                | 18.3  |
| Mean DBH   | 3.98                            | 3.95  |                     |       |
| D & CD Ht. | 25.3                            | 24.5  |                     |       |

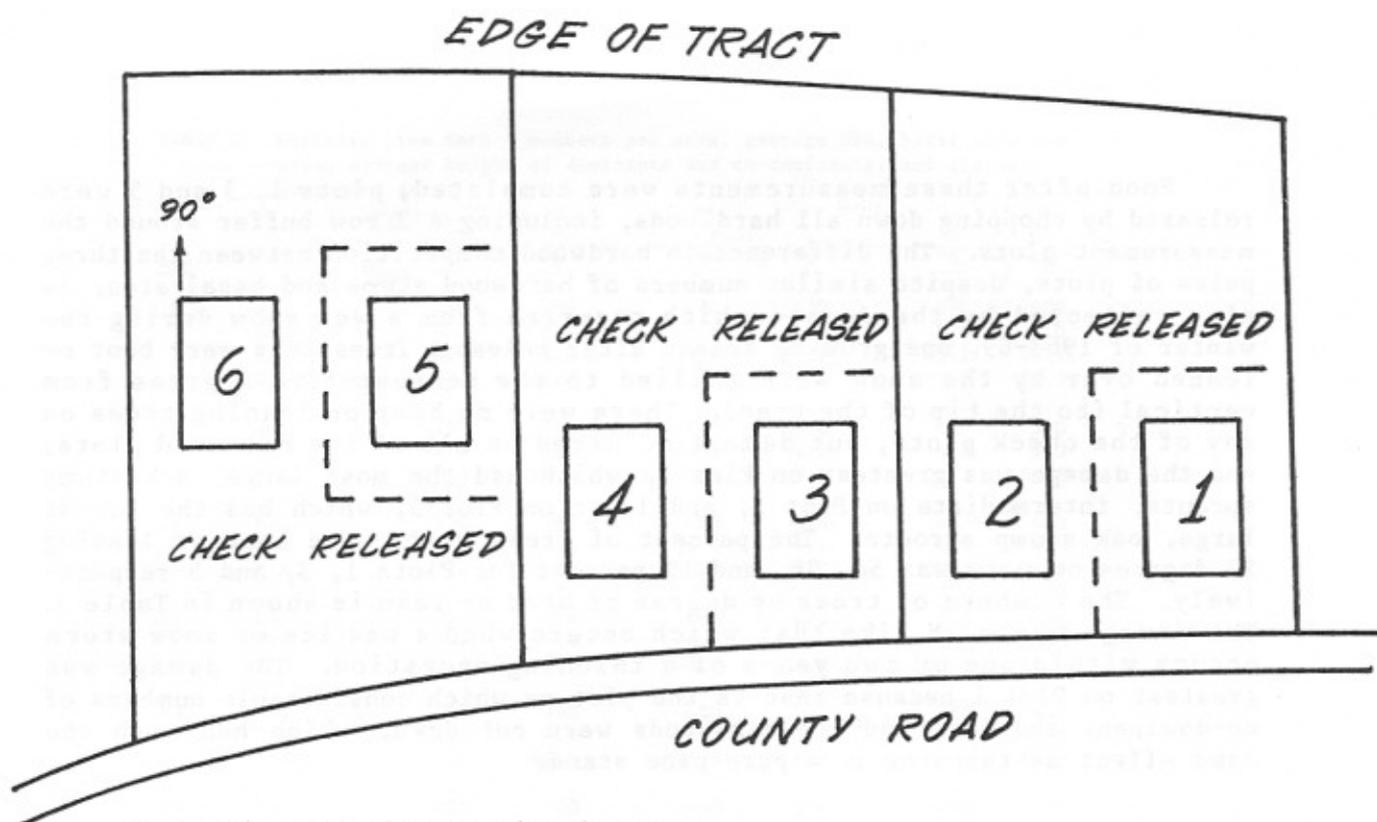


FIGURE 1. Map showing plot layout.

