



# SLASH PINE AT AUBURN A CASE HISTORY

FORESTRY  
DEPARTMENTAL SERIES NO. 1

JUNE 1964



AGRICULTURAL EXPERIMENT STATION  
AUBURN UNIVERSITY

E. V. SMITH, *Director*

AUBURN, ALABAMA



# SLASH PINE AT AUBURN A CASE HISTORY

FORESTRY  
DEPARTMENTAL SERIES NO. 1

JUNE 1964



AGRICULTURAL EXPERIMENT STATION  
AUBURN UNIVERSITY

E. V. SMITH, *Director*

AUBURN, ALABAMA

## CONTENTS

	<i>Page</i>
OBJECTIVES.....	3
DESCRIPTION OF PLANTING SITE AND ITS RELATION TO NATURAL RANGE.....	4
CULTURAL OPERATIONS.....	6
STAND DEVELOPMENT AND GROWTH OF PLANTATIONS.....	8
YIELDS OF SLASH PINE SPACING PLANTATIONS.....	17
OTHER PLANTINGS.....	19
SUMMARY AND GENERAL OBSERVATIONS.....	24
LITERATURE CITED.....	25
APPENDIX A.....	26
APPENDIX B.....	41

# SLASH PINE AT AUBURN A CASE HISTORY

KNOX W. LIVINGSTON

Assistant Professor

AT PRESENT and when plantations here described were established, slash pine was one of four southern pines of most commercial importance. Since the beginning of the pine timber industry in the South, the importance of slash pine relative to other species has gradually increased, both as the supply of slash pine increased and as stands of virgin longleaf pine were depleted.

Lumber from slash pine, in common with the other three species, is marketed as southern yellow pine. If it meets certain requirements for number of rings per inch and per cent summerwood it may be classed as longleaf yellow pine, a designation allowed only slash and longleaf pines by the lumber industry. It is used in all types of construction, and the dense lumber is especially valuable in heavy construction where strength is an important factor. Southern yellow pine is used extensively for packing, railway ties, poles, piling, and mine timbers. A major use of continually increasing importance is for pulp and paper products. The gum naval stores industry in North America is dependent entirely on slash and longleaf pines. Of all North American pines, slash pine has wood of the highest average density and the highest average values of practically all strength characteristics (14).

Slash pine (*Pinus elliottii* Engelm. var. *elliottii*) is described (6), as a large tree, about 50-100 ft. tall and 24-40 inches in diameter, with erect straight axis and narrow pointed crown. In the original forests it grew mainly in depressions and on low sites with an abundance of moisture in the surface layers, while longleaf pine occupied higher ground in the same general area (5).

The natural geographic range of slash pine extends north and east to the Santee River in coastal South Carolina, south to Lake Okeechobee in Florida, and west to the Mississippi River in coastal Louisiana (6). The natural altitudinal range is mostly from sea level to less than 300 feet (5). Like loblolly pine, slash pine is an aggressive species that quickly takes over abandoned fields (5). With the exclusion of fire, slash pine often invades longleaf pine land on ridges and slopes (2).

## OBJECTIVES

Slash pine was first planted at Auburn, outside its natural range, as a means of testing the adaptability of a species of recognized economic importance and with desirable characteristics. Because of the early apparent success of the first planting, more extensive plantings were made to test the effects on growth and yield of different original planting spacings and different thinning practices and to compare slash pine with the native pines. Other, more limited plantings of the several species were made to test effects of burning (3), topographic situation, hardwood competition (11), competition between different species of planted pines, and cultivation with fertilization (4).

There were no specific forest management objectives in terms of products or markets. The idea was to grow wood and to seek favorable markets at the appropriate time.

## Dates of Planting and Persons Responsible

The first field plantings were made in early 1927 under the direction of L. M. Ware and the late Otto Brown.<sup>1</sup> Locally grown, 1-year old seedlings were used. The bulk of the planting at Auburn was done from 1932 to 1934, under Ware's direction. It was not until 1935 that a professional forester was hired by the Agricultural Experi-

<sup>1</sup> Professor Ware was then and is now Head of the Department of Horticulture, Auburn University, then the Alabama Polytechnic Institute. His department became the Department of Horticulture and Forestry in 1928, retaining that title until a separate Department of Forestry was established in 1947. It is largely the result of efforts by Mr. Ware that a Department of Forestry exists at Auburn. Mr. Brown was forester for the Cooperative Extension Service of the Alabama Polytechnic Institute. Later he worked for several years with the USDA Soil Conservation Service, returned to Alabama to join the Agricultural Experiment Station, and recently, 1959, retired as Superintendent of the Gulf Coast Substation. That neither Mr. Ware nor Mr. Brown was a professionally trained forester makes especially remarkable and commendable their foresight and their contribution in initiating forestry research in Alabama.

ment Station. He was the late D. J. Weddell,<sup>2</sup> who supervised the plantations until he resigned in 1939. Other foresters who have planned and supervised work in the plantations include R. Stahelin, J. E. Bryan, Jr., W. R. Bogess, G. I. Garin, and the writer.

### Design

The design of the experiment was not as extensive as might be used today. When the Auburn Plantations were established, statistical methods and design were not used as extensively as presently in agriculture and forestry.<sup>3</sup> Furthermore, plots had to be fitted into limited space. Establishment was accomplished with extremely limited funds. The allotment to initiate forestry research at Auburn was \$80. Finally, in relation to the limited knowledge of pine silviculture of the time, meeting the original objectives did not require an elaborate design.

Because the original design of the Auburn plantations did not, and could not conform with modern, accepted experimental design, this publication should be accepted more as a historical account than as a research report. Detailed data are presented in order that the reader who wishes can make his own comparisons. Readers are cautioned against assuming that results will be duplicated under different conditions.

### DESCRIPTION OF PLANTING SITE AND ITS RELATION TO NATURAL RANGE

The locality of the Auburn Plantations is about 75 or 100 miles north of the natural range of slash pine in the Gulf Coastal Plain.<sup>4</sup> It is a little more than 100 miles west of the farthest inland range of the species, in the Atlantic Coastal Plain of Georgia, and about 40 or 50 miles south of the latitude of the northernmost extent, in coastal South Carolina.

The climate at Auburn (13) is not much different from that at most of the weather stations within the natural range of slash pine. Averages and extremes of temperature are within the range of those recorded at the other stations. The average growing season of 237 days at Auburn, however, is shorter than at most stations. Average annual precipitation at Auburn, 52.7 inches, is higher than that in much of the natural slash pine belt. Average warm season<sup>5</sup> precipitation, however, is only 23.5 inches, which is 2½ or more inches less than that at stations in the slash pine area.

The Auburn plantation area is one of transition from Piedmont to Upper Coastal Plain. Topography is gently rolling. Elevation is about 700 feet above sea level, more than double the highest elevation of reported natural oc-

<sup>2</sup> Mr. Weddell became State Forester of Georgia, then Dean of the School of Forestry, University of Georgia. He remained in the latter position until his death in 1956.

<sup>3</sup> The first edition of R. A. Fisher's classic text, *Statistical Methods for Research Workers*, had not been published until 1925; and it was not until 1935 that his other well known text, *The Design of Experiments*, appeared in its first edition. *Statistical Methods*, by G. W. Snedecor, was first published in 1937.

<sup>4</sup> This excepts the major river valleys. Along the Alabama River slash pine occurs naturally to within about 50 miles of the latitude of Auburn. This point is a little more than 100 miles from Auburn in a west-southwesterly direction.

<sup>5</sup> April through September.

currence of slash pine. Soils are sandy loams and loamy sands of the Chesterfield and Norfolk series, Coastal Plain in origin. They are underlain at depths of 1½ to 6 or more feet by residual clays or sandy clays of Piedmont origin.

Pines native to the area are loblolly, longleaf, and shortleaf. Naturally occurring forest types are loblolly pine-shortleaf pine, loblolly pine, and loblolly pine-hardwoods (10).

All of the plantations were established on abandoned fields that had been in field crops, probably cotton and corn exclusively, until 1926. Between 1926 and 1932, experimental horticulture plots occupied the area not already planted in trees. Under cultivation, the area had suffered moderate to severe soil erosion. Severity of erosion was highly variable from place to place. A complex pattern of difficult to evaluate site differences over the area resulted from varying original soil conditions and varying severity of erosion.

### Plot Layout

**Original Design.** The first pure slash pine planting was made in 1927 on a single, 1-acre plot (see Block No. 4 on map). It adjoins similar plantings of loblolly pine (Block 3) and shortleaf pine (Block 5). Also established in 1927 was a single-row mixture of slash, loblolly, shortleaf, and longleaf pines on a long, narrow plot of about 1 acre (Block 2). Most of the subsequent plantings were made on ¼-acre plots. There are 30 of these in the main body of slash pine plantings (Blocks 31, 32, and 35). To each plot was assigned an original planting spacing, a spacing after first thinning (if made) and a final spacing.

**Modification of Design.** Through the years from the time the plantations were established, original plans were modified from time to time. The 1-acre slash and loblolly pine plots established in 1927 were divided into quarters at the time of first thinning (see map). Two subplots of each species were thinned more heavily than the other two.

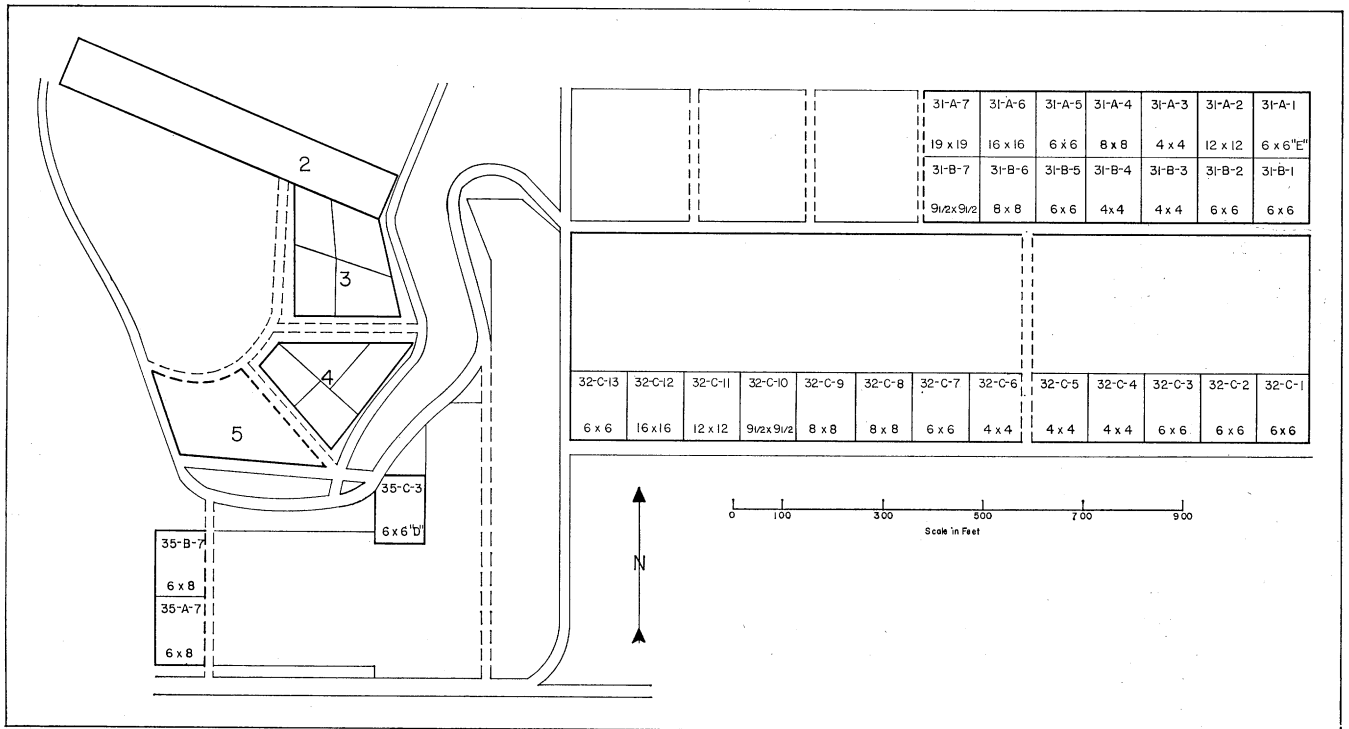
The thinning pattern envisioned for the ¼-acre spacing plots was not followed after the time of first thinning. Not only were the somewhat arbitrarily planned thinning spacings abandoned, but some plots originally designated for no thinning at any time were thinned, and plots originally assigned only one thinning were thinned again.

**Final Plot Arrangement.** When the acre planted to slash pine in 1927 was later subdivided to provide four thinning plots (see map), the area of record was cut to approximately 0.8 acre in order to provide a buffer strip around the outside boundary. Thereby, approximately 0.2 acre was provided for each thinning plot. The entire area of record is an irregular quadrilateral. Three of the thinning plots are trapezoidal, the other triangular.

The planting of slash, loblolly, shortleaf, and longleaf pines in single row mixture is on an approximately rectangular plot 72 feet wide and about 620 feet long (see map). No further subdivision was made except by topographic position.

Each of the 30 plots that make up the main body of slash pine plantings<sup>6</sup> has an area of ¼-acre (see map). All

<sup>6</sup> Usually described to visitors as the spacing plantations or spacing plots.



This is a map of the experimental area.

are rectangular, with dimensions slightly varied to allow best use of available land. Most plots are about 96 by 114 feet.

To the 30 slash pine spacing plots were assigned 8 different planting spacings, ranging from 4 × 4 feet to 19 × 19 feet. Different thinning practices later applied brought the number of different spacing-thinning combinations to 15. All possible combinations are not represented, and the number of plots assigned to each combination that is represented ranging from 1 to 4, Table 1.

Fourteen of the plots are in a group arranged in two rows of seven plots each, all planted to slash pine (Block 31). Thirteen plots are in a single row, which is part of a group of plots in three rows, one slash pine, one longleaf pine, and the other loblolly pine (Block 32). Adjacent plots of different species were planted at the same spacing. The remaining three slash pine plots are scattered within a group planted mostly to longleaf pine (Block 35).

There are no isolation strips between adjoining plots. where plots adjoin roads or fire lanes there are buffer strips of trees, usually a single row, planted at appropriate spacings.

**Relation of Plot Layout to Soils and Topography.** Originally, sites were classed roughly into two groups, good and poor. It was stated by Ware *et al* (15) that different spacings were fairly evenly divided between good and poor sites, except for the 8' × 8' plots, of which three fell on poor sites and only one on a good site. This statement is in most part upheld by site index estimates made from height measurements when the plantations had reached the age of 31 years. The only serious exceptions are that both of the two 6' × 8' plots are on poor sites and all 12' × 12' and wider spaced plots are on better than average sites. Estimates of site index (index age 50) range from 77 to 102 and average 87.6.

The plot with site index 102, a 6' × 6' plot that has never been thinned, is exceptional in its situation. It is in a low-lying area with excellent soil moisture conditions. Trees planted on this plot were subjected to severe competition from vines, briars, and brush. Because it is exceptional, this plot has been given the special designation, 6' × 6' E, and will be considered apart from other plots of the same spacing.

TABLE 1. NUMBER OF SLASH PINE PLOTS REPRESENTING EACH SPACING-THINNING COMBINATION

Thinnings	Spacings (in feet)								
	4×4	6×6	6×8	8×8	9½×9½	12×12	16×16	19×19	All
	No.	No.	No.	No.	No.	No.	No.	No.	No.
None	1	2	---	---	---	---	---	1	4
One commercial	1	2	---	3	2	2	2	---	12
One pre-commercial and 1 commercial	4	---	---	---	---	---	---	---	4
Two commercial, first light	---	4	1	1	---	---	---	---	6
Two commercial, first heavy	---	3	1	---	---	---	---	---	4
All	6	11	2	4	2	2	2	1	30

## Establishment

**Seed Source.** With one exception, geographic source of seed for the Auburn plantations is not definitely known. Slash pine seed sown at Auburn in 1926 for the 1927 plantings were procured from a dealer in Pennsylvania.<sup>7</sup> They may have come from anywhere in the slash pine belt. Shortleaf pine seed for the same plantings were donated by Page S. Bunker, then Alabama State Forester; and loblolly pine seed were collected locally by Extension Forester Brown. The longleaf pine seedlings planted in 1927 were donated by the Great Southern Lumber Company, Bogalusa, Louisiana.

The spacing plantations were established with seedlings furnished by the Louisiana Department of Conservation. It is likely that the seed were collected near the western limit of slash pine's natural range.

**Nursery Practice.** Seedlings for the 1927 plantings (except longleaf pine) were grown at the Agricultural Experiment Station in nursery beds prepared in an area with a heavy grass sod. After the sod was broken, most of the roots were raked out. The 4-foot wide beds were bordered with planks, then about 4 inches of leaf mold and topsoil were placed in the beds and leveled. The beds were treated with 0.6 per cent formaldehyde solution at a rate of 22 ounces per square foot, then watered to carry the solution down through the leaf mold and topsoil.<sup>8</sup> The treatment was apparently ineffective, as there was no odor of formaldehyde the next day and active grubs were present.

In March 1926 seed were sown by hand in ¼-inch deep furrows and covered with sand, which had been heated to a temperature thought sufficient to kill harmful fungi. There was practically no damping-off when seed germinated, but investigators carrying out the work did not attribute this to soil treatment. Seedbeds were kept covered with lath frames during germination period and growing season. The beds were watered from a nearby hydrant during dry seasons.

Seedlings for all later plantings presumably were grown under standard conditions in state nurseries.

**Planting Practices.** All field planting was done by hand. One-year-old<sup>9</sup> nursery grown seedlings were slit planted by two-man crews using mattocks or planting bars. Spacing within rows and between rows was carefully controlled.

**Initial Survival.** Records of survival at the end of the second growing season were kept for some plots in the spacing plantations. There are no records of first year survival that the writer considers reliable. Second year survival on six slash pine plots planted at 4' × 4' averaged 76 per cent, with a range from 57 to 98 per cent. Second year survival on the only 6' × 6' plot for which it was recorded was 96 per cent. On the two 6' × 8' plots, second year survival was 91 and 94 per cent.

<sup>7</sup> Conyers B. Fleu, Germantown.

<sup>8</sup> Purpose of the treatment is not recorded. Fumigation with formaldehyde was a common practice in horticultural seedbeds for the control of injurious insects and other organisms.

<sup>9</sup> One probable exception. Longleaf pine seedlings received from Bogalusa and planted in 1927 appeared to be two years old.

The weighted average of second year survival on the nine slash pine plots for which there is a record is 78 per cent. This compares with 79 per cent for loblolly pine and 51 per cent for longleaf pine plots with comparable records.