It is unfortunate that we did not take time to tally the hardwoods greater than .5 inch DBH by species and crown class as well as DBH. The only hardwood information we have at the time the plots were released is total numbers by DBH and basal area. All six plots are quite similar with respect to total numbers and basal area of hardwoods. However, there were striking differences in hardwood competition between different pairs of plots. Plots 1 and 2 had the greatest numbers of vigorous oak stump sprouts that were in co-dominant and intermediate crown positions at age 9. There were fewer large oak stump sprouts in plots 3 and 4, and fewer still in plots 5 and 6. Plots 5 and 6 had considerable numbers of yellow poplar seedlings, and at age 9 most of these were already dropping into the under-story. The loblolly pine crown class distributions reflect this, as shown in Table 2.

Table 2. Loblolly pine crown class distribution at age 9.

| <u>Plot</u> | <u>Dominant &amp; Co-dominant</u> | <u>Percent of Loblolly</u> |                   |     | <u>Total</u> |
|-------------|-----------------------------------|----------------------------|-------------------|-----|--------------|
|             |                                   | <u>Intermediate</u>        | <u>Suppressed</u> |     |              |
| 1           | 77                                | 9                          | 14                | 100 |              |
| 2           | 56                                | 21                         | 23                | 100 |              |
| 3           | 72                                | 19                         | 9                 | 100 |              |
| 4           | 84                                | 7                          | 9                 | 100 |              |
| 5           | 84                                | 12                         | 4                 | 100 |              |
| 6           | 86                                | 10                         | 4                 | 100 |              |

EDGE OF TRACT

Soon after these measurements were completed, plots 1, 3 and 5 were released by chopping down all hardwoods, including a 3 row buffer around the measurement plots. The difference in hardwood competition between the three pairs of plots, despite similar numbers of hardwood stems and basal area, is also reflected by the damage which occurred from a wet snow during the winter of 1968-69, one growing season after release. Trees that were bent or leaned over by the snow were tallied to the nearest five degrees from vertical (to the tip of the tree). There were no bent or leaning trees on any of the check plots, but damage occurred on all of the released plots, and the damage was greatest on Plot 1, which had the most large, oak stump sprouts, intermediate on Plot 3, and least on Plot 5, which had the fewest large, oak stump sprouts. The percent of trees which were bent or leaning 10 degrees or more was 54, 26, and 12 percent for Plots 1, 3, and 5 respectively. The numbers of trees by degree of bend or lean is shown in Table 3. The damage was much like that which occurs when a bad ice or snow storm occurs within one or two years of a thinning operation. The damage was greatest on Plot 1 because that is the plot on which considerable numbers of co-dominant and intermediate hardwoods were cut down, which had much the same effect as thinning in a pure pine stand.

Table 3. Snow damage at age 10 - percent of trees by degree of lean, on the released plots.

| Degree<br>of Lean | Percent of Trees |        |        |
|-------------------|------------------|--------|--------|
|                   | Plot 1           | Plot 2 | Plot 3 |
| 0 - 5             | 46               | 74     | 88     |
| 10 - 25           | 11               | 13     | 4      |
| 30 - 45           | 23               | 9      | 6      |
| 50 - 65           | 14               | 4      | 2      |
| 70 - 85           | 6                |        |        |
| Totals            | 100              | 100    | 100    |

### RESULTS AND DISCUSSION

We measured the plots annually through age 23. At ages 15, 21 and 23 we measured the total height of all trees over 4.5 inches DBH and tallied the crown class of every tree. At age 23, basal area and live crown ratios on some of the plots indicated that a thinning was necessary, and the entire plantation was marked and thinned soon after the 23 year measurement was completed. Table 4 presents the loblolly data for each measurement: number per acre; average DBH; basal area per acre; average height of dominants and co-dominants at ages 9, 15, 21 and 23; and standard cords per acre at ages 15, 21 and 23.