**Replanting.** All plots were replanted at least once to bring number of living trees and spacing back to the original. By replanting is meant going to every individual tree planting spot and planting new seedlings wherever the originals were dead or missing. Most plots, including all the slash pine spacing plots, were replanted one time, after the second growing season.

It is now recognized (1) that seedlings planted even 1 year after a plantation is established are usually quickly overtopped by their older neighbors. They may remain alive for a number of years; but except where large openings occur, they seldom contribute significantly to stand development except in terms of number of trees.

## CULTURAL OPERATIONS

### Thinning

**Time of Thinning.** All thinning operations were conducted between growing seasons. On the basis of plantation age (and, hence, size of trees) thinnings in the spacing plantings may be categorized as follows: 1. pre-commercial, made only in 4' × 4' plantings; 2. early commercial, made in 6' × 6', 6' × 8', and 8' × 8' plantings; and 3. later commercial, made in all of the plots that had pre-commercial or early commercial thinnings, in representative 4' × 4' and 6' × 6' plantings that had not been thinned before, and in all plantings between and including 6' × 8' and 16' × 16' spacings.

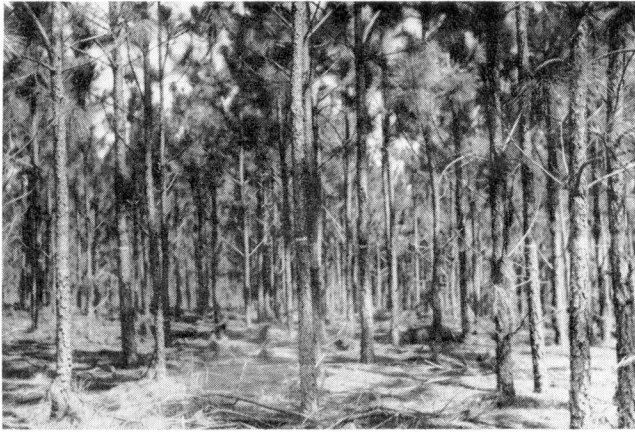
Age of the 4' × 4' plantings when they were thinned pre-commercially was 8 years. Early commercial thinnings of the spacing plantations were made at age 12 in the 6' × 6' plantings, age 14 in the 6' × 8' plantings, and age 15 in the 8' × 8' planting. Only slash pine and loblolly pine received pre-commercial or early commercial thinnings. Later commercial thinnings of all spacing plantations except the two 6' × 8' plots and one of the 6' × 6' plots (all slash pine) were made at age 19. None of the three plots excepted had received an earlier thinning, and their age at time of thinning was 18 years.<sup>10</sup>

Commercial thinnings in the slash and loblolly pine plantings established in 1927 were made at ages 17 and 25 years. The single row mixture of four pine species, also established in 1927, was thinned when the planting had reached the age of 18 and again at age 25. The shortleaf pine planting established in 1927 had not been thinned before the final measurement.

**Methods and Degree of Thinning.** All thinnings were primarily low thinnings, with certain modifications. Defective trees, regardless of crown class, were removed if they seriously competed with trees to be left. Some trees of lower crown classes and a few recognized defective trees were left, if they did not seriously compete with other remaining trees and appeared vigorous enough to maintain satisfactory growth. An attempt was made to

<sup>10</sup> Because it was thinned at an age different from the others, the 6' × 6' plot thinned at age 18 has been given the special designation 6' × 6' D.



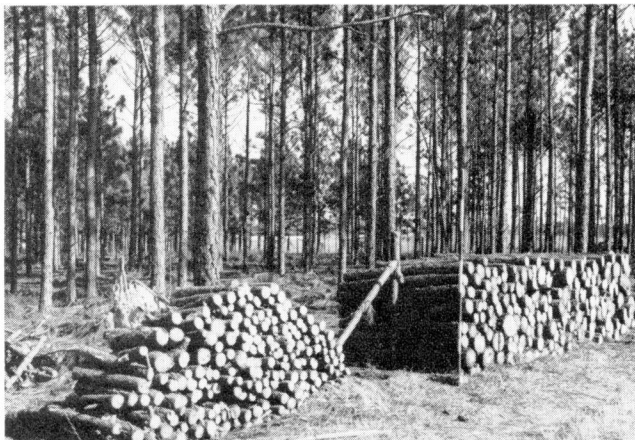


This Slash pine, planted at  $4' \times 4'$  spacing, is pictured after pre-commercial thinning at age 8.

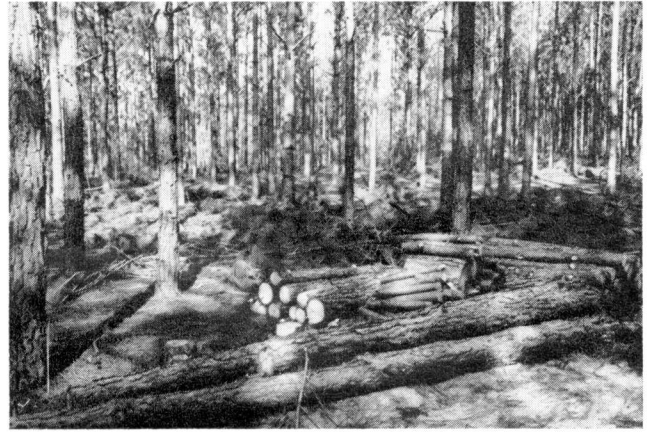
provide promising trees remaining with some degree of crown release. Though these modifications are features of the crown, or French, thinning method, it is believed that the thinnings as carried out were modified low, or German, thinnings. From an entirely different approach toward nomenclature, they could be termed improvement thinnings.

On both pre-commercial and early commercial thinnings, degree of thinning was defined in terms of number of trees left after thinning, or average spacing of remaining trees. Pre-commercial thinnings were designed to widen the spacing from the original  $4' \times 4'$  to an average of  $8' \times 8'$  (680 trees per acre). Actually, an average of 730 trees per acre was left on the four slash pine plots that were thinned pre-commercially. Undoubtedly, the excess was in trees too small to harvest even for local use products (fuel wood and fence posts). Leaving such small trees is in line with definitions of low thinning.

Early commercial thinnings were in two different degrees of severity, light and heavy. In  $6' \times 6'$  and  $6' \times 8'$  plantings, light thinnings left about 600 trees per acre and heavy thinnings left about 400 trees per acre. The only early thinning conducted in an  $8' \times 8'$  slash pine planting left only 412 trees per acre but is classed as a



This Slash pine, planted at  $6' \times 6'$  spacing, is shown after second commercial thinning at age 19. Products from  $\frac{1}{4}$ -acre area are shown. Volume of tops and small trees cut into firewood (left, foreground) is not included as merchantable yield.



Slash pine, planted at  $16' \times 16'$  spacing, is shown after first thinning at age 19.

light thinning. This seemingly conflicting classification is justified because basal area left after thinning as well as percentage of basal area removed in thinning were in line with the other light thinnings. Furthermore, fewer trees were cut than in any of the other early thinnings, light or heavy.

As previously stated, plans were changed before later commercial thinnings were made. The concept of thinning to a specified number of trees to be left was abandoned. Instead, decisions of which trees and how many to cut were based on ocular examination of the trees and crowns and, to a lesser extent, on basal area. The idea was to choose the best remaining trees and provide them with sufficient growing space for an additional 5 to 10-year period. Also considered were the necessity of providing a commercially operable cut and the desirability of avoiding creation of large openings in the stand.

Percentage of basal area removed in the later commercial thinnings of the slash pine spacing plots averaged 34. The range on individual plots was from 22 to 43 per cent. Basal area left after the later thinnings averaged 83 square feet and ranged from 54 to 117 square feet per acre on individual plots.

There are unthinned plots in only 3 different spacings,  $4' \times 4'$  (1 plot),  $6' \times 6'$  (2 plots),<sup>11</sup> and  $19' \times 19'$  (1 plot).

**Reasons for Thinning.** Thinnings were directly related to the original objective of testing thinning practices. The change in concept from one of thinning to a specified number of trees to one of improvement thinning was made on the basis of the investigators' judgment that good silviculture demanded more attention to crown density than to number of stems. Most plots originally designated for no thinning throughout their rotation or for no second thinning were thinned (later commercial thinning) because the investigators decided to consider periodic improvement thinning a feature of normal plantation management.

The unthinned  $4' \times 4'$  and  $6' \times 6'$  plots were retained as check plots. The  $19' \times 19'$  plot was not thinned because it had not developed a closed crown canopy.

<sup>11</sup> One of these is  $6' \times 6'$  E, the exceptional plot.

## Salvage Cuts

**Timing and Degree.** Trees badly diseased with southern fusiform rust<sup>12</sup> were cut in most of the spacing plantations when they were 11 years old. Plot 6' × 6' D, the one that was 18 years old at the time of later commercial thinning, was 10 years old when the salvage cut was made. The two 6' × 8' plots received no salvage cut, nor did the four 4' × 4' plots that had been thinned pre-commercially.

Number of cankered trees per acre removed in the salvage cut ranged from 4 to 120 per acre. Trees cut represented from 3 to 18 per cent of the basal area on individual slash pine plots.

**Reasons.** Salvage cuts were made merely as a feature of plantation management. They had no experimental purpose. The reason that salvage cuts were made on many plots only a year before they were thinned commercially in accord with the original plans is obscure. The pre-commercially thinned 4' × 4' plots received no salvage cut because most diseased trees already had been removed. There is no recorded reason why the 6' × 8' plots received no salvage cut.

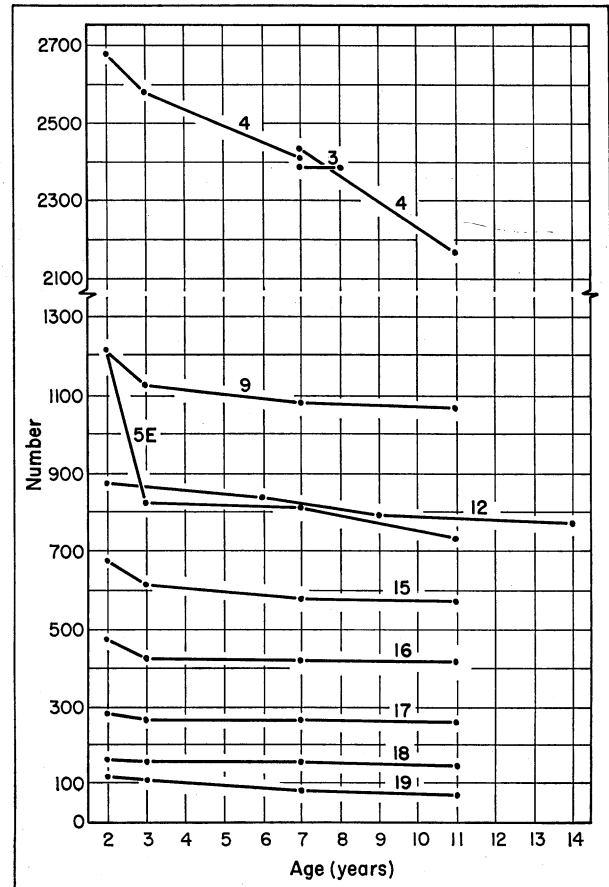
## STAND DEVELOPMENT AND GROWTH OF PLANTATIONS

### Number of Trees per Acre

**Original Spacing and Survival before any Cultural Treatment.** From the limited records available<sup>13</sup> there appears to be no relationship between planting spacing and survival of seedlings during the first 2 years after planting. Because even at the closest spacing little if any competition between seedlings could occur, any relationship during this period would be unexpected. Survival trends after the second year are clouded by the replanting. It is evident (Figure 1) that mortality on most plots was relatively heavy (average of 26 plots, 6 per cent) during the third year. Undoubtedly, this resulted largely from the death of a high proportion of the replanted seedlings in their first year. The magnitude of this effect and its duration cannot be determined from the available data.

During the 8-year period between the third year and time of salvage cutting, survival on 6' × 6' and wider plantings appears not to be associated with planting spacing. However, it appears that spacing as close as 4' × 4' did result in sufficient competition between planted trees to reduce survival during this period. Mortality on 4' × 4' plots was 16 per cent from age 3 to age 11, compared with an average of 6 per cent on the 6' × 6' and wider spaced plots.

The exceptional plot, 6' × 6' E, showed mortality of 12 per cent during the 3 to 11-year age period, Figure 1, Curve 5E. As was stated in the section on design, this plot occupies a low area, with excellent soil moisture conditions and exceptionally high site index. From the beginning it has supported a dense growth of vines, briars, and brush. Mortality of planted trees during the third year (first year after replanting) was 32 per cent, much higher than on any other plot. Undoubtedly, the low rate of survival on the exceptional plot was related to site con-



**FIGURE 1.** This is the number of trees per acre before any cultural treatment. Curves on the chart present the following: curve 3, 4' × 4' 1 pre-commercial and 1 commercial thinning (4 plots); 4, 4' × 4', average, more than one group; 5E, 6' × 6' E no thinning (1 plot); 9, 6' × 6', average, more than one group; 12, 6' × 8', average; 15, 8' × 8', average; 16, 9½' × 9½', 1 commercial thinning (2 plots); 17, 12' × 12', 1 commercial thinning (2 plots); 18, 16' × 16', 1 commercial thinning (2 plots); and 19, 19' × 19', no thinning (1 plot).

ditions rather than to original spacing or cultural treatments.

**Original Spacing and Survival Following Salvage Cut, Early Thinning, or Both.** There is little doubt that competition between trees planted at 4' × 4' and not thinned early was a factor affecting survival between age 11 and 19 years. In fact, survival during this period may be related to spacing across the entire spacing range from 4' × 4' to 16' × 16'. There is a steady decline in age 11 to 19 mortality rate with increasing spacing:

4' × 4', 39 per cent (2 plots, 37 and 41 per cent);

6' × 6', 17 per cent (2 plots, 14 and 21 per cent);

8' × 8', 9 per cent (3 plots, range 7 to 13 per cent);

9½' × 9½', 5 per cent (2 plots, 2 and 8 per cent);

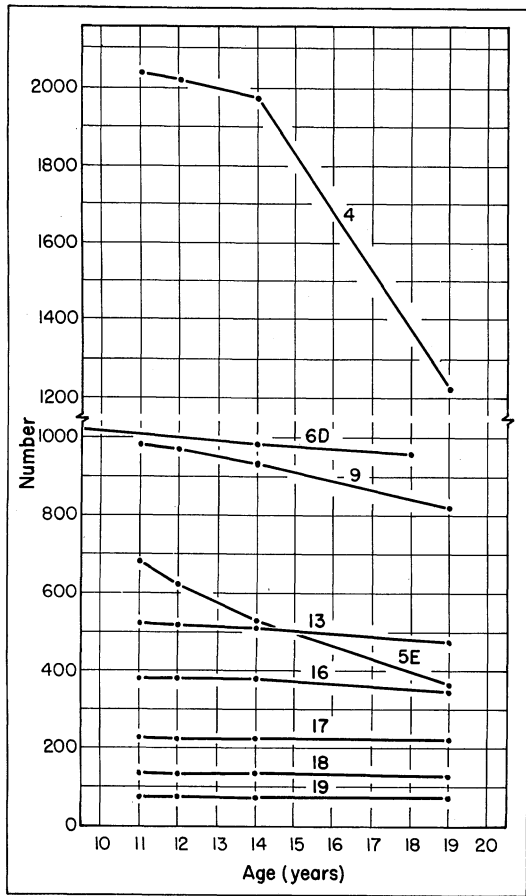
12' × 12', 3 per cent (2 plots, 0 and 8 per cent); and

16' × 16', 1 per cent (2 plots, 0 and 3 per cent).

A 5 per cent mortality is indicated for the one 19' × 19' plot (Figure 2); but, with only 19 trees on the ¼-acre plot at the beginning of the period, the only possible rate lower than 5 per cent would be zero. Combining the 19' × 19' plot with the two 16' × 16' plots gives a mortality rate of 2 per cent, which is based on a more substantial number of trees.

<sup>12</sup> Caused by *Cronartium fusiforme* (Ph.) Hedge and Hunt.

<sup>13</sup> Initial Survival, p. 6.

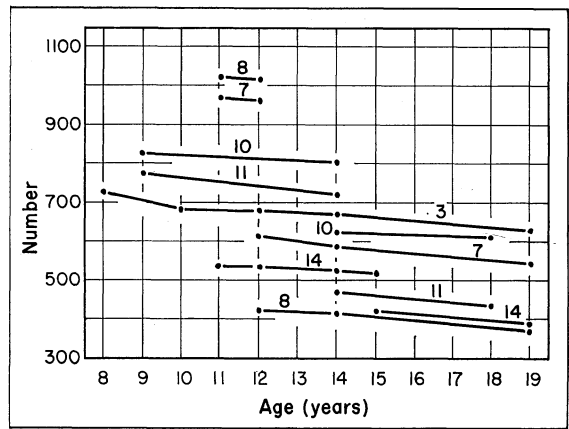


**FIGURE 2.** This is the number of trees per acre between time of first cultural treatment and later commercial thinning, plots not thinned early. Curves on the chart show the following: curve 4, 4' x 4', average, more than one group; 5E, 6' x 6' E, no thinning (1 plot); 6D, 6' x 6' D, 1 commercial thinning (1 plot); 9, 6' x 6', average, more than one group; 13, 8' x 8', 1 commercial thinning (3 plots); 16, 9½' x 9½', 1 commercial thinning (2 plots); 17, 12' x 12', 1 commercial thinning (2 plots); 18, 16' x 16', 1 commercial thinning (2 plots); and 19, 19' x 19', no thinning (1 plot).

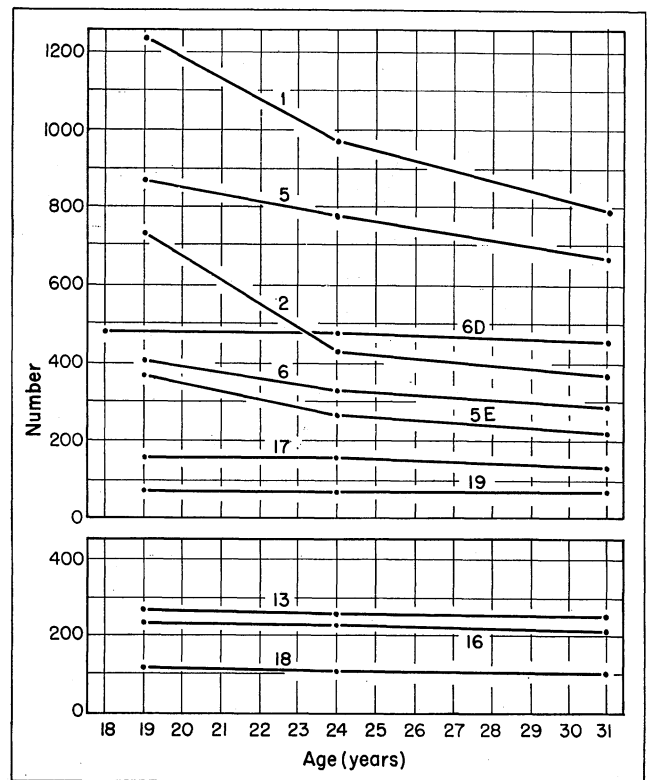
The slope of curve 6D on Figure 2, which represents the 6' x 6' plot tallied at different ages (6' x 6' D), appears somewhat out of line with the general trend. It is more nearly like the slope of curves for the wider spacings. There is no ready explanation for this erratic behavior.

Mortality on plot 6' x 6' E was 46 per cent during the 8-year period from age 11 to 19 years. Since basal area stocking throughout the period was lower on plot 6' x 6' E than on a number of the plots with higher survival rates, the excessively high mortality apparently was caused by factors other than competition between planted trees.

For plots thinned early, there appears to be little consistent difference in mortality rate among different original spacings during the period between thinning, Figure 3. The only spacings represented are 4' x 4', 6' x 6', 6' x 8', and 8' x 8'. Because each spacing was thinned at a different age, comparisons are difficult. Mortality rate appears to be mostly in the same range as the 8' x 8' and 9½' x 9½' plots not thinned early, Figure 2.



**FIGURE 3.** Given here is number of trees per acre between time of first cultural treatment and later commercial thinning, plots thinned early. Curves on chart show the following: curve 3, 4' x 4', 1 pre-commercial and 1 commercial thinning (4 plots); 7, 6' x 6', 2 commercial thinnings, first light (4 plots); 8, 6' x 6', 2 commercial thinnings, first heavy (3 plots); 10, 6' x 8', 2 commercial thinnings, first light (1 plot); 11, 6' x 8', 2 commercial thinnings, first heavy (1 plot); and 14, 8' x 8', 2 commercial thinnings, first light (1 plot).



**FIGURE 4.** This chart presents the number of trees per acre after time of late thinning on plots not thinned early. Curves on the chart give the following: curve 1, 4' x 4', no thinning (1 plot); 2, 4' x 4', 1 commercial thinning (1 plot); 5, 6' x 6', no thinning (1 plot); 5E, 6' x 6' E, no thinning (1 plot); 6, 6' x 6', 1 commercial thinning (1 plot); 6D, 6' x 6' D, 1 commercial thinning (1 plot); 13, 8' x 8', 1 commercial thinning (3 plots); 16, 9½' x 9½', 1 commercial thinning (2 plots); 17, 12' x 12', 1 commercial thinning (2 plots); 18, 16' x 16', 1 commercial thinning (2 plots); and 19, 19' x 19', no thinning (1 plot).

TABLE 2. NUMBER OF TREES PER ACRE AT DIFFERENT PLANTATION AGES, SLASH PINE SPACING PLANTINGS

Plot	Plant space	Thin	Age, years										
			2	3	6	7	8	8	9	10	10	11	11
			Cultural operation										
			None	None	None	None	Pre-comm. thinning		None	None	Salvage cutting		
No.	No.	No.	No.	Before	After	No.	No.	Cut	Before	After			
6	4×4	1	2,688 <sup>1</sup>	2,584 <sup>1</sup>	---	2,405 <sup>1</sup>	---	---	---	---	---	---	---
2	4×4	2	2,688 <sup>2</sup>	2,580 <sup>2</sup>	---	2,418 <sup>2</sup>	---	---	---	---	---	2,158 <sup>2</sup>	2,046 <sup>2</sup>
1	4×4	0	2,688	2,540	---	2,340	---	---	---	---	---	2,220	2,108
1	4×4	1	2,688	2,620	---	2,496	---	---	---	---	---	2,096	1,984
4	4×4	2	2,688	2,586	---	2,398	2,398	730	---	688	---	---	---
9	6×6	1	1,216 <sup>1</sup>	1,126 <sup>1</sup>	---	1,077 <sup>1</sup>	---	---	---	---	---	1,062 <sup>1</sup>	984 <sup>1</sup>
2	6×6	2	1,216 <sup>2</sup>	1,140 <sup>2</sup>	---	1,094 <sup>2</sup>	---	---	---	---	---	1,074 <sup>2</sup>	976 <sup>2</sup>
1	6×6	0	1,216	1,160	---	1,140	---	---	---	---	---	1,128	1,008
1	6×6	1	1,216	1,120	---	1,048	---	---	---	---	---	1,020	944
4	6×6	2	1,216	1,107	---	1,049	---	---	---	---	---	1,043	969
3	6×6	2	1,216	1,143	---	1,103	---	---	---	---	---	1,079	1,010
1	6×6E	0 <sup>3</sup>	1,216 <sup>3</sup>	832 <sup>3</sup>	---	808 <sup>3</sup>	---	---	---	---	---	728 <sup>3</sup>	680 <sup>3</sup>
1	6×6D	1 <sup>3</sup>	1,216 <sup>3</sup>	---	1,124	---	---	---	1,072	---	52	---	---
2	6×8	1	896 <sup>1</sup>	---	826 <sup>1</sup>	---	---	---	798 <sup>1</sup>	---	---	---	---
1	6×8	2	896	---	844	---	---	---	820	---	---	---	---
1	6×8	2	896	---	808	---	---	---	776	---	---	---	---
4	8×8	1	672 <sup>1</sup>	609 <sup>1</sup>	---	574 <sup>1</sup>	---	---	---	---	---	567 <sup>1</sup>	525 <sup>1</sup>
3	8×8	1	672	609	---	572	---	---	---	---	---	568	521
1	8×8	2	672	608	---	580	---	---	---	---	---	564	536
2	9½×9½	1	480	430	---	420	---	---	---	---	---	412	378
2	12×12	1	288	266	---	264	---	---	---	---	---	262	232
2	16×16	1	168	160	---	156	---	---	---	---	---	148	142
1	19×19	0	120	104	---	92	---	---	---	---	---	80	76

<sup>1</sup> Average, all plots of specified spacing (with exceptions noted).

<sup>2</sup> Average, plots of specified spacing not thinned early.

<sup>3</sup> Not included in averages.

<sup>4</sup> Average no longer appropriate, following different thinning treatments.

Continued

**Original Spacing and Survival Following the Time of Later Thinning.** It is evident from curves 1 and 2 on Figure 4 that mortality on the 4' × 4' plots not thinned early continued at high rates following time of later commercial thinning. Proportional mortality on 6' × 6' and wider spacings not thinned early remained fairly well in line with preceding period except for an increased rate on the 6' × 6' plot thinned at age 19 (curve 6), especially during the first 5 years, and a decreased rate on the exceptional 6' × 6' plot (curve 5E).

The later thinning left plantings thinned twice with only a small range in number of trees, Figure 5. No particular pattern of survival differences among the various spacings is evident.

**Thinning and Survival in the 4' × 4' Plantings.** It is quite obvious that pre-commercial thinning in the 4' × 4' plantings reduced subsequent mortality. The highest average periodic annual rate of mortality in the plantings thinned at age 8 occurred during the 2 years immediately following thinning. This rate, 1.2 per cent, compares with an average rate of 2.7 per cent per year in the unthinned 4' × 4' plantings during a 4-year period including the same ages (8 to 10 yrs. for thinned plots, 7 to 11 years for plots not thinned). During the year following salvage cutting, mortality in the plantings not thinned pre-commercially averaged 1.4 per cent, Figures 1 and 2. This may be compared with 0.4 per cent per year in the pre-commercially thinned plantings during the eleventh and

twelfth years.<sup>14</sup> The big difference occurred during the 12 to 19 year period, when mortality on the unthinned 4' × 4' plots was 39 per cent. This is almost 8 times as high as the mortality on the thinned plots (5 per cent) during the same period. From age 19 to 31 years, 36 per cent of the trees on the unthinned 4' × 4' plot were lost, 49 per cent died on the plot thinned first at age 19, and only 10 per cent died on the 4 plots thinned twice.

While severe early thinning obviously reduced mortality in the 4' × 4' plantings, it appears that thinning in the previously unthinned 19-year-old plot may have had the opposite effect. Although a comparison between two single plots cannot be conclusive, the difference, especially during the first 5 years after the time of thinning, is substantial. There was 43 per cent periodic mortality as against 21 per cent during the same period on the plot not thinned. In absolute figures, 64 of 309 trees (256 of 1,236 per acre) died on the unthinned plot, and 77 of 180 trees (308 of 720 per acre) on the thinned plot. There was a difference of only 1 tree (4 per acre) between the two plots immediately before thinning.

**Thinning and Survival in the 6' × 6' Plantings.** Early commercial thinning, both light and heavy, in the 6' × 6'

<sup>14</sup> These comparisons for short intervals are presented to show that during no subsequent comparable period of observation was average mortality as high on the plots thinned pre-commercially as on the other 4' × 4' plots. Records for exactly equivalent periods between age 8 and 12 years are not available.

TABLE 2. (Cont'd.) NUMBER OF TREES PER ACRE AT DIFFERENT PLANTATION AGES, SLASH PINE SPACING PLANTINGS

Age, years																Total trees cut, salv. and thinnings
12	12	12	14	14	14	15	15	18	18	19	19	19	24	31		
Cultural operation																
None	Comm. th.		None	Commercial thinning						None	Comm. thinning		None	None or Before	No.	
	Before	After		Before	After	Before	After	Before	After		Before	After				
No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	
2,018 <sup>4</sup>	---	---	1,976 <sup>2</sup>	---	---	---	---	---	---	---	1,238 <sup>2</sup>	---	---	---	---	
2,100	---	---	2,052	---	---	---	---	---	---	---	---	---	---	---	---	
1,936	---	---	1,900	---	---	---	---	---	---	1,236	---	---	980	792	112	
682	---	---	673	---	---	---	---	---	---	---	1,240	720	412	368	632	
975 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---	647	328	305	294	1,987	
966 <sup>2</sup>	---	---	938 <sup>2</sup>	---	---	---	---	---	---	---	---	---	---	---	---	
1,004	---	---	992	---	---	---	---	---	---	864	806 <sup>2</sup>	---	---	---	---	
928	---	---	884	---	---	---	---	---	---	---	---	---	788	668	120	
---	955	604	599	---	---	---	---	---	---	---	748	400	316	288	424	
---	1,006	427	417	---	---	---	---	---	---	---	549	302	286	274	672	
628 <sup>3</sup>	---	---	520 <sup>3</sup>	---	---	---	---	---	---	---	389	246	220	213	791	
---	---	---	988 <sup>3</sup>	---	---	---	---	---	---	364	---	---	272	208	48	
---	---	---	---	764 <sup>1</sup>	---	---	---	---	---	---	---	---	---	488	516	
---	---	---	---	804	636	---	---	---	---	---	---	---	---	456	---	
---	---	---	---	724	456	---	---	---	---	952	488	---	---	---	---	
524 <sup>1</sup>	---	---	519 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---	---	---	
520	---	---	515	---	---	---	---	---	---	---	---	---	---	---	---	
536	---	---	532	---	---	---	---	---	---	---	---	---	---	---	---	
378	---	---	376	---	---	---	---	---	---	---	---	---	---	---	---	
232	---	---	230	---	---	---	---	---	---	---	---	---	---	---	---	
140	---	---	140	---	---	---	---	---	---	---	---	---	---	---	---	
76	---	---	72	---	---	---	---	---	---	---	---	---	---	---	---	
---	---	---	---	---	---	---	---	---	---	72	---	---	---	68	68	4

<sup>1</sup> Average, all plots of specified spacing (with exceptions noted).

<sup>2</sup> Average, plots of specified spacing not thinned early.

<sup>3</sup> Not included in averages.

<sup>4</sup> Average no longer appropriate, following different thinning treatments.

plantings appeared to reduce mortality rates, but the evidence is not conclusive. There was no difference in mortality rate between light and heavy thinnings. During the 7-year period following thinning at age 12, average mor-

tality rates were 9 per cent on the 7 thinned plots and 17 per cent on the 2 plots not thinned early (6' x 6' E omitted). Though the difference between 9 and 17 per cent appears substantial, the ranges for individual plots in the two groups overlap. Furthermore, the curve for the plot not thinned early and tallied at different ages from the others (curve 6D on Figure 2) has a slope that indicates an even lower proportional mortality than the average of the thinned plots (curves 7 and 8 on Figure 3).

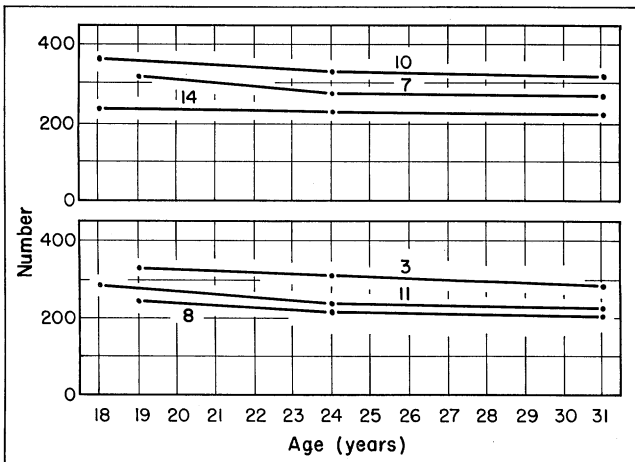


FIGURE 5. This is the number of trees per acre after time of later commercial thinning on plots thinned early. Curves on the chart give the following: curve 3, 4' x 4', 1 pre-commercial and 1 commercial thinning (4 plots); 7, 6' x 6', 2 commercial thinnings, first light (4 plots); 8, 6' x 6', 2 commercial thinnings, first heavy (3 plots); 10, 6' x 8', 2 commercial thinnings, first light (1 plot); 11, 6' x 8', 2 commercial thinnings, first heavy (1 plot); and 14, 8' x 8', 2 commercial thinnings, first light (1 plot).

During the first 5 years following the time of later commercial thinning, average mortality on 6' x 6' plots that had light and heavy early commercial thinnings was, respectively, 5 and 11 per cent. Ranges of the two groups overlap widely, and the overall range on the 7 plots is from 1 to 15 per cent. Averages for the next 7 years were 4 and 3 per cent, with overall range of 0 to 9 per cent. The one 6' x 6' plot never thinned (6' x 6' E not considered) had a 9 per cent periodic mortality for the first 5 years, near the average of the plots thinned twice, but jumped to 15 per cent for the next 7 years. The plot thinned first at age 18 showed no mortality over the 5 years, 6 per cent over the next 7 years. Considerably different was the plot thinned first at age 19, with a 21 per cent mortality rate for the first period and 9 per cent for the next. As on the 4' x 4' plots, more trees out of a smaller total died immediately following thinning on the plot first thinned at age 19 than on the plot never thinned. Together, evidence from the 4' x 4' and 6' x 6' spacings might be taken as an indication that delayed, drastic

TABLE 3. AVERAGE BREAST HEIGHT DIAMETER AT DIFFERENT PLANTATION AGES, SLASH PINE SPACING PLANTINGS

Plots	Plant space	Thin.	Age, years											
			6	7	8	8	9	10	10	11	11	12	12	12
			Cultural operation											
			None	None	Pre-comm. thinning		None	None	Salvage cutting			None	Comm. thinning	
Before	After	Cut			Before	After			Before	After				
No.	Ft.	No.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
6	4×4	<sup>1</sup>	---	2.4 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---
2	4×4	<sup>2</sup>	---	2.3 <sup>2</sup>	---	---	---	---	---	---	---	---	---	---
1	4×4	0	---	2.3	---	---	---	---	---	3.1 <sup>2</sup>	3.1 <sup>2</sup>	3.6 <sup>2</sup>	---	---
1	4×4	1	---	2.4	---	---	---	---	---	3.2	3.1	3.7	---	---
4	4×4	2	---	2.4	2.7	3.4	---	4.3	---	3.1	3.0	3.6	---	---
9	6×6	<sup>1</sup>	---	2.9 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---
2	6×6	<sup>2</sup>	---	2.9 <sup>2</sup>	---	---	---	---	---	---	---	---	---	---
1	6×6	0	---	3.1	---	---	---	---	---	4.2 <sup>1</sup>	4.1 <sup>1</sup>	---	4.7 <sup>1</sup>	---
1	6×6	1	---	2.7	---	---	---	---	---	4.2 <sup>2</sup>	4.1 <sup>2</sup>	4.7 <sup>2</sup>	---	---
4	6×6	2	---	2.7	---	---	---	---	---	4.4	4.3	4.8	---	---
3	6×6	2	---	3.1	---	---	---	---	---	4.1	4.0	4.5	---	---
1	6×6E	0 <sup>3</sup>	---	2.9 <sup>3</sup>	---	---	---	---	---	4.0	4.0	---	4.6	4.9
1	6×6D	1 <sup>3</sup>	1.8	---	---	---	3.0	---	4.0	---	---	---	4.8	5.6
2	6×8	2 <sup>1</sup>	2.3 <sup>1</sup>	---	---	---	---	3.7 <sup>1</sup>	---	---	---	---	---	---
1	6×8	2	2.2	---	---	---	---	3.7	---	---	---	---	---	---
1	6×8	2	2.4	---	---	---	---	3.7	---	---	---	---	---	---
4	8×8	<sup>1</sup>	---	2.6 <sup>1</sup>	---	---	---	---	---	4.3 <sup>1</sup>	4.2 <sup>1</sup>	5.0 <sup>1</sup>	---	---
3	8×8	1	---	2.5	---	---	---	---	---	4.1	4.0	4.8	---	---
1	8×8	2	---	3.0	---	---	---	---	---	4.6	4.6	5.4	---	---
2	9½×9½	1	---	3.0	---	---	---	---	---	5.2	5.2	5.8	---	---
2	12×12	1	---	3.6	---	---	---	---	---	5.8	5.8	6.9	---	---
2	16×16	1	---	3.4	---	---	---	---	---	6.1	6.1	7.2	---	---
1	19×19	0	---	2.4	---	---	---	---	---	4.3	4.2	5.8	---	---

<sup>1</sup> Average, all plots of specified spacing (with exceptions noted).

<sup>2</sup> Average, all plots of specified spacing not thinned early.

<sup>3</sup> Not included in average.

<sup>4</sup> Average no longer appropriate, following different thinning treatments.

Continued

thinning in these heavily stocked plantations may have hastened the death of some of the released trees.

**Thinning and Survival in the 6' × 8' and 8' × 8' Plantings.** Mortality for the 4-year period between thinnings was 3.1 per cent on the 6' × 8' plot first thinned lightly, 2.6 per cent on the plot first thinned heavily. Mortality was 8 and 13 per cent, respectively, on the two plots during the first 6 years following the second thinning, 3.3 and 2.4 per cent during the next 7 years.