Table 4. Loblolly pine data - numbers per acre, average DBH, basal area per acre, average height of dominants and co-dominants, and standard cords per acre.

| Age |            | TRT 0  |      | Plot 1 |       | 0     |       | 1 |  |
|-----|------------|--------|------|--------|-------|-------|-------|---|--|
|     |            | Plot 1 | 2    | 3      | 4     | 5     | 3     | 6 |  |
| 9   | No.        | 350    | 390  | 470    | 430   | 490   | 500   |   |  |
|     | DBH        | 3.2    | 2.8  | 3.6    | 3.8   | 4.0   | 4.0   |   |  |
|     | B.A.       | 22.7   | 20.7 | 38.7   | 36.2  | 45.2  | 46.1  |   |  |
|     | D & CD Ht. | 22.6   | 22.7 | 25.3   | 24.5  | 25.3  | 24.5  |   |  |
| 10  | No.        | 350    | 390  | 460    | 420   | 480   | 500   |   |  |
|     | DBH        | 3.6    | 3.1  | 4.1    | 4.2   | 4.4   | 4.3   |   |  |
|     | B.A.       | 29.4   | 25.3 | 47.4   | 43.6  | 54.3  | 55.3  |   |  |
| 11  | No.        | 350    | 380  | 460    | 420   | 480   | 490   |   |  |
|     | DBH        | 4.2    | 3.4  | 4.6    | 4.6   | 4.9   | 4.8   |   |  |
|     | B.A.       | 40.0   | 30.7 | 59.3   | 52.8  | 65.7  | 66.4  |   |  |
| 12  | No.        | 350    | 350  | 440    | 410   | 480   | 480   |   |  |
|     | DBH        | 4.6    | 4.0  | 5.2    | 5.0   | 5.2   | 5.2   |   |  |
|     | B.A.       | 47.9   | 35.5 | 68.7   | 60.0  | 75.0  | 74.6  |   |  |
| 13  | No.        | 350    | 350  | 450    | 400   | 480   | 480   |   |  |
|     | DBH        | 5.0    | 4.3  | 5.4    | 5.5   | 5.6   | 5.5   |   |  |
|     | B.A.       | 56.6   | 41.4 | 79.6   | 68.4  | 85.6  | 84.2  |   |  |
| 14  | No.        | 350    | 330  | 440    | 390   | 480   | 480   |   |  |
|     | DBH        | 5.5    | 4.7  | 5.9    | 5.8   | 5.8   | 5.7   |   |  |
|     | B.A.       | 66.1   | 46.6 | 88.6   | 74.8  | 94.3  | 91.6  |   |  |
| 15  | No.        | 350    | 320  | 430    | 390   | 480   | 470   |   |  |
|     | DBH        | 5.8    | 5.1  | 6.2    | 6.1   | 6.1   | 6.1   |   |  |
|     | B.A.       | 75.2   | 52.9 | 96.2   | 83.1  | 103.6 | 100.2 |   |  |
|     | D & CD Ht. | 39.6   | 38.6 | 42.4   | 42.4  | 43.4  | 42.8  |   |  |