Among the four 8' × 8' plots, the one thinned twice had 4 per cent mortality during the 4 years between thinnings. The remaining 3 plots, thinned once, averaged 8 per cent mortality during the 5-year period ending at the same time. The plot that had been thinned twice had no mortality during the first 5 years following second thinning. The 3 plots thinned only once had an average of 6 per cent mortality during the period, but one of the 3 had no mortality. During the last 7 years the plots thinned once had 2.0 per cent mortality, the plot thinned twice, 1.7 per cent.

For spacings wider than 8' × 8', there are no comparisons between thinning treatments to be made.

#### Tree Diameters<sup>15</sup>

**Original Spacing and d.b.h. at Age 7 Years.** On all but 3 plots the earliest record of tree diameters is for age 7

<sup>15</sup> Average diameter was determined by calculating the diameter of the tree of average basal area.

years. Diameters were recorded for age 6 on plot 6' × 6' D, which is the one thinned at a different age from most others, and on the two 6' × 8' plots. The age 6 averages are 1.8 inches for 6' × 6' D and 2.3 inches for the 6' × 8' plots. Age 7 averages for different spacings are:

- 4' × 4' , 2.4 inches (6 plots, range 2.2 to 2.5 inches);
- 6' × 6' , 2.9 inches (9 plots, range 2.1 to 3.4 inches);
- 8' × 8' , 2.6 inches (4 plots, range 2.4 to 3.0 inches);
- 9½' × 9½' , 3.0 inches (2 plots, 2.6 and 3.3 inches);
- 12' × 12' , 3.6 inches (2 plots, 3.2 and 3.8 inches);
- 16' × 16' , 3.4 inches (2 plots, 3.1 and 3.8 inches); and
- 19' × 19' , 2.4 inches (1 plot).

There is little evidence that average diameter had been materially affected by spacing as early as age 7. The range of the 6' × 6' plots (6' × 6' E omitted) overlaps the range of every other spacing, and it includes all the averages except the 12' × 12'. On the 26 individual plots, the coefficient of correlation between average diameter and average growing space per tree alive at age 7 is .256. An equal or greater coefficient could occur about 21 times per 100 samples of this size where no correlation exists.

**Original Spacing and d.b.h. at Age 11 and 12 Years.** By age 11 there had begun to appear some relationship

TABLE 3 (Cont'd.) AVERAGE BREAST HEIGHT DIAMETER AT DIFFERENT PLANTATION AGES, SLASH PINE SPACING PLANTINGS

Age, years											
14	14	14	15	15	18	19	19	19	24	31	
Cultural operation											
None	Commercial thinning						None	Comm. thinning		None	None or Before
	Before	After	Before	After	Before	After		Before	After		
In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
---	---	---	---	---	---	---	---	---	---	---	---
4.0 <sup>2</sup>	---	---	---	---	---	---	---	5.3 <sup>2</sup>	---	---	---
4.0	---	---	---	---	---	---	5.4	---	---	6.2	7.0
3.9	---	---	---	---	---	---	---	5.1	5.5	6.9	8.2
5.4	---	---	---	---	---	---	---	6.3	6.9	7.9	8.9
---	---	---	---	---	---	---	---	---	---	---	---
5.4 <sup>2</sup>	---	---	---	---	---	---	---	6.3 <sup>2</sup>	---	---	---
5.5	---	---	---	---	---	---	6.4	---	---	7.1	7.7
5.3	---	---	---	---	---	---	---	6.3	6.9	7.8	8.7
5.7	---	---	---	---	---	---	---	6.7	7.3	8.4	9.4
6.4	---	---	---	---	---	---	---	7.6	7.9	9.1	10.4
6.7 <sup>2</sup>	---	---	---	---	---	---	---	---	---	9.7	11.6
4.7 <sup>3</sup>	---	---	---	---	5.5	5.9	---	---	---	6.9	8.2
---	5.6 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---
---	5.5	5.4	---	---	6.4	6.6	---	---	---	7.8	8.9
---	5.6	5.8	---	---	6.9	7.0	---	---	---	8.2	9.5
---	---	---	---	---	---	---	---	---	---	---	---
5.7 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---	---
5.5	---	---	---	---	---	---	---	6.6	7.1	8.0	8.9
6.1	---	---	6.4	6.4	---	---	---	7.2	7.9	9.2	10.2
6.6	---	---	---	---	---	---	---	8.0	8.2	9.2	10.3
7.7	---	---	---	---	---	---	---	9.1	9.0	10.4	11.8
8.3	---	---	---	---	---	---	---	10.1	10.0	11.5	12.8
6.9	---	---	---	---	---	---	9.4	---	---	11.1	12.8

<sup>1</sup> Average, all plots of specified spacing (with exceptions noted).

<sup>2</sup> Average, plots of specified spacing not thinned early.

<sup>3</sup> Not included in average.

<sup>4</sup> Average no longer appropriate, following different thinning treatments.

between spacing and diameter, Table 3.<sup>16</sup> At age 12, a definite pattern of increasing average diameter with wider spacing had developed:

- 4' × 4' , 3.6 inches (2 plots not pre-c. th., 3.6 and 3.7 inches);
- 6' × 6' , 4.7 inches (9 plots, range 4.3 to 5.0 inches);
- 8' × 8' , 5.0 inches (4 plots, range 4.6 to 5.4 inches);
- 9½' × 9½', 5.8 inches (2 plots, 5.4 and 6.2 inches);
- 12' × 12', 6.9 inches (2 plots, 6.6 and 7.1 inches);
- 16' × 16', 7.2 inches (2 plots, 6.8 and 7.6 inches); and
- 19' × 19', 5.8 inches (1 plot).

Based on the data from 22<sup>17</sup> individual plots, there is a highly significant correlation between age 12 average diameter before thinning and average growing space per tree at age 7 (observed  $r = .679$ ;  $r_{.01} = .537$ ).

**Original Spacing and d.b.h. after Age 12 Years.** Subsequent to age 12, differences in diameter between differ-

<sup>16</sup> In most cases, salvage cutting resulted in an immediate slight reduction in average diameter. The reason for this is a generally recognized tendency for rapidly growing slash pines to be more susceptible to fusiform rust than slower growing trees in the same stand. Because additional rust cankered trees were found and removed in the commercial thinnings, the same explanation applies where the thinnings resulted in slight reduction or no immediate change in diameter. Otherwise, the essentially low thinnings would invariably have resulted in immediate increase in average d.b.h.

<sup>17</sup> Not included are 6' × 6' E, 4 plots thinned pre-commercially, and 3 plots not tallied at age 12.

ent spacings with similar thinning histories increased, in most cases fairly steadily. By age 31 the overall range in plot averages was from 7.0 inches on the 4' × 4' plot never thinned to 13.0 inches on one of the two 16' × 16' plots. However, there was not much spread among plots thinned twice, Table 3.

The exceptional plot (6' × 6' E) had trees of larger diameter than others of the same spacing at all ages of 12 years and more. This is commensurate with the high quality of the site occupied by the plot and with the relatively low stocking due to high mortality. Only the 3 widest spacings had trees of larger average diameter than did 6' × 6' E.

**Thinning and d.b.h., 4' × 4' Plantings.** There is little doubt that pre-commercial thinning in the 4' × 4' plantings resulted in increased average diameter. In the first place, the average diameter of trees left after the age 8 thinning was 3.4 inches, 21 per cent greater than the stand average before thinning. Secondly, mean annual increase on thinned plots during the 4 years from age 8 to 12 was 44 per cent greater than the annual increase on unthinned plots during the 5-year period ending at the same time. At the beginning of this 5-year period (age 7), there was only 0.1 inch difference between the averages of thinned and unthinned plots. Plots not thinned pre-commercially were not measured at age 8, so a comparison between identical periods cannot be made. At the end of the pe-

riods the difference was 1.3 inches. During the 2-year period from age 12 to 14, the average diameter increase was 25 per cent greater on the thinned plots than on the unthinned plots.

During the next 5 years, from age 14 to 19, there was a reversal. Diameter increase on thinned 4' × 4' plots was 44 per cent less than increase in the unthinned plots. Nevertheless, during the entire period from first measurement or thinning to age 19 annual diameter increase on thinned plots was 5 per cent greater than the increase on unthinned plots. The reversal during the 14 to 19 year age period resulted from high mortality among small trees on the unthinned plots rather than from any faster diameter growth of trees on the unthinned plots.

During the 19 to 31 year age period, diameter increases on the unthinned, once-thinned, and twice-thinned 4' × 4' plots averaged 1.6, 2.7, and 2.0 inches, respectively. Here, as on the unthinned plots during an earlier period, the relatively large increase on the plot thinned only at age 19 was related to high mortality among the smallest trees.

**Thinning and d.b.h., 6' × 6' Plantings.** In the 6' × 6' plantings (6' × 6' E omitted) diameters were progressively larger with increased intensity of thinning at every measurement interval after thinnings were begun, Table 3. Light early commercial thinning resulted in an immediate average diameter increase of 0.3 inch; heavy early commercial thinning, an increase of 0.8 inch. Periodic increases from age 12 to 19 years were:

- no early thinning , 1.6 inches (2 plots, 1.6 and 1.8 in.);
- light early thinning , 1.8 inches (4 plots, range 1.6 to 1.9 inches);
- heavy early thinning, 2.0 inches (3 plots, each 2.0 inches).

Age 19 thinning resulted in immediate average increases of 0.6 inch both on the plot not thinned before and on the plots thinned lightly before. The increase averaged 0.3 inch in the plots thinned heavily before. Periodic increases from age 19 to 31 were:

- no thinning , 1.3 inches (1 plot);
- one thinning, age 19 , 1.8 inches (1 plot);
- 2 thinnings, first light , 2.1 inches (4 plots, range 1.8 to 2.3 inches);
- 2 thinnings, first heavy, 2.5 inches (3 plots, range 2.3 to 2.7 inches).

**Thinning and d.b.h., 6' × 8' and Wider Spacings.** There appears to be no substantially different effect on diameter of the two intensities of early thinning in the 6' × 8' plantings. Diameter comparisons between early thinning and no early thinning in the 8' × 8' plantings are not valid because of the large difference in site quality. No thinning comparisons are applicable in the spacings wider than 8' × 8'.

### Tree Heights

**Height and Spacing.** It is recognized that height of trees at a given age is related more closely to site quality than to stand density. In the slash pine spacing plots there is little evidence that either original spacing or number of trees surviving the first few years had any appreciable ef-

fect on height growth.<sup>18</sup> There was essentially no correlation between average growing space per tree alive at age 7 and average height at age 11 ( $r = -.022$  for 22<sup>19</sup> plots. An equal or greater  $r$  could occur more than 90 times per 100 samples of this size where no correlation exists.) Average height of all trees at age 31 was 65 feet. The range for individual plots was 56 to 80 feet. Heights at different ages are given in Table 4.

**Height and Thinning.** The slight apparent increase in height associated with thinning in the closer spacings is a direct result of removal of the smaller trees. It probably does not represent any stimulation of height growth.

### Basal Area

**Original Spacing and Basal Area.** Basal area is a function of number of trees and diameter.<sup>20</sup> It follows that trends in basal area per acre fall between the trends in number of trees per acre and average diameter. It may be recalled from previous sections that proportional mortality tended to decrease and diameter to increase with increasingly wide spacings. These trends tend to equalize basal area for different spacings. Nevertheless, there are substantial differences, Figures 6-9. The greatest proportional differences appeared at the young ages, before spacing had greatly affected mortality and diameter. At age 7 years the plot averages ranged from 3 square feet (the 19' × 19' plot) to 80 square feet (a 4' × 4' plot), almost a 27-fold difference. At age 31 the extremes were 61 square feet (the 19' × 19' plot) and 217 square feet (6' × 6' never thinned) a less than 4-fold difference.

Although all spacings do not appear exactly in the expected places at all ages, the graphs show an obvious trend of substantially greater basal areas with closer spacings.

**Thinning and Basal Area.** A direct and immediate result of any thinning is reduction in basal area. In fact, basal area reduction is a commonly used measure of thinning intensity. Following are the basal area percentages removed by thinnings in the slash pine spacing plantations.

4' × 4', one thinning:	age 19, 34 per cent.
4' × 4', two thinnings:	age 8, 54 per cent; age 19, 40 per cent.
6' × 6', one thinning:	age 19, 36 per cent (6' × 6' D - age 18, 40 per cent).
6' × 6', two thinnings:	age 12, 27 per cent; age 19, 36 per cent.
6' × 6', two thinnings:	age 12, 44 per cent; age 19, 31 per cent.
6' × 8', two thinnings:	age 14, 22 per cent; age 18, 36 per cent.
6' × 8', two thinnings:	age 14, 33 per cent; age 18, 30 per cent.
8' × 8', one thinning:	age 19, 36 per cent.
8' × 8', two thinnings:	age 15, 23 per cent; age 19, 28 per cent.

<sup>18</sup> Height records are not accurate enough for comparisons of periodic increases. Some plot averages are based on samples instead of all trees.

<sup>19</sup> The 4 plots thinned pre-commercially and 4 others not tallied at these ages are not included.

<sup>20</sup> Basal area of a tree =  $0.005454$  (d.b.h.)<sup>2</sup>, basal area expressed in square feet and diameter at breast height in inches.



TABLE 4. AVERAGE TOTAL HEIGHT OF ALL TREES AT DIFFERENT AGES, SLASH PINE SPACING PLANTATIONS

Plots	Plant space	Thin.	Age, years													
			3	9	10	11	12	12	14	14	18	19	19	24	31	
			Cultural operation													
No.	Ft.	No.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	
6	4×4	<sup>1</sup>	3 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---	---	---	---
2	4×4	<sup>2</sup>	3 <sup>2</sup>	---	---	25 <sup>2</sup>	33 <sup>2</sup>	---	---	---	---	---	---	---	---	---
1	4×4	0	3	---	---	25	33	---	---	---	---	---	---	---	---	---
1	4×4	1	3	---	---	25	32	---	---	---	---	---	---	---	---	---
4	4×4	2	2	---	30	---	---	---	---	---	---	---	---	---	---	---
9	6×6	<sup>1</sup>	3 <sup>1</sup>	---	---	28 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---
2	6×6	<sup>2</sup>	3 <sup>2</sup>	---	---	29 <sup>2</sup>	33 <sup>2</sup>	---	---	---	---	---	---	---	---	---
1	6×6	0	3	---	---	30	34	---	---	---	---	---	---	---	---	---
1	6×6	1	2	---	---	27	32	---	---	---	---	---	---	---	---	---
4	6×6	2	3	---	---	28	---	---	---	---	---	---	---	---	---	---
3	6×6	2	3	---	---	29	---	---	---	---	---	---	---	---	---	---
1	6×6E	0 <sup>3</sup>	3 <sup>3</sup>	---	---	31	36	---	---	---	---	---	---	---	---	---
1	6×6D	1 <sup>3</sup>	---	21	---	---	---	---	---	---	---	---	---	---	---	---
2	6×8	2 <sup>1</sup>	---	23 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---	---	---
1	6×8	2	---	23	---	---	---	---	---	---	---	---	---	---	---	---
1	6×8	2	---	23	---	---	---	---	---	---	---	---	---	---	---	---
4	8×8	<sup>1</sup>	2 <sup>1</sup>	---	---	25 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---
3	8×8	1	2	---	---	24	---	---	---	---	---	---	---	---	---	---
1	8×8	2	2	---	---	28	---	---	---	---	---	---	---	---	---	---
2	9½×9½	1	2	---	---	29	33	---	---	---	---	---	---	---	---	---
2	12×12	1	3	---	---	32	35	---	---	---	---	---	---	---	---	---
2	16×16	1	3	---	---	30	34	---	---	---	---	---	---	---	---	---
1	19×19	0	2	---	---	23	30	---	---	---	---	---	---	---	---	---

<sup>1</sup> Average, all plots of specified spacing (with exceptions noted).

<sup>2</sup> Average, all plots of specified spacing not thinned early.

<sup>3</sup> Not included in average.

<sup>4</sup> Average no longer appropriate, following different thinning treatments.

9½' × 9½', one thinning: age 19, 30 per cent.

12' × 12', one thinning: age 19, 31 per cent.

16' × 16', one thinning: age 19, 23 per cent.

Actual basal areas before and after thinning appear in Table 5.

Basal area increment following thinning was, in most cases, less rapid than increment on plots of the same spacing not thinned. In the 4' × 4' plantings thinned pre-commercially at age 8, basal area per acre increased at an average rate of 10.7 square feet per acre per year for the next 6 years. On plots not thinned pre-commercially, the average is 12.3 square feet for the same period.<sup>21</sup> Similar differences in favor of the unthinned plots hold for all possible subdivisions of the 6-year period following pre-commercial thinning.

After age 14, there was a reversal. Basal area increment during the 14- to 19-year period was 3.2 square feet per acre per year in the unthinned 4' × 4' plantings, 6.6 square feet in the thinned plantations. By age 19

<sup>21</sup> Based on the assumption that the two groups of plots increased at the same rate from age 7, when both groups had the same average basal area, until age 8. Actual increase from age 7 to 14 years on the plots not thinned pre-commercially averages 13.7 square feet per acre per year, not including the 11 square feet per acre removed in the salvage cut on the unthinned plots. Inclusion of the salvaged basal area would further increase the apparent difference between thinning treatments.

there was a net balance in basal area growth of only 4 square feet per acre in favor of the plots not previously thinned.

During the 5-year period immediately following commercial thinning at age 19, basal area on the plots thinned pre-commercially increased at an average rate of 3.4 square feet per acre per year to a total of 102 square feet per acre. On the plot never thinned basal area increased from 197 to 208 square feet per acre, an annual rate of 2.2 square feet. The plot thinned for the first time at age 19, its basal area reduced from 176 to 117 square feet by thinning, suffered a subsequent decrease to 106 square feet at age 24, a periodic annual rate of 2.2 (negative). This decrease reflects the high mortality that followed thinning, possibly a result of drastic cutting in the heavily over-stocked stand.

The 4' × 4' plantings thinned twice maintained the average annual increase of 3.4 square feet per acre for the final 7-year period to attain a total basal area of 126 square feet at age 31. The plot thinned once, its trees apparently recovering vigor to utilize extra growing space, increased in basal area at a periodic annual rate of 4.1 square feet, while the plot never thinned increased at only 1.0 square foot during the final 7 years. In the entire 12-year period following thinning, the unthinned and once thinned plots showed the same average increase, 1.5 square feet per year, to attain basal areas respectively of 215 and 135 square feet per acre at age 31.

TABLE 5. BASAL AREA PER ACRE AT DIFFERENT PLANTATION AGES, SLASH PINE SPACING PLANTINGS

Plots	Plant space	Thin.	Age, years															
			6	7	8	8	9	10	10	11	11	12	12	12				
			Cultural operation															
			None	None	Pre-comm. thinning		None	None	Salvage cutting			None	Comm. thinning					
Before	After	Cut			Before	After			Before	After								
<i>No.</i>	<i>Ft.</i>	<i>No.</i>	<i>Square feet</i>															
6	4×4	1 <sup>1</sup>	---	74 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	4×4	2 <sup>2</sup>	---	74 <sup>2</sup>	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1	4×4	0	---	70	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1	4×4	1	---	79	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	4×4	2	---	74	96	44	---	---	---	---	---	---	---	---	---	---	---	---
9	6×6	1 <sup>1</sup>	---	49 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	6×6	2 <sup>2</sup>	---	50 <sup>2</sup>	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1	6×6	0	---	58	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1	6×6	1	---	42	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	6×6	2	---	44	---	---	---	---	---	---	---	---	---	---	---	---	---	---
3	6×6	2	---	57	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1	6×6E	0 <sup>3</sup>	---	36 <sup>3</sup>	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1	6×6D	1 <sup>3</sup>	20	---	---	---	---	52	---	---	---	---	---	---	---	---	---	---
2	6×8	2 <sup>1</sup>	24 <sup>1</sup>	---	---	---	---	59 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---
1	6×8	2	23	---	---	---	---	60	---	---	---	---	---	---	---	---	---	---
1	6×8	2	24	---	---	---	---	58	---	---	---	---	---	---	---	---	---	---
4	8×8	1 <sup>1</sup>	---	21 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---	---	---	---	---
3	8×8	1	---	19	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1	8×8	2	---	28	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	9½×9½	1	---	20	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	12×12	1	---	18	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	16×16	1	---	10	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1	19×19	0	---	3	---	---	---	---	---	---	---	---	---	---	---	---	---	---

<sup>1</sup> Average, all plots of specified spacing (with exceptions noted).

<sup>2</sup> Average, all plots of specified spacing not thinned early.

<sup>3</sup> Not included in average.

<sup>4</sup> Average no longer appropriate, following different thinning treatments.

Continued

During the 7-year period following early commercial thinning in the 6' × 6' plantings, average annual basal area increment was 7.1 square feet per acre on plots thinned heavily (to about 400 trees per acre) and 8.3 square feet on plots thinned more lightly (to about 600 trees per acre). The increment was 8.6 square feet for the same period on plots not thinned. Most of the difference in rates occurred during the first 2 years after time of thinning. Respectively, annual rates for heavy, light, and no early thinning were 10.5, 13.5, and 16.0 for the first 2 years; 5.8, 6.2, and 5.6 for the next 5-year period, ending at age 19.

From age 19 to 24 years, the most rapid basal area increment in the 6' × 6' plantings was on the plot never thinned. The average annual rate was 4.8 square feet per acre. On the plot first thinned at age 19, its basal area reduced from 160 to 103 square feet per acre by the thinning, increment was negligible, leading to 105 square feet per acre at age 24. Apparently recovering, this once thinned plot increased at an annual rate of 1.9 square feet during the final 7 years to 118 square feet per acre at age 31. Meanwhile, the unthinned plot increased hardly at all, from 216 square feet at age 24 to 217 square feet at age 31. Rates of basal area increase from age 19 to 31 were 2.1 square feet per acre per year on the plot never thinned and 1.2 square feet on the plot thinned once.

On the plots thinned twice, the early thinning light, average basal area per acre increased from 86 square feet after the age 19 thinning to 133 square feet at age 31, an annual rate of 3.9 square feet. On plots thinned twice, the early thinning heavy, the increase was from 84 to 126 square feet, an annual rate of 3.5 square feet.

In the 6' × 8' spacing, basal area gain was more rapid on the lightly thinned plot than on the heavily thinned plot, both between thinnings and following the second thinning. The average annual increment rates were 8.8 and 7.5 square feet per acre respectively between thinnings and 4.2 and 2.5 square feet during the 12-year period following later thinning. At age 31, basal area stocking was 142 square feet per acre on the plot first thinned lightly and 113 square feet on the plot first thinned heavily.

Since the 8' × 8' plots thinned only once were not measured at age 15, when the other plot got an early thinning, there is no direct comparison for the period between time of early and later thinning. Average annual basal area increment from age 14 to 19 was 5.4 square feet per acre on the plots not thinned early. It was 5.2 square feet per acre from age 15 to 19 on the plot that had a light early thinning. During the 12-year period following later thinning, annual increment was 2.8 square feet per acre on the once-thinned plots and 4.2 square feet

TABLE 5 (Cont'd.) BASAL AREA PER ACRE AT DIFFERENT PLANTATION AGES, SLASH PINE SPACING PLANTINGS

Age, years											
14	14	14	15	15	18	18	19	19	19	24	31
Cultural operation											
None	Commercial thinning						None	Comm. thinning		None	None or Before
	Before	After	Before	After	Before	After		Before	After		
Square feet											
---	---	---	---	---	---	---	---	---	---	---	---
170 <sup>2</sup>	---	---	---	---	---	---	---	186 <sup>2</sup>	---	---	---
181	---	---	---	---	---	---	197	---	---	208	215
159	---	---	---	---	---	---	---	176	117	106	135
108	---	---	---	---	---	---	---	141	85	102	126
---	---	---	---	---	---	---	---	---	---	---	---
148 <sup>2</sup>	---	---	---	---	---	---	---	176 <sup>2</sup>	---	---	---
163	---	---	---	---	---	---	192	---	---	216	217
133	---	---	---	---	---	---	---	160	103	105	118
107	---	---	---	---	---	---	---	138	86	106	133
93	---	---	---	---	---	---	---	122	84	100	126
127 <sup>3</sup>	---	---	---	---	---	---	136 <sup>3</sup>	---	---	141	152
117 <sup>3</sup>	---	---	---	---	156	94	---	---	---	128	166
---	129 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---
---	132	103	---	---	138	88	---	---	---	110	142
---	125	84	---	---	114	80	---	---	---	89	113
91 <sup>1</sup>	---	---	---	---	---	---	---	---	---	---	---
86	---	---	---	---	---	---	---	113	72	88	105
108	---	---	118	91	---	---	---	112	81	109	132
90	---	---	---	---	---	---	---	124	86	104	126
74	---	---	---	---	---	---	---	102	70	92	97
52	---	---	---	---	---	---	---	78	60	78	89
19	---	---	---	---	---	---	35	---	---	46	61

<sup>1</sup> Average, all plots of specified spacing (with exceptions noted).

<sup>2</sup> Average, plots of specified spacing not thinned early.

<sup>3</sup> Not included in average.

<sup>4</sup> Average no longer appropriate, following different thinning treatments.

on the twice-thinned plot, representing increases from 72 to 105 and 81 to 132 square feet per acre.<sup>22</sup>

## YIELDS OF SLASH PINE SPACING PLANTATIONS

### Introduction

Volume yields, however measured, are affected by such a variety of factors that direct comparisons between different spacings and cultural treatments can be misleading. Much of the irregularity is a result of differences in site quality. Averages are presented, but the reader is cautioned to accept them for what they are, part of a historical summary of the Auburn Plantations. By no means are they yield tables in the conventional sense.

Stand volumes presented were computed from volume tables for second growth slash pine (12). Pulpwood cut was actually scaled, in stacks. For the sake of conformity with early records, pulpwood volumes include trees in the 4-inch diameter class (d.b.h. 3.6 to 4.5 inches), even though they are not generally considered merchantable. In no case does the 4-inch class add appreciably to total pulpwood yield of a plot.<sup>23</sup> Total yields are volumes cut added to standing volume.

<sup>22</sup> The fact that the twice-thinned plot had the highest basal area left after later thinning in the four 8' x 8' plots was not an intended result. It is probably associated with the relatively low site quality of the once-thinned plots.

ably to total pulpwood yield of a plot.<sup>23</sup> Total yields are volumes cut added to standing volume.

**Pulpwood.** The principal commercial product of young pine plantations is pulpwood. For the slash pine spacing plantations, yields are summarized in Table 6. Highest total yield through age 31 was on the 6' x 6' plot not thinned, 85 cords per acre including 4 cords removed in the salvage cut. The pulpwood yield on plot 6' x 6' E, which also was not thinned but occupied a high quality site with trees subjected to exceptional competition, was 64 cords per acre. Second highest yield, 80 cords per acre, was on the 4' x 4' plot not thinned. Lowest yield, 21 cords per acre, was on the 19' x 19' plot, which was not thinned.

Among the plantings that were thinned once, there is a fairly steady decline in total pulpwood yield from close to wider spacing. Only the 8' x 8' plots are out of line, and this might be explained by their lower than average site quality. Direct comparisons between spacings in the plantings thinned twice have little meaning, for the critical early thinnings were made at different ages.

<sup>23</sup> Tabular volumes for the 4-inch class have allowances for the fact that some trees in the class do not contain a merchantable stick of pulpwood. Strict adherence to a 4.0 inch minimum diameter limit for pulpwood sticks (5'3" long) stacked for scaling provided a similar allowance in the volume cut.

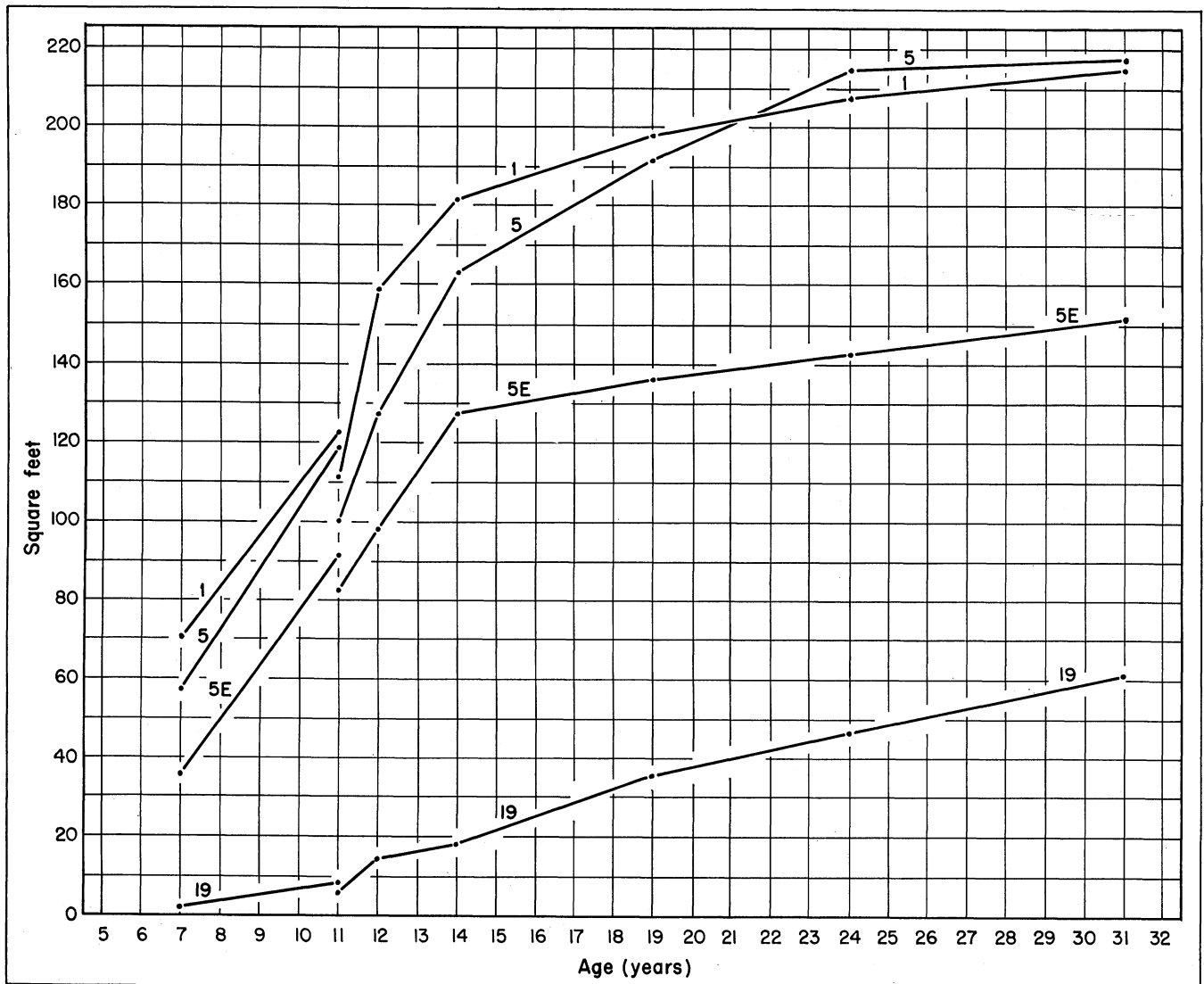


FIGURE 6. This chart gives the basal area per acre on plots never thinned. Curves on chart give the following: curve 1, 4' x 4', no thinning (1 plot); 5, 6' x 6', no thinning

(1 plot); 5E, 6' x 6' E, no thinning (1 plot); and 19, 19' x 19', no thinning (1 plot).

In the 4' x 4' spacing, two thinnings gave the lowest total yield, no thinning gave the highest. The 4' x 4' plot thinned only at age 19 shows a relatively small increment immediately following thinning, possibly from shock of the severe thinning.

Highest yield in the 6' x 6' spacing also came with no thinning. However, plots thinned twice gave a slightly higher average yield than plots thinned only once. Plots thinned once are on sites of lower quality, and the one thinned at age 19 shows a relatively small increment following drastic thinning. However, the age 18 thinning in the other plot (6' x 6' D) caused no such setback.

In the 6' x 8' spacing, light early thinning may have resulted in a higher yield than heavy early thinning. The difference in yield appears to be greater than should be attributed to the small difference in site quality.

In the 8' x 8' spacing, the plot thinned twice gave the highest yield. It is on a much better site than the 3 plots thinned only once.

**Sawtimber.** Sawtimber volumes at time of the last 3 measurements are presented in Table 7. Although a few sawtimber size trees were cut in the later thinnings, no sawtimber volume cut is shown. The amount was not sufficient for a commercially operable sawtimber cut. Therefore the material was scaled as pulpwood.

The volume tables used in the computation of sawlog volumes include the 7-inch diameter class as their minimum limit. Under most circumstances the 9-inch class is more nearly the minimum merchantable size. Volumes to both minima are presented. The scale in which volumes are expressed is based on the International (1/4-inch kerf) log rule, which closely approximates actual lumber output attainable in a well run, properly adjusted sawmill. Volumes are gross scale, that is, no deduction for defect was made. The reader who wishes to make comparisons on a different basis can derive volumes by other rules and to other limits of merchantability from the stand tables (Appendix B).

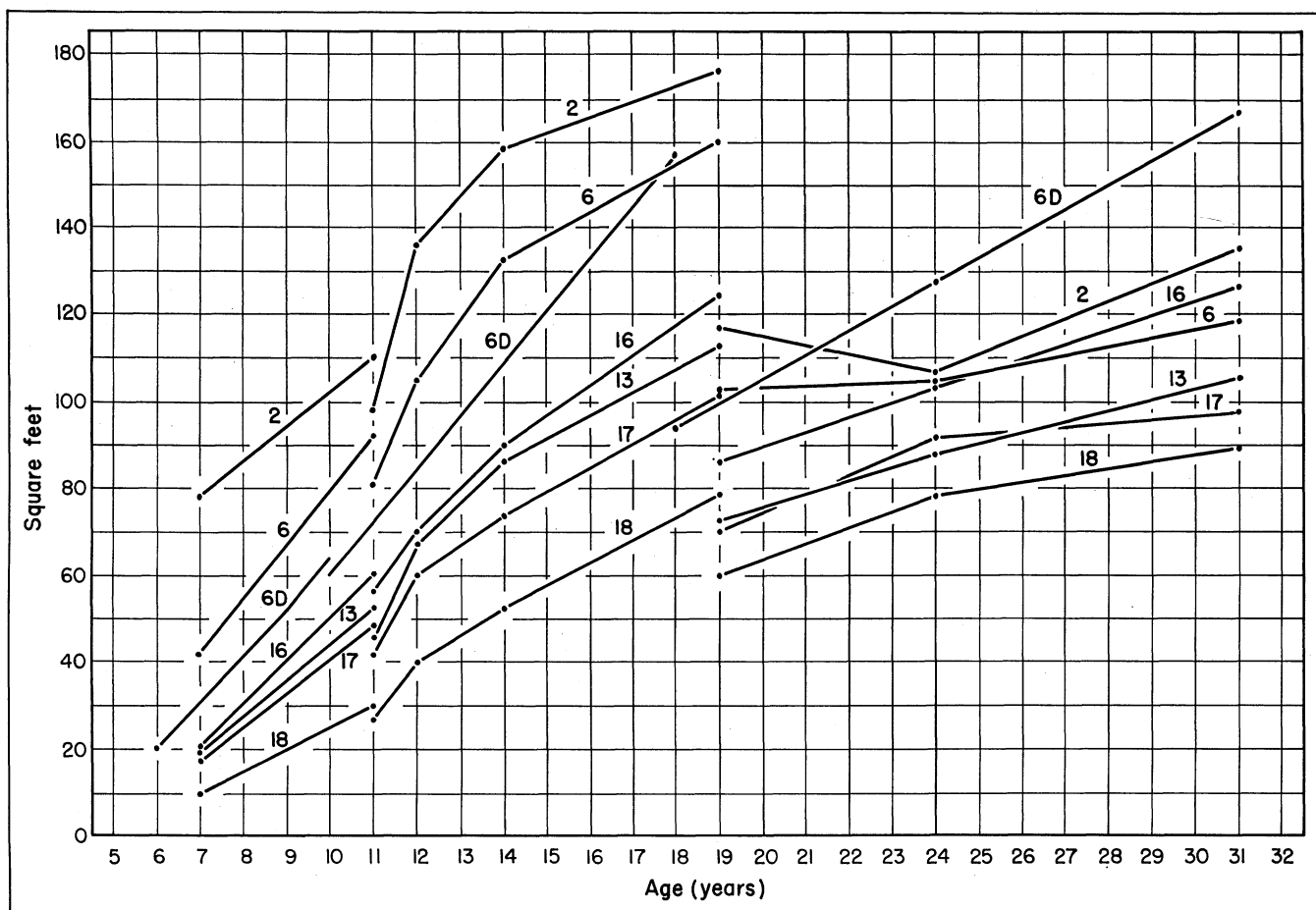


FIGURE 7. This chart gives the basal area per acre on plots thinned once. Curves in the chart present the following: curve, 2, 4' x 4', 1 commercial thinning (1 plot); 6, 6' x 6', 1 commercial thinning (1 plot); 6D, 6' x 6' D, 1 commercial

thinning (1 plot); 13, 8' x 8', 1 commercial thinning (3 plots); 16, 9½' x 9½', 1 commercial thinning (2 plots); 17, 12' x 12', 1 commercial thinning (2 plots); and 18, 16' x 16', 1 commercial thinning (2 plots).