|     | Std. Cords | 11.8   | 7.6  | 16.1   | 14.1  | 18.2  | 16.7  |   |  |
| 16  | No.        | 350    | 310  | 430    | 390   | 480   | 470   |   |  |
|     | DBH        | 6.2    | 5.5  | 6.4    | 6.4   | 6.4   | 6.4   |   |  |
|     | B.A.       | 84.7   | 58.3 | 105.3  | 91.7  | 112.7 | 109.6 |   |  |
| 17  | No.        | 340    | 300  | 430    | 390   | 480   | 470   |   |  |
|     | DBH        | 6.6    | 5.8  | 6.6    | 6.6   | 6.5   | 6.5   |   |  |
|     | B.A.       | 92.0   | 62.1 | 110.7  | 97.1  | 118.1 | 115.1 |   |  |
| 18  | No.        | 340    | 290  | 430    | 390   | 480   | 470   |   |  |
|     | DBH        | 6.8    | 6.2  | 6.8    | 6.8   | 6.6   | 6.6   |   |  |
|     | B.A.       | 99.1   | 66.4 | 116.5  | 102.6 | 123.1 | 120.5 |   |  |
| 19  | No.        | 340    | 280  | 430    | 380   | 470   | 470   |   |  |
|     | DBH        | 7.1    | 6.5  | 6.9    | 7.1   | 6.9   | 6.8   |   |  |
|     | B.A.       | 106.0  | 70.4 | 121.8  | 108.3 | 129.3 | 127.5 |   |  |
| 20  | No.        | 320    | 270  | 430    | 380   | 470   | 450   |   |  |
|     | DBH        | 7.6    | 6.8  | 7.0    | 7.2   | 7.0   | 7.2   |   |  |
|     | B.A.       | 110.8  | 73.1 | 127.2  | 112.1 | 134.4 | 132.1 |   |  |
| 21  | No.        | 320    | 260  | 420    | 380   | 470   | 440   |   |  |
|     | DBH        | 7.8    | 7.1  | 7.2    | 7.4   | 7.2   | 7.4   |   |  |
|     | B.A.       | 117.2  | 76.7 | 131.6  | 117.1 | 139.9 | 136.6 |   |  |
|     | D & CD Ht. | 54.4   | 53.2 | 57.7   | 57.2  | 57.5  | 56.8  |   |  |
|     | Std. Cords | 28.1   | 17.6 | 32.4   | 29.6  | 35.0  | 34.9  |   |  |
| 22  | No.        | 320    | 260  | 410    | 380   | 460   | 440   |   |  |
|     | DBH        | 8.0    | 7.3  | 7.5    | 7.5   | 7.4   | 7.5   |   |  |
|     | B.A.       | 124.0  | 80.8 | 135.7  | 122.4 | 144.8 | 143.3 |   |  |
| 23  | No.        | 320    | 260  | 400    | 370   | 460   | 440   |   |  |
|     | DBH        | 8.1    | 7.4  | 7.6    | 7.6   | 7.4   | 7.6   |   |  |
|     | B.A.       | 128.7  | 83.6 | 137.8  | 122.2 | 147.1 | 146.0 |   |  |
|     | D & CD Ht. | 57.6   | 56.4 | 60.6   | 60.3  | 60.5  | 60.8  |   |  |
|     | Std. Cords | 32.8   | 19.4 | 34.8   | 32.6  | 38.9  | 40.5  |   |  |