Sawtimber yields show relatively smaller variations between spacings than do pulpwood yields. This is to be expected because sawtimber volume varies more with diameter difference, and the generally greater diameters of the wider spacings tend to compensate for the lower basal areas.

**Cubic Volume.** Total cubic volume yields of stemwood are summarized in Table 8. The trend is toward greater volumes at closer spacings. It is probable that thinning had no appreciable effect on total volume yields.

### Other Plantings

**Eroded Field Plantings.** In Table 9 are presented pulpwood yields of the 1927 plantings, of locally grown seedlings, made on a severely eroded field. Planting spacing was 6' x 6'. Slash pine gave the highest yield of the three species planted. Growth of shortleaf pine was so slow that no thinnings were made before the last measurement.

With both slash and loblolly pine, increment between thinnings was higher on plots that had light first thinnings than on plots that had heavy first thinnings. There was a reversal following the second thinning, and total yields are not substantially different.

**Planting of 4 Species in Single Row Mixture.** The long, narrow plot extends from near the top of a ridge to a moist flat, or well-drained bottom. Actually, the flat is roughly midway, both in distance and elevation, between the ridge crest and a permanent stream. Planting rows extend the length of the plot, and there are 3 repetitions of the sequence, shortleaf pine, longleaf pine, slash pine, and loblolly pine. Planting spacing is 6' x 6'. The plot has had two commercial thinnings, at age 18 and 25 years.

The plot is subdivided into 4 topographic situations, Table 10. The upper slope is a gently sloping area adjacent to the loblolly pine eroded field planting. The middle slope has almost the same appearance, but presumably has somewhat better soil conditions. The lower slope is steeper and is very badly eroded. The bottom is almost flat.

On the upper slope, slash pine makes up most of the dominant stand and has given the highest yield of the 4 species. On all other situations, loblolly pine has given the highest yield. However, there is a complicating factor. Adjacent to the plot edge along the middle and lower slopes is a woods trail that provides the outside row of loblolly pine freedom from competition on one side. This outside row accounts for more than its proportional share of the volume. Slash pines are generally larger and taller



FIGURE 8. This chart gives the basal area per acre on plots thinned twice, early thinning light commercial. Curves in the chart present the following: curve 7, 6' x 6', 2 commercial thinnings, first light (4 plots); 10, 6' x 8', 2 commercial thinnings, first light (1 plot); and 14, 8' x 8', 2 commercial thinnings, first light (1 plot).

than loblolly pines of inside rows on all the slope situations. On the flat, however, loblolly pines of all rows are usually larger.

As is to be expected because of its early growth characteristics, longleaf pine made a negligible contribution to yield from this mixed planting. There are only a few longleaf pines still living. Shortleaf pine made a relatively

small, but more than negligible contribution to yield. Living shortleaf pines are present in some number, but they are small in relation to loblolly and slash. Highest relative and absolute per acre yield of shortleaf pine was on the upper slope, where one outside row had an advantage similar to that of loblolly pine on the middle and lower slopes.

TABLE 6. PULPWOOD VOLUME PER ACRE AT DIFFERENT AGES AND TOTAL 31-YEAR YIELD, SLASH PINE SPACING PLANTINGS

Plots	Plant space	Thin.	Age, years											
			9	10	11	12	12	14	14	15	15	18	18	
			Cultural operation											
			None	Salvage		Early commercial thinning		None	Early commercial thinning			Later commercial thinning		
No.	Ft.	No.	Cut	Cut	Cut	Left	Cut	Cut	Left	Cut	Left			
													Cords per acre	
1	4x4	0	---	---	2.8	---	---	---	---	---	---	---		
1	4x4	1	---	---	3.2	---	---	---	---	---	---	---		
4	4x4	2	---	---	---	---	---	---	---	---	---	---		
1	6x6	0	---	---	4.0	---	---	---	---	---	---	---		
1	6x6	1	---	---	2.4	---	---	---	---	---	---	---		
4	6x6	2	---	---	2.7	3.0	12.1	---	---	---	---	---		
3	6x6	2	---	---	1.9	5.5	10.7	---	---	---	---	---		
1	6x6E	0	---	---	2.0	---	---	---	---	---	---	---		
1	6x6D	1	---	0.4	---	---	---	19.2	---	---	11.8	17.1		
1	6x8	2	6.3	---	---	---	---	---	6.3	---	10.9	19.7		
1	6x8	2	6.0	---	---	---	---	---	8.4	---	6.2	14.6		
3	8x8	1	---	---	1.2	---	---	---	---	---	---	---		
1	8x8	2	---	---	2.0	---	---	---	5.2	17.4	---	---		
2	9½x9½	1	---	---	.8	---	---	---	---	---	---	---		
2	12x12	1	---	---	1.6	---	---	---	---	---	---	---		
2	16x16	1	---	---	.3	---	---	---	---	---	---	---		
1	19x19	0	---	---	.4	---	---	---	---	---	---	---		

Continued

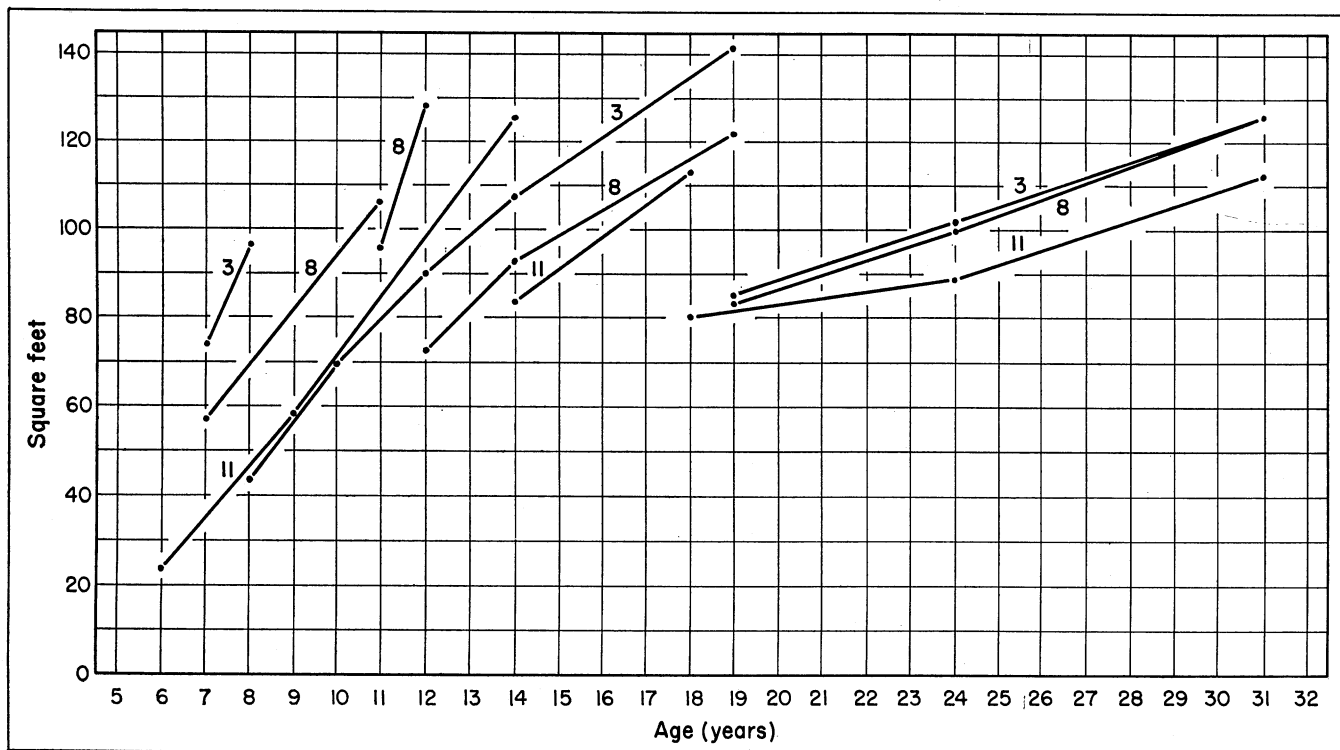


FIGURE 9. This chart presents the basal area per acre on plots thinned twice, early thinning pre-commercial or heavy commercial. Curves in the chart present the following: curve

3, 4' x 4', 1 pre-commercial and 1 commercial thinning (4 plots); 8, 6' x 6', 2 commercial thinnings, first heavy (3 plots); and 11, 6' x 8', 2 commercial thinnings, first heavy (1 plot).

TABLE 6 (Cont'd.) PULPWOOD VOLUME PER ACRE AT DIFFERENT AGES AND TOTAL 3-YEAR YIELD, SLASH PINE SPACING PLANTINGS

Age, years					Total volume harvested	Total 31-year yield	Average site index	Ratio, total yield to normal yield <sup>1</sup>
19	19	19	24	31				
Cultural operation								
None	Commercial thinning		None	None				
	Cut	Left						
<i>Cords per acre</i>								
46.3	----	----	61.2	77.3	2.8	80.1	88	1.48
----	14.1	27.9	30.7	47.1	17.3	64.4	89	1.18
----	14.0	21.9	31.2	45.3	14.0	59.3	88	1.10
52.5	----	----	64.8	81.2	4.0	85.2	92	1.51
----	11.9	23.0	29.1	37.1	14.3	51.4	80	1.04
----	12.8	23.2	31.6	46.3	18.5	64.8	87	1.21
----	9.6	21.4	31.4	45.3	17.0	62.3	89	1.14
38.1	----	----	47.9	61.7	2.0	63.7	102	1.04
----	----	----	31.9	51.1	12.2	63.3	79	1.31
----	----	----	29.5	45.2	17.2	62.4	80	1.27
----	----	----	22.5	34.1	14.6	48.7	77	1.04
----	9.5	16.9	24.1	35.1	10.7	45.8	82	.91
----	7.1	19.5	33.4	46.7	14.3	61.0	88	1.13
----	9.8	22.0	31.0	42.9	10.6	53.5	86	1.01
----	8.5	18.5	29.4	36.0	10.1	46.1	95	.80
----	4.2	15.2	24.9	32.5	4.5	37.0	94	.65
7.8	----	----	13.0	21.0	.4	21.4	90	.39

<sup>1</sup> Normal yield from (USDA, 1929).

TABLE 7. SAWTIMBER VOLUME PER ACRE AND RECENT PERIODIC ANNUAL INCREMENT, SLASH PINE SPACING PLANTINGS

Plots	Plant space	Thin.	9 inch minimum d.b.h.					
			Volume after later thinning (if made)		Periodic annual increment (age 19-24)	Volume at age 24	Periodic annual increment (age 24-31)	Volume at age 31
			Age 18	Age 19				
<i>No.</i>	<i>Ft.</i>	<i>No.</i>	<i>Board feet<sup>1</sup> per acre</i>					
1	4×4	0	---	250	676	3,630	1,526	14,310
1	4×4	1	---	1,040	836	5,220	1,249	13,960
4	4×4	2	---	740	706	4,270	1,129	12,175
1	6×6	0	---	4,020	1,400	11,020	1,231	19,640
1	6×6	1	---	1,960	844	6,180	659	10,790
4	6×6	2	---	2,500	965	7,325	988	14,240
3	6×6	2	---	3,030	1,053	8,295	1,140	16,275
1	6×6E	0	---	8,720	1,490	16,170	1,333	25,500
1	6×6D	1	370	---	445	3,040	1,200	11,440
1	6×8	2	910	---	568	4,320	1,084	11,910
1	6×8	2	1,220	---	523	4,360	949	11,000
3	8×8	1	---	1,895	590	4,845	809	10,510
1	8×8	2	---	3,210	1,158	9,000	979	15,850
2	9½×9½	1	---	4,645	879	9,040	873	15,150
2	12×12	1	---	4,855	1,051	10,110	650	14,660
2	16×16	1	---	4,800	983	9,715	575	13,740
1	19×19	0	---	2,370	490	4,820	517	8,440

<sup>1</sup> International ¼" Rule.

<sup>2</sup> (USDA, 1929).

Continued

TABLE 8. TOTAL YIELD IN CUBIC FEET PER ACRE FOR TREES OF 4 INCH DIAMETER CLASS AND LARGER, SLASH PINE SPACING PLANTATIONS AT 31 YEARS OF AGE

Thinning Group	Planting spacing								
	4'×4'	6'×6'	6'×8'	8'×8'	9½'×9½'	12'×12'	16'×16'	19'×19'	
	<i>Cu. ft.</i>	<i>Cu. ft.</i>	<i>Cu. ft.</i>	<i>Cu. ft.</i>	<i>Cu. ft.</i>	<i>Cu. ft.</i>	<i>Cu. ft.</i>	<i>Cu. ft.</i>	
No thinning	6,224	6,764 <sup>1</sup>	---	---	---	---	---	1,798	
One th., later comm.	5,010	4,159 <sup>2</sup>	---	3,685	4,413	3,842	3,082	---	
Two th., 1st light comm.	---	5,394 <sup>3</sup>	5,003	5,083	---	---	---	---	
Two th., 1st heavy comm.	---	5,481 <sup>3</sup>	4,002	---	---	---	---	---	
Two th., 1st pre-comm.	5,299 <sup>3</sup>	---	---	---	---	---	---	---	

<sup>1</sup> 6'×6'E, with 5,279 cubic feet, excluded. Average including 6'×6'E is 6,022.

<sup>2</sup> 6'×6'D, with 5,076 cubic feet, excluded. Average including 6'×6'D is 4,618.

<sup>3</sup> Includes a small, but unknown, amount from trees smaller than 3.6 inches d.b.h. cut in the early thinning.

TABLE 9. PULPWOOD YIELD THROUGH 36 YEARS, PLANTINGS ON BADLY ERODED FIELD<sup>1</sup>

Species and thinning group	Area	Age 17		Periodic annual increment age 17-25	Age 25		Periodic annual increment age 25-36	Volume, age 36	Total yield in 36 years
		Cut in 1st thinning	Stand after thinning		Cut in 2nd thinning	Stand after thinning			
	<i>Acres</i>	<i>Cords per acre</i>							
Slash pine, 1st thinned to about 600 trees per acre	.196	6.12	18.37	1.18	10.55	17.24	0.74	25.43	42.10
	.208	6.49	12.50	1.41	7.85	15.95	.65	23.05	37.39
	.404	6.31	15.35	1.30	9.16	16.58	.69	24.20	39.67 <sup>2</sup>
Slash pine, 1st thinned to about 400 trees per acre	.203	8.97	13.30	.69	5.28	13.53	.71	21.31	35.56
	.202	10.64	11.88	1.19	7.24	14.18	.81	23.05	40.93
	.405	9.80	12.59	.94	6.26	13.86	.76	22.18	38.24 <sup>2</sup>
Loblolly pine, 1st thinned to about 600 trees per acre	.202	2.97	11.88	1.20	6.84	14.67	.33	18.35	28.16
	.203	1.23	17.24	1.40	11.38	17.08	.03	17.45	30.06
	.405	2.10	14.57	1.30	9.11	15.87	.18	17.90	29.11 <sup>2</sup>
Loblolly pine, 1st thinned to about 400 trees per acre	.202	7.18	10.40	.73	4.61	11.62	.32	15.16	26.95
	.203	4.19	19.21	.72	6.46	18.52	.48	23.81	34.46
	.405	5.68	14.81	.73	5.54	15.08	.40	19.50	30.72 <sup>2</sup>
Shortleaf pine, never thinned	.932	---	---	---	---	9.15	.23	11.63	11.63

<sup>1</sup> Planting spacing 6'×6'.

<sup>2</sup> The third row in each instance indicates the weighted average production of the two subplots above.



TABLE 7 (Cont'd.) SAWTIMBER VOLUME PER ACRE AND RECENT PERIODIC ANNUAL INCREMENT, SLASH PINE SPACING PLANTINGS

7 inch minimum d.b.h.						
Volume after later thinning (if made)		Periodic annual increment (age 19-24)	Volume at age 24	Periodic annual increment (age 24-31)	Volume at age 31	Normal yield <sup>2</sup> age 31
Age 18	Age 19					
<i>Board feet<sup>1</sup> per acre</i>						
---	5,510	1,188	11,450	1,300	20,550	16,710
---	3,740	882	8,150	1,104	15,880	17,220
---	4,460	732	8,120	996	15,095	16,710
---	10,120	1,284	16,540	1,193	24,890	18,730
---	5,320	682	8,730	569	12,710	12,580
---	5,050	870	9,400	994	16,355	16,190
---	5,855	937	10,540	954	17,220	17,220
---	11,080	1,276	17,460	1,217	25,980	23,710
2,780	---	677	7,532	1,263	15,680	12,110
3,650	---	735	8,120	850	14,010	12,580
2,960	---	528	6,600	839	12,000	11,170
---	3,935	605	6,960	701	11,865	13,610
---	5,260	1,100	10,760	960	17,480	16,710
---	6,420	816	10,500	809	16,160	15,670
---	5,990	934	10,660	605	14,895	20,230
---	5,225	923	9,840	568	13,815	19,730
---	2,760	472	5,120	526	8,800	17,740

<sup>1</sup> International 1/4" Rule.

<sup>2</sup> (USDA, 1929).

TABLE 10. PULPWOOD YIELD THROUGH 36 YEARS, PLANTING OF LOBLOLLY, LONGLEAF, SHORTLEAF, AND SLASH PINES IN SINGLE ROW MIXTURE<sup>1</sup>

Topographic situation	Species	Area	Site index	Age 25		Periodic annual increment age 25-31	Volume age 31	Periodic annual increment age 31-36	Volume, age 36	Total yield in 36 years
				Cut in thinning	Stand after thinning					
		<i>Acres</i>	<i>Feet</i>	<i>Cords per acre</i>						
Upper slope (gentle)	Loblolly pine	0.082	64	14.7	12.7	1.63	22.5	-0.50	20.0	34.7
	Longleaf pine	.081	---	.0	.0	.07	.4	.02	.5	.5
	Shortleaf pine	.082	57	3.4	10.5	.68	14.6	.46	16.9	20.3
	Slash pine	.082	64	8.3	28.4	3.35	48.5	3.48	65.9	74.2
	All combined	.327	---	6.6	12.9	1.43	21.5	.88	25.9	32.5
Middle slope (gentle)	Loblolly pine	.058	70	14.3	38.5	3.88	61.8	1.60	69.8	84.1
	Longleaf pine	.058	---	.0	.0	.00	.0	.00	.0	.0
	Shortleaf pine	.058	55	1.2	8.3	.58	11.8	.04	12.0	13.2
	Slash pine	.059	73	8.4	35.1	2.98	53.0	3.10	68.5	76.9
	All combined	.233	---	6.0	20.6	1.85	31.7	1.20	37.7	43.7
Lower slope (steep)	Loblolly pine	.031	82	11.1	54.7	4.35	80.8	1.98	90.7	101.8
	Longleaf pine	.033	---	.0	.0	.00	.0	.00	.0	.0
	Shortleaf pine	.034	---	.0	5.6	-.35	3.5	.02	3.6	3.6
	Slash pine	.031	84	6.4	30.2	1.63	40.0	-.60	37.0	43.4
	All combined	.129	---	4.2	21.8	1.33	29.8	.36	31.6	35.8
Well-drained bottom (practically fiat)	Loblolly pine	.084	88	22.1	70.0	8.07	118.4	4.54	141.1	163.2
	Longleaf pine	.084	---	.0	.0	.03	.2	-.02	.1	.1
	Shortleaf pine	.084	70	.7	6.3	.28	8.0	.26	9.3	10.0
	Slash pine	.085	86	11.4	28.4	2.42	42.9	2.86	57.2	68.6
	All combined	.337	---	8.5	26.2	2.70	42.4	1.92	52.0	60.5
All positions	Loblolly pine	.255	---	16.6	42.6	4.60	70.2	1.92	79.8	96.4
	Longleaf pine	.257	---	.0	.0	.03	.2	.00	.2	.2
	Shortleaf pine	.258	---	1.6	7.8	.42	10.3	.26	11.6	13.2
	Slash pine	.256	---	9.1	30.2	2.73	46.6	2.76	60.4	69.5
	All combined	1.026	---	6.8	20.1	1.93	31.7	1.24	37.9	44.7 <sup>2</sup>

<sup>1</sup> In addition, a light thinning at age 18 yielded 6.1 cords per acre. The distribution by topographic situation and species is not known. It is believed that it was mostly loblolly pine that had been planted by mistake in the slash pine rows.

<sup>2</sup> Including the age 18 thinning, average total yield is 50.8 cords per acre.



The area at left was badly eroded before planting to Slash pine in 1927. The same area is at right 25 years later, pictured before second commercial thinning.

## SUMMARY AND GENERAL OBSERVATIONS

Slash pine, one of the four southern pine species of highest commercial importance, was first established in 1927 in forest plantations at the Agricultural Experiment Station at Auburn, Alabama, outside the natural range of the species. Plantings, made on abandoned agricultural land mostly of extremely poor quality, were successful. Except on moist sites, slash pine outgrew and out-produced loblolly pine, its closest competitor, over a period of at least 36 years.

Additional plantings made in 1932 confirmed the success of slash pine in the Auburn area. Planted at different spacings and given different cultural treatments, they demonstrated the following general trends in growth and development:

Reduced survival resulted from the closest spacing ( $4' \times 4'$ ) from the fourth year on.

With no early thinning, there was a steady increase in survival with increasingly wide spacing ( $4' \times 4'$  to  $16' \times 16'$ ) from age 11 to 19.

Mortality increased following thinning at age 19 on previously unthinned  $4' \times 4'$  and  $6' \times 6'$  plantings.

Tree diameters were greater with increasingly wide spacings.

Tree diameters were greater with increasing intensity of thinning.

There was lower basal area increment with increasingly wide spacings.

There was lower basal area increment with increasing intensity of thinning.

A negligible periodic increase or actual decrease in basal area occurred during the 5 years following thinning at age 19 on previously unthinned  $4' \times 4'$  and  $6' \times 6'$  plantings.

Following are statements concerning differences in yield:

The trend is toward higher pulpwood yields for closer spacings.

Early thinning (age 8 or 12) probably reduced total pulpwood yield. The heavier the thinning, the greater the apparent reduction.

Pulpwood volume increment following drastic later thinning (age 19) in  $4' \times 4'$  and  $6' \times 6'$  plantings not thinned earlier was lower than that on similar plantings thinned twice or never thinned.

There is evidence, though not conclusive, that first thinning at some age between 12 and 19 (ages 14, 15, and 18 are actually represented) may not have reduced pulpwood yields as much as apparently did earlier and later first thinnings.<sup>24</sup>

There were similar but smaller differences in sawlog volumes for different spacings and thinnings.

Total cubic volume yields apparently varied inversely with spacing, but showed no consistent variation between different thinnings.

**Economic Considerations.** It should be emphasized that maximum yields attained by extremely close planting spacing may not provide the highest net monetary returns (9). Furthermore, if interest is considered, thinnings can increase net monetary returns without increasing total yields (7).

**Reproduction.** Instances of slash pine reproduction established by natural seeding in and near the Auburn Plantations, outside the natural range of the species, have been reported (8). Since that report, many more, naturally established slash pine seedlings and saplings have been noted.

<sup>24</sup> This can be supported on a theoretical basis. Too early thinning removes many trees with only a small portion of their total volume merchantable as pulpwood. Left uncut, these trees by only a small increase in diameter would provide a relatively large increase in merchantable volume. On the other hand, thinning delayed too long in a dense stand may provide little stimulation to diameter growth of the trees left, while it may cause increased mortality.

## LITERATURE CITED

- (1) BENNETT, FRANK. Growth of Slash Pine Plantations on the George Walton Experiment Forest. Station Paper No. 66. Southeastern Forest Experiment Station. 1956.
- (2) DEVALL, WILBUR B. Invasion of Longleaf Pine Site by Slash Pine and Inferior Hardwoods. Journal of the Alabama Academy of Science, Vol. 22. Montevallo. 1952.
- (3) FOLSOM, REID I. The Effects of Fire on Pine Plantations. Highlights of Agricultural Research, Vol. 8. No. 1, Spring 1961.
- (4) GILMORE, A. R., AND LIVINGSTON, KNOX W. Cultivating and Fertilizing a Slash Pine Plantation: Effects on Volume and Fusiform Rust. Journal of Forestry, Vol. 56 No. 7, July 1958.
- (5) HARLOW, WILLIAM M., AND HARRAR, ELLWOOD S. Textbook of Dendrology. McGraw-Hill. New York. 1941.
- (6) LITTLE, ELBERT L., AND DORMAN, KEITH W. Slash Pine (*Pinus elliottii*), Including South Florida Slash Pine, Nomenclature and Description. Station Paper No. 36. Southeastern Forest Experiment Station. Asheville, N.C. April 1954.
- (7) LIVINGSTON, K. W. Thin—or Not to Thin? Highlights of Agricultural Research, Vol. 3 No. 3. Fall 1956.
- (8) ..... Reproduction of Slash Pine Outside its Natural Range. Journal of Forestry, Vol. 54 No. 8, August 1956.
- (9) ....., AND CAROTHERS, J. E. Pines Pay. Highlights of Agricultural Research, Vol. 2, No. 3, Fall 1955.
- (10) Society of American Foresters. Forest Cover Types of North America: Report of the Committee on Forest Types. Washington, D.C. 1954.
- (11) STAHELIN, RUDOLPH. The Conversion of Hardwood to Pine Stands in Alabama. The Journal of the Alabama Academy of Science, Vol. 18. May 1946.
- (12) United States Department of Agriculture, Forest Service. Volume, Yield, and Stand Tables for Second-Growth Southern Pines. U.S. Dept. Agr. Misc. Pub. 50. Washington, D.C. 1929.
- (13) United States Department of Agriculture, Climate and Man, Yearbook of Agriculture. Washington, D.C. 1941.
- (14) ..... Forest Products Laboratory. Wood Handbook. Washington, D.C. 1955.
- (15) WARE, L. M., AND STAHELIN, R. Growth of Southern Pine Plantations at Various Spacings. Journal of Forestry, Vol. 46 No. 4, April 1948.

## APPENDIX A

Summaries of developmental factors and yields at different ages of the individual plots in the slash pine spacing plantations are presented in the following tables. All values are on a per acre basis.

APPENDIX TABLE A 1. SLASH PINE PLANTED AT 4'×4' SPACING AND NOT THINNED (PLOT 31A3)

Planta- tion age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp- wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	2,688	---	---	---	---	---	---	---	---	---	---
2	Re-plant.	1,004	---	---	---	---	---	---	---	---	---	---
2	After re-.	2,688	---	---	---	---	---	---	---	---	---	---
3	Living	2,540	---	3	---	---	---	---	---	---	---	---
7	Living	2,340	2.3	---	70	280	4.0	---	24	425	---	---
11	Cut (salv.)	112	4.0	---	10	112	4.0	---	10	196	2.8	---
11	Left	2,108	3.1	25	112	---	---	---	---	---	---	---
12	Living	2,100	3.7	33	159	996	4.9	---	133	2,420	---	---
14	Living	2,052	4.0	---	181	1,052	5.2	---	156	2,899	---	---
19	Living	1,236	5.4	49	197	1,008	5.8	50	188	3,649	46.3	5,510
24	Living	980	6.2	53	208	916	6.4	55	206	4,698	61.2	11,450
31	Living	792	7.0	60	215	708	7.4	64	212	6,028	77.3	20,550
	31-year production	---	---	---	---	---	---	---	---	6,224	80.1	---

<sup>1</sup> International ¼" Rule, trees of 7" diameter class and larger.

APPENDIX TABLE A 2. SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNINGS AT PLANTATION AGE 19 YEARS (PLOT 32C4)

Planta- tion age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp- wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	2,688	---	---	---	---	---	---	---	---	---	---
2	Re-plant.	626	---	---	---	---	---	---	---	---	---	---
2	After re-.	2,688	---	---	---	---	---	---	---	---	---	---
3	Living	2,620	---	3	---	---	---	---	---	---	---	---
7	Living	2,496	2.4	---	79	292	4.1	---	27	464	---	---
11	Cut (salv.)	112	4.4	---	12	112	4.4	---	12	244	3.2	---
11	Left	1,984	3.0	25	98	---	---	---	---	---	---	---
12	Living	1,936	3.6	32	136	848	4.8	---	105	1,909	---	---
14	Living	1,900	3.9	---	159	936	5.1	---	131	2,425	---	---
19	Cut (thin.)	520	4.6	---	59	392	5.0	---	53	966	14.1	---
19	Left	720	5.5	49	117	516	6.3	50	110	2,149	27.9	3,740
24	Living	412	6.9	52	106	304	7.8	60	101	2,480	30.7	8,150
31	Living	368	8.2	58	135	308	8.9	65	132	3,800	47.1	15,880
	31-year production	---	---	---	---	---	---	---	---	5,010	64.4	---

<sup>1</sup> International ¼" Rule, trees of 7" diameter class and larger.

APPENDIX TABLE A 3. SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED TWICE—PRE-COMMERCIAL THINNING AT AGE 8 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C5)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>3</sup></i>
0	Planted	2,688	---	---	---	---	---	---	---	---	---	---
2	Re-planted	54	---	---	---	---	---	---	---	---	---	---
2	After re-	2,688	---	---	---	---	---	---	---	---	---	---
3	Living	2,628	---	3	---	---	---	---	---	---	---	---
7	Living	2,444	2.4	---	73	280	4.1	---	26	446	---	---
8	Cut (thng.)	1,704	2.0	---	36	---	---	---	---	712 <sup>1</sup>	---	---
8	Left	740	3.3	---	44	---	---	---	---	---	---	---
10	Living	660	4.3	31	67	---	---	---	---	---	---	---
12	Living	660	5.0	---	89	640	5.0	---	89	1,628	---	---
14	Living	648	5.5	---	108	628	5.6	---	108	2,008	---	---
19	Cut (thng.)	308	5.9	---	58	300	5.9	---	58	1,068	14.5	---
19	Left	324	7.0	53	86	320	7.0	53	86	1,716	22.1	4,280
24	Living	284	8.3	63	107	280	8.4	64	107	2,760	34.8	10,230
31	Living	280	9.2	70	130	272	9.4	71	130	3,949	48.7	17,300
	31-year production	---	---	---	---	---	---	---	---	5,729 <sup>2</sup>	63.2	---

<sup>1</sup> Includes trees to the 2-inch diameter class.

<sup>2</sup> Includes the small, but unknown, volume in 2 and 3 inch trees cut at age 8.

<sup>3</sup> International ¼" rule, trees of 7" diameter class and larger.

APPENDIX TABLE A 4. SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED TWICE—PRE-COMMERCIAL THINNING AT AGE 8 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B4)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>3</sup></i>
0	Planted	2,688	---	---	---	---	---	---	---	---	---	---
2	Re-planted	1,145	---	---	---	---	---	---	---	---	---	---
2	After re-	2,688	---	---	---	---	---	---	---	---	---	---
3	Living	2,496	---	2	---	---	---	---	---	---	---	---
7	Living	2,356	2.5	---	77	312	4.1	---	29	512	---	---
8	Cut (thng.)	1,632	2.5	---	57	---	---	---	---	616 <sup>1</sup>	---	---
8	Left	724	3.5	---	48	---	---	---	---	---	---	---
10	Living	720	4.6	30	83	---	---	---	---	---	---	---
12	Living	704	4.9	33	94	672	5.0	---	93	1,674	---	---
14	Living	692	5.5	---	115	684	5.5	---	115	2,137	---	---
19	Cut (thng.)	320	5.7	---	57	316	5.7	---	56	1,071	14.2	---
19	Left	312	7.2	53	89	312	7.2	53	89	1,828	23.1	4,920
24	Living	284	7.9	61	98	284	7.9	61	98	2,404	30.5	8,310
31	Living	260	9.2	69	119	260	9.2	69	119	3,462	42.9	14,630
	31-year production	---	---	---	---	---	---	---	---	5,149 <sup>2</sup>	57.1	---

<sup>1</sup> Includes trees to the 2-inch diameter class.

<sup>2</sup> Includes the small, but unknown, volume in 2 and 3 inch trees cut at age 8.

<sup>3</sup> International ¼" rule.

APPENDIX TABLE A 5. SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED TWICE—PRE-COMMERCIAL THINNING AT AGE 8 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B3)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger						
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Merch. volume	
Years		Number	In.	Ft.	Sq. ft.	Number	In.	Ft.	Sq. ft.	Cu. ft.	Pulp-wood	Sawlogs
0	Planted	2,688	---	---	---	---	---	---	---	---	---	---
2	Re-planted	747	---	---	---	---	---	---	---	---	---	---
2	After re-	2,688	---	---	---	---	---	---	---	---	---	---
3	Living	2,568	---	2	---	---	---	---	---	---	---	---
7	Living	2,416	2.5	---	80	372	4.1	---	34	602	---	---
8	Cut (thng.)	1,700	2.6	---	62	---	---	---	---	560 <sup>1</sup>	---	---
8	Left	716	3.6	---	50	---	---	---	---	---	---	---
10	Living	692	4.4	33	74	---	---	---	---	---	---	---
12	Living	684	5.2	35	100	672	5.2	---	99	1,118	---	---
14	Living	672	5.6	---	114	668	5.6	---	113	2,117	---	---
19	Cut (thng.)	356	5.8	---	64	356	5.8	---	64	1,217	16.2	---
19	Left	304	7.1	53	83	300	7.1	53	83	1,693	21.5	4,460
24	Living	280	7.8	61	92	280	7.8	61	92	2,374	30.0	8,120
31	Living	276	9.0	70	122	276	9.0	70	122	3,602	44.7	15,020
31-year production		---	---	---	---	---	---	---	---	5,379 <sup>2</sup>	60.9	---

<sup>1</sup> Includes trees to the 2-inch diameter class.

<sup>2</sup> Includes the small, but unknown, volume in 2 and 3 inch trees cut at age 8.

<sup>3</sup> International ¼" rule.

APPENDIX TABLE A 6. SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED TWICE—PRE-COMMERCIAL THINNING AT AGE 8 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C6)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger						
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Merch. volume	
Years		Number	In.	Ft.	Sq. ft.	Number	In.	Ft.	Sq. ft.	Cu. ft.	Pulp-wood	Sawlogs
0	Planted	2,688	---	---	---	---	---	---	---	---	---	---
2	Re-planted	341	---	---	---	---	---	---	---	---	---	---
2	After re-	2,688	---	---	---	---	---	---	---	---	---	---
3	Living	2,652	---	2	---	---	---	---	---	---	---	---
7	Living	2,376	2.2	---	64	216	4.1	---	19	337	---	---
8	Cut (thng.)	1,636	2.4	---	49	---	---	---	---	568 <sup>1</sup>	---	---
8	Left	740	3.0	---	36	---	---	---	---	---	---	---
10	Living	680	3.9	28	58	---	---	---	---	---	---	---
12	Living	680	4.5	---	76	560	4.8	---	71	1,296	---	---
14	Living	680	5.1	---	94	648	5.1	---	93	1,723	---	---
19	Cut (thng.)	292	5.3	---	44	292	5.3	---	44	789	10.9	---
19	Left	372	6.4	51	83	364	6.5	52	83	1,635	21.1	2,840
24	Living	372	7.4	54	110	356	7.5	56	110	2,403	29.4	6,840
31	Living	360	8.3	63	134	348	8.4	64	134	3,582	44.8	13,440
31-year production		---	---	---	---	---	---	---	---	4,939	55.7	---

<sup>1</sup> Includes trees to the 2-inch diameter class.

<sup>2</sup> Includes the small, but unknown, volume in 2 and 3 inch trees cut at age 8.

<sup>3</sup> International ¼" rule.

APPENDIX TABLE A 7. SLASH PINE PLANTED AT 6'×6' SPACING AND NOT THINNED (PLOT 32C13)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.</i> <sup>1</sup>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	1,160	---	3	---	---	---	---	---	---	---	---
7	Living	1,140	3.1	---	58	328	4.2	---	31	548	---	---
11	Cut (Salv.)	120	5.4	---	19	120	5.4	---	19	332	4.0	---
11	Left	1,008	4.3	30	100	---	---	---	---	---	---	---
12	Living	1,004	4.8	34	127	716	5.4	---	116	2,182	---	---
14	Living	992	5.5	---	163	752	6.1	---	154	2,881	---	---
19	Living	864	6.4	54	192	732	6.9	55	186	4,049	52.5	10,120
24	Living	788	7.1	56	216	696	7.5	58	212	5,112	64.8	16,540
31	Living	668	7.7	65	217	604	8.1	68	214	6,432	81.2	24,890
	31-year production	---	---	---	---	---	---	---	---	6,764	85.2	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 8. SLASH PINE PLANTED AT 6'×6' SPACING ON EXCEPTIONAL SITE AND NOT THINNED (PLOT 31A1, 6'×6'E)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.</i> <sup>1</sup>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	832	---	3	---	---	---	---	---	---	---	---
7	Living	808	2.9	---	36	164	4.2	---	16	304	---	---
11	Cut (salv.)	48	5.5	---	8	48	5.5	---	8	156	2.0	---
11	Left	680	4.7	31	83	---	---	---	---	---	---	---
12	Living	628	5.4	36	98	500	5.8	---	93	1,808	---	---
14	Living	520	6.7	---	127	496	6.8	---	126	2,325	---	---
19	Living	364	8.3	57	136	356	8.4	57	136	3,093	38.1	11,080
24	Living	272	9.7	65	141	264	9.9	66	140	3,935	47.9	17,460
31	Living	208	11.6	80	152	204	11.7	81	152	5,123	61.7	25,980
	31-year production	---	---	---	---	---	---	---	---	5,279	63.7	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 9. SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C1)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
Years		Number	In.	Ft.	Sq. ft.	Number	In.	Ft.	Sq. ft.	Cu. ft.	Cords	Bd. ft. <sup>1</sup>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	1,120	---	2	---	---	---	---	---	---	---	---
7	Living	1,048	2.7	---	42	228	4.2	---	22	380	---	---
11	Cut (salv.)	76	5.2	---	11	76	5.2	---	11	200	2.4	---
11	Left	944	4.0	27	81	---	---	---	---	---	---	---
12	Living	928	4.5	32	105	628	5.3	---	94	1,775	---	---
14	Living	884	5.3	33	133	664	5.9	---	125	2,338	---	---
19	Cut (thng.)	348	5.5	---	57	292	5.9	---	55	925	11.9	---
19	Left	400	6.9	48	103	328	7.5	49	101	1,889	23.0	5,320
24	Living	316	7.8	52	105	272	8.3	56	103	2,354	29.1	8,730
31	Living	288	8.7	56	118	260	9.1	59	117	3,034	37.1	12,710
	31-year production	---	---	---	---	---	---	---	---	4,159	51.4	---

<sup>1</sup> International 1/4" rule.