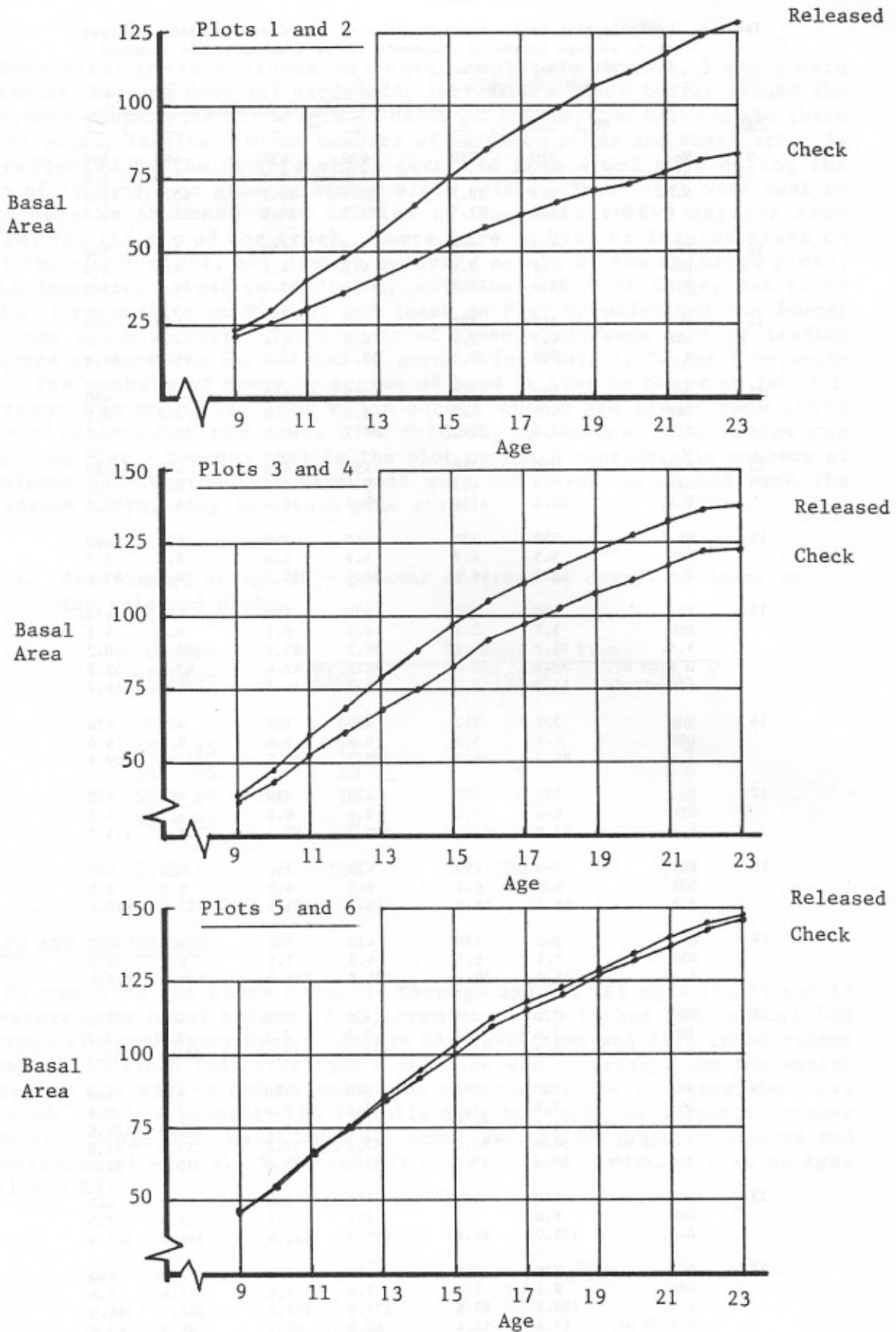


FIGURE 2. Basal area per acre of loblolly pine from age 9 through 23.

The response to release varied greatly among the three pairs of plots. The greatest response was between Plots 1 and 2, where the greatest number of large, vigorous oak stump sprouts occurred at the time of release. At age 23, Plot 1 had 54 percent more basal area and 69 percent more volume in standard cords than Plot 2. On Plots 3 and 4, the released plot had 13 percent more basal area and 7 percent more volume, and on Plots 5 and 6 the released plot had only 1 percent more basal area and 4 percent less volume than the check plot, at age 23. The basal area differences between Plots 1 and 2, and Plots 3 and 4, increased each year. The response to release is illustrated by annual basal area growth in Figure 2.

At the final measurement at age 23, all hardwoods greater than .5 inch DBH were tallied by species, crown class, and 1 inch diameter class. This data is summarized in Tables 5, 6 and 7. All of the hardwoods on the three released plots were over-topped at age 23, while on the check plots there were still a few intermediate hardwoods but no co-dominant hardwoods. There were more hardwood stems on the released plots than the check plots on all three pairs of plots. The hand-chopping frequently increased the number of stems in a sprout clump. But even though there were fewer hardwood stems on the check plots, there were more large stems and more hardwood basal area on the check plots than the released plots. This hardwood data at age 23: number of stems per acre by DBH, basal area per acre, and crown class distribution, does not explain or account for the great difference in response to release among the three pairs of plots. Response to release seems to have been related to the amount of hardwood competition for crown growing space at the time of release, and the hardwood data collected at age 9 and age 23 does not reflect or quantify this competition for sunlight and crown growing space.

Table 5. Number of hardwoods per acre over .5 inch DBH on each plot, at age 23.

| DBH | <u>Number of Hardwoods by DBH</u> |                |                   |                |                   |                |
|-----|-----------------------------------|----------------|-------------------|----------------|-------------------|----------------|
|     | <u>1-Released</u>                 | <u>2-Check</u> | <u>3-Released</u> | <u>4-Check</u> | <u>5-Released</u> | <u>6-Check</u> |
| 1   | 2,270                             | 1,210          | 2,260             | 1,140          | 2,790             | 1,470          |
| 2   | 480                               | 390            | 390               | 580            | 420               | 520            |
| 3   | 90                                | 230            |                   | 250            |                   | 140            |
| 4   | 10                                | 110            |                   | 70             |                   | 40             |
| 5   |                                   | 30             |                   | 10             |                   | 20             |
| 6   |                                   | 30             |                   |                |                   | 10             |
| 7   |                                   | 10             |                   |                |                   |                |
|     | 2,850                             | 2,010          | 2,650             | 2,050          | 3,210             | 2,200          |

Table 6. Numbers and basal area per acre of hardwoods over .5 inch DBH by crown class, at age 23.

| Plot       | Overtopped |            | Intermediate <sup>1/</sup> |            | Total |            |
|------------|------------|------------|----------------------------|------------|-------|------------|
|            | No.        | Basal Area | No.                        | Basal Area | No.   | Basal Area |
| 1-Released | 2,850      | 28.1       | 0                          | 0          | 2,850 | 28.1       |
| 2-Check    | 1,920      | 34.8       | 90                         | 13.9       | 2,010 | 48.7       |
| 3-Released | 2,650      | 20.8       | 0                          | 0          | 2,650 | 20.8       |
| 4-Check    | 2,020      | 35.5       | 30                         | 3.1        | 2,050 | 38.6       |
| 5-Released | 3,210      | 24.4       | 0                          | 0          | 3,210 | 24.4       |
| 6-Check    | 2,180      | 31.1       | 20                         | 3.3        | 2,200 | 34.4       |

Table 7. Species composition of hardwoods over .5 inches DBH, at age 23.

| Species       | Percent Composition |       |          |       |          |       |          |       |          |       |          |       |
|---------------|---------------------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|
|               | 1                   |       | 2        |       | 3        |       | 4        |       | 5        |       | 6        |       |
|               | Released            | Check | Released | Check | Released | Check | Released | Check | Released | Check | Released | Check |
| Red oak       | 20                  | 22    | 19       | 26    | 12       | 14    |          |       |          |       |          |       |
| White oak     | 36                  | 37    | 34       | 20    | 18       | 13    |          |       |          |       |          |       |
| Yellow poplar | 15                  | 3     | 7        | 11    | 4        | 32    |          |       |          |       |          |       |
| Red maple     | 5                   | 10    | 13       | 12    | 3        | 13    |          |       |          |       |          |       |
| Dogwood       | 15                  | 13    | 17       | 16    | 8        | 16    |          |       |          |       |          |       |
| Black gum     | 5                   | 9     | 6        | 11    | 7        | 6     |          |       |          |       |          |       |
| Hickory       | 3                   | 2     | 3        | 1     | 1        | 2     |          |       |          |       |          |       |
| Sweet gum     | 0                   | 0     | 0        | 0     | 0        | 2     |          |       |          |       |          |       |
| Miscellaneous | 1                   | 3     | 2        | 3     | 3        | 1     |          |       |          |       |          |       |
| Totals        | 100                 | 99    | 101      | 100   | 100      | 99    |          |       |          |       |          |       |

Pine seedlings are usually released from hardwood competition within three or four years after planting. It is during these early years that competition from hardwood brush for crown growing space is most severe. This study demonstrates, however, that pine seedlings can benefit from release even as late as nine years after planting, if there are considerable numbers of large, vigorous hardwoods that are competing for crown growing space. On the other hand, this study also demonstrates that release may not increase pine growth if most of the hardwood competition has already been relegated to an understory position or is rapidly being over-topped.

<sup>1/</sup> All intermediate trees were scarlet oaks.