APPENDIX TABLE A 10. SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 18 YEARS (PLOT 35C3, 6'×6'D)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
Years		Number	In.	Ft.	Sq. ft.	Number	In.	Ft.	Sq. ft.	Cu. ft.	Cords	Bd. ft. <sup>1</sup>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	Re-planted	52	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
6	Living	1,124	1.8	---	20	12	4.0	---	1	18	---	---
9	Living	1,072	3.0	21	52	240	4.3	---	24	436	---	---
10	Cut (salv.)	52	4.0	---	4	52	4.0	---	4	64	0.4	---
14	Living	988	4.7	36	117	716	5.2	---	107	1,974	19.2	---
18	Cut (thng.)	464	4.9	---	62	368	5.3	---	57	890	11.8	---
18	Left	488	5.9	44	94	404	6.4	46	91	1,582	17.1	2,780
24	Living	488	6.9	49	128	404	7.5	52	125	2,592	31.9	7,532
31	Living	456	8.2	57	166	408	8.6	61	164	4,122	51.1	15,680
	31-year production	---	---	---	---	---	---	---	---	5,076	63.3	---

<sup>1</sup> International 1/4" rule.



APPENDIX TABLE A 11. SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B1)

Planta- tion age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp- wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>3</sup></i>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	1,172	---	3	---	---	---	---	---	---	---	---
7	Living	1,144	3.1	---	60	320	4.3	---	33	590	---	---
11	Cut (salv.)	68	5.3	---	10	68	5.3	---	10	248	3.2	---
11	Left	1,076	4.3	32	107	---	---	---	---	---	---	---
12	Cut (thng.)	432	3.8	---	34	---	---	---	---	580 <sup>1</sup>	4.4	---
12	Left	612	5.3	36	92	572	5.4	---	90	1,719	15.6	---
14	Living	596	6.2	---	125	588	6.2	---	125	2,345	---	---
19	Cut (thng.)	248	6.6	---	60	244	6.7	---	60	1,243	16.3	---
19	Left	288	7.6	55	90	288	7.6	55	90	1,958	24.6	5,750
24	Living	264	8.7	63	108	264	8.7	63	108	2,847	35.3	11,030
31	Living	264	9.6	72	134	264	9.6	72	134	4,164	51.2	18,900
31-year production		---	---	---	---	---	---	---	---	6,235 <sup>2</sup>	75.1	---

<sup>1</sup> Includes trees to the 2-inch class.

<sup>2</sup> Includes the small, but unknown, volume in 2- and 3-inch trees cut at age 12.

<sup>3</sup> International ¼" rule.

APPENDIX TABLE A 12. SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31A5)

Planta- tion age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp- wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>3</sup></i>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	892	---	2	---	---	---	---	---	---	---	---
7	Living	800	2.1	---	19	60	4.0	---	5	---	---	---
11	Cut (salv.)	32	5.5	---	5	32	5.5	---	5	40	0.4	---
11	Left	752	3.6	24	54	---	---	---	---	---	---	---
12	Cut (thng.)	144	3.3	---	8	---	---	---	---	124 <sup>1</sup>	.8	---
12	Left	608	4.5	32	67	428	5.1	---	60	1,053	9.2	---
14	Living	608	5.3	---	93	500	5.7	---	89	1,664	---	---
19	Cut (thng.)	224	5.8	---	40	200	6.0	---	39	806	10.8	---
19	Left	360	6.7	53	88	328	7.0	54	87	1,850	23.7	4,580
24	Living	344	7.8	55	114	328	8.0	56	113	2,624	33.7	9,580
31	Living	312	9.3	66	147	312	9.3	66	147	4,128	50.7	17,540
31-year production		---	---	---	---	---	---	---	---	5,098 <sup>2</sup>	62.7	---

<sup>1</sup> Includes trees to the 2-inch class.

<sup>2</sup> Includes the small, but unknown, volume in 2- and 3-inch trees cut at age 12.

<sup>3</sup> International ¼" rule.

APPENDIX TABLE A 13. SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C7)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>4</sup></i>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	1,184	---	2	---	---	---	---	---	---	---	---
7	Living	1,128	2.6	---	41	136	4.2	---	13	224	---	---
11	Cut (salv.)	104	4.7	---	12	104	4.7	---	12	248	3.2	---
11	Left	1,024	3.7	25	77	---	---	---	---	---	---	---
12	Cut (thng.)	416	3.6	---	30	---	---	---	---	464 <sup>2</sup>	2.4	---
12	Left	600	4.7	31	74	516	5.0	---	70	1,331	10.0	---
14	Living	596	5.5	---	97	528	5.7	---	94	1,758	---	---
19	Cut (thng.)	264	5.7	---	46	244	5.8	---	45	890	12.3	---
19	Left	316	6.9	54 <sup>1</sup>	81	296	7.1	54	80	1,707	21.9	4,180
24	Living	312	7.7	52 <sup>1</sup>	101	288	8.0	54	100	2,128	26.5	6,950
31	Living	300	8.8	62	127	296	8.9	62	127	3,283	40.5	13,060
	31-year production	---	---	---	---	---	---	---	---	4,885 <sup>3</sup>	58.4	---

<sup>1</sup> Discrepancy is due to sampling. The age 19 average height is based on a sample. The age 24 average height is based on measurement of all trees.

<sup>2</sup> Includes trees to the 2-inch class.

<sup>3</sup> Includes the small, but unknown, volume in 2- and 3-inch trees cut at age 12.

<sup>4</sup> International ¼" rule.

APPENDIX TABLE A 14. SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C2)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>3</sup></i>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	1,180	---	3	---	---	---	---	---	---	---	---
7	Living	1,124	3.1	---	58	340	4.2	---	33	132	---	---
11	Cut (salv.)	92	4.9	---	12	92	4.9	---	12	272	4.0	---
11	Left	1,024	4.2	28	97	---	---	---	---	---	---	---
12	Cut (thng.)	412	4.4	---	44	196	5.3	---	31	664 <sup>1</sup>	4.4	---
12	Left	596	5.2	33	88	552	5.3	---	85	1,583	13.6	---
14	Living	596	5.9	---	112	564	6.0	---	110	2,062	---	---
19	Cut (thng.)	252	5.7	---	44	244	5.7	---	43	884	11.9	---
19	Left	244	7.9	56	84	244	7.9	56	84	1,810	22.6	5,700
24	Living	224	9.2	62	103	224	9.2	62	103	2,582	30.8	10,040
31	Living	220	10.1	69	122	220	10.1	69	122	3,538	42.9	15,930
	31-year production	---	---	---	---	---	---	---	---	5,358 <sup>2</sup>	63.2	---

<sup>1</sup> Includes trees to the 2-inch class.

<sup>2</sup> Includes the small, but unknown, volume in 2- and 3-inch trees cut at age 12.

<sup>3</sup> International ¼" rule.

APPENDIX TABLE A 15. SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—HEAVY, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C3)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>3</sup></i>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	1,208	---	4	---	---	---	---	---	---	---	---
7	Living	1,180	3.4	---	73	496	4.3	---	50	221	---	---
11	Cut (salv.)	120	4.6	---	14	120	4.6	---	14	276	3.2	---
11	Left	1,028	4.4	30	109	---	---	---	---	---	---	---
12	Cut (thng.)	584	4.3	---	60	---	---	---	---	956 <sup>1</sup>	6.0	---
12	Left	432	5.8	35	78	412	5.8	---	77	1,490	11.6	---
14	Living	416	6.7	---	101	408	6.7	---	101	1,886	---	---
19	Cut (thng.)	156	7.5	---	48	156	7.5	---	48	996	12.0	---
19	Left	216	8.0	55	76	212	8.1	55	76	1,629	19.4	5,410
24	Living	184	9.4	62	88	180	9.5	63	88	2,247	27.0	9,210
31	Living	184	10.7	69	115	180	10.8	70	115	3,379	40.8	15,860
31-year production		---	---	---	---	---	---	---	---	5,607 <sup>2</sup>	62.0	---

<sup>1</sup> Includes trees to the 2-inch class.

<sup>2</sup> Includes the small, but unknown, volume in 2- and 3-inch trees cut at age 12.

<sup>3</sup> International ¼" rule.

APPENDIX TABLE A 16. SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—HEAVY, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B5)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>3</sup></i>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	1,100	---	2	---	---	---	---	---	---	---	---
7	Living	1,044	2.8	---	46	204	4.2	---	20	350	---	---
11	Cut (salv.)	56	4.4	---	6	56	4.4	---	6	128	1.6	---
11	Left	968	3.9	27	81	---	---	---	---	---	---	---
12	Cut (thng.)	524	4.1	---	48	284	4.8	---	35	607 <sup>1</sup>	4.4	---
12	Left	448	5.3	32	70	416	5.5	---	69	1,320	10.0	---
14	Living	440	6.2	---	92	420	6.3	---	91	1,718	---	---
19	Cut (thng.)	156	6.5	---	36	152	6.6	---	36	718	9.2	---
19	Left	272	7.8	55	90	272	7.8	55	90	1,897	22.5	5,900
24	Living	252	9.0	61	110	252	9.0	61	110	2,738	33.4	11,110
31	Living	240	10.1	70	133	240	10.1	70	133	3,897	47.6	17,570
31-year production		---	---	---	---	---	---	---	---	5,350 <sup>2</sup>	62.8	---

<sup>1</sup> Includes trees to the 2-inch class.

<sup>2</sup> Includes the small, but unknown, volume in 2- and 3-inch trees cut at age 12.

<sup>3</sup> International ¼" rule.

APPENDIX TABLE A 17. SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—HEAVY, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B2)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>3</sup></i>
0	Planted	1,216	---	---	---	---	---	---	---	---	---	---
2	After re-	1,216	---	---	---	---	---	---	---	---	---	---
3	Living	1,120	---	3	---	---	---	---	---	---	---	---
7	Living	1,084	3.0	---	52	264	4.2	---	6	420	---	---
11	Cut (salv.)	32	4.0	---	3	32	4.0	---	3	56	0.8	---
11	Left	1,032	4.1	30	98	---	---	---	---	---	---	---
12	Cut (thng.)	632	4.3	---	62	---	---	---	---	900 <sup>1</sup>	6.0	---
12	Left	400	5.6	35	68	368	5.7	---	66	1,244	10.4	---
14	Living	396	6.3	---	86	376	6.4	---	85	1,590	---	---
19	Cut (thng.)	116	6.9	---	30	116	6.9	---	30	604	7.5	---
19	Left	252	7.9	55	86	248	8.0	55	86	1,823	22.2	6,250
24	Living	224	9.1	66	101	224	9.1	66	101	2,750	33.9	11,300
31	Living	216	10.5	72	130	216	10.5	72	130	3,927	47.6	18,240
	31-year production	---	---	---	---	---	---	---	---	5,487 <sup>2</sup>	61.9	---

<sup>1</sup> Includes trees to the 2-inch diameter class.

<sup>2</sup> Includes the small, but unknown, volume in 2 and 3 inch trees cut at age 12.

<sup>3</sup> International ¼" rule.

APPENDIX TABLE A 18. SLASH PINE PLANTED AT 6'×8' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 14 YEARS AND LATER COMMERCIAL THINNING AT AGE 18 YEARS (PLOT 35A7)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	896	---	---	---	---	---	---	---	---	---	---
2	Re-planted	56	---	---	---	---	---	---	---	---	---	---
2	After re-	896	---	---	---	---	---	---	---	---	---	---
6	Living	844	2.2	---	23	16	4.0	---	1	23	---	---
9	Living	820	3.7	23	60	472	4.3	---	48	880	6.3	---
14	Cut (thng.)	168	5.6	---	29	152	5.8	---	28	484	6.3	---
14	Left	636	5.4	39	103	556	5.7	---	100	1,694	---	---
18	Cut (thng.)	252	6.0	---	50	244	6.1	---	49	837	10.9	---
18	Left	364	6.6	47	88	324	7.0	48	86	1,574	19.7	3,650
24	Living	336	7.8	52	110	304	8.1	55	109	2,392	29.5	8,120
31	Living	328	8.9	60	142	304	9.2	63	141	3,682	45.2	14,010
	31-year production	---	---	---	---	---	---	---	---	5,003	62.4	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 19. SLASH PINE PLANTED AT 6'×8' SPACING AND THINNED TWICE—HEAVY, EARLY COMMERCIAL THINNING AT AGE 14 YEARS AND LATER COMMERCIAL THINNING AT AGE 18 YEARS (PLOT 35B7)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
Years		Number	In.	Ft.	Sq. ft.	Number	In.	Ft.	Sq. ft.	Cu. ft.	Cords	Bd. ft. <sup>1</sup>
0	Planted	896	---	---	---	---	---	---	---	---	---	---
2	Re-planted	84	---	---	---	---	---	---	---	---	---	---
2	After re-	896	---	---	---	---	---	---	---	---	---	---
6	Living	808	2.4	---	24	32	4.0	---	3	13	---	---
9	Living	776	3.7	23	58	476	4.3	---	48	780	6.0	---
14	Cut (thng.)	268	5.3	---	41	256	5.4	---	40	660	8.4	---
14	Left	456	5.8	40	84	408	6.1	---	82	1,332	---	---
18	Cut (thng.)	148	6.5	---	34	144	6.6	---	34	498	6.2	---
18	Left	296	7.0	41	80	276	7.3	41	79	1,202	14.6	2,960
24	Living	244	8.2	50	89	228	8.4	52	89	1,865	22.5	6,600
31	Living	236	9.4	58	113	220	9.7	60	112	2,844	34.1	12,000
	31-year production		---	---	---		---	---	---	4,002	48.7	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 20. SLASH PINE PLANTED AT 8'×8' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C9)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
Years		Number	In.	Ft.	Sq. ft.	Number	In.	Ft.	Sq. ft.	Cu. ft.	Cords	Bd. ft. <sup>1</sup>
0	Planted	672	---	---	---	---	---	---	---	---	---	---
2	After re-	672	---	---	---	---	---	---	---	---	---	---
3	Living	644	---	2	---	---	---	---	---	---	---	---
7	Living	600	2.5	---	20	76	4.0	---	7	108	---	---
11	Cut (salv.)	52	4.6	---	6	52	4.6	---	6	96	1.2	---
11	Left	548	4.0	23	48	---	---	---	---	---	---	---
12	Living	548	4.8	28	69	412	5.3	---	64	1,120	---	---
14	Living	540	5.5	38	89	452	5.9	---	85	1,474	---	---
19	Cut (thng.)	228	6.3	---	49	216	6.4	---	48	883	11.3	---
19	Left	272	7.0	48	72	248	7.2	49	71	1,348	16.8	3,750
24	Living	272	7.7	50	88	248	8.0	52	87	1,826	22.7	5,970
31	Living	272	8.4	58	104	248	8.7	61	103	2,602	32.1	10,130
	31-year production		---	---	---		---	---	---	3,581	44.6	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 21. SLASH PINE PLANTED AT 8'×8' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C8)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	672	---	---	---	---	---	---	---	---	---	---
2	After re-	672	---	---	---	---	---	---	---	---	---	---
3	Living	660	---	2	---	---	---	---	---	---	---	---
7	Living	628	2.4	---	20	64	4.1	---	6	91	---	---
11	Cut (salv.)	56	5.6	---	10	56	5.6	---	10	100	1.2	---
11	Left	560	3.9	23	46	---	---	---	---	---	---	---
12	Living	560	4.6	29	65	412	5.2	---	60	1,024	---	---
14	Living	556	5.3	38	84	452	5.7	---	80	1,378	---	---
19	Cut (thng.)	236	5.7	---	41	216	5.8	---	40	705	9.3	---
19	Left	276	6.6	47	66	236	7.1	48	65	1,208	15.2	3,160
24	Living	260	7.6	51	83	228	8.1	54	81	1,746	21.8	5,940
31	Living	248	8.4	59	96	224	8.8	63	95	2,529	31.1	9,890
	31-year production	---	---	---	---	---	---	---	---	3,334	41.6	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 22. SLASH PINE PLANTED AT 8'×8' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31A4)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	672	---	---	---	---	---	---	---	---	---	---
2	After re-	672	---	---	---	---	---	---	---	---	---	---
3	Living	524	---	2	---	---	---	---	---	---	---	---
7	Living	488	2.5	---	16	64	4.0	---	6	93	---	---
11	Cut (salv.)	32	4.8	---	4	32	4.8	---	4	84	1.2	---
11	Left	456	4.3	26	45	---	---	---	---	---	---	---
12	Living	452	5.2	34	66	340	5.8	---	62	1,069	---	---
14	Living	448	5.9	43	84	364	6.4	---	80	1,416	---	---
19	Cut (thng.)	152	6.4	---	34	128	6.8	---	32	620	7.8	---
19	Left	244	7.7	50	78	240	7.7	50	78	1,535	18.8	4,900
24	Living	216	8.9	60	92	216	8.9	60	92	2,279	27.9	8,980
31	Living	212	10.0	70	116	212	10.0	70	116	3,436	42.0	15,580
	31-year production	---	---	---	---	---	---	---	---	4,140	51.0	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 23. SLASH PINE PLANTED AT 8'×8' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 15 AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B6)

Plantation age	Operation or status	Total volume				Stand 3.6 inches d.b.h. and larger						
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Merch. volume	
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	672	---	---	---	---	---	---	---	---	---	---
2	After re-	672	---	---	---	---	---	---	---	---	---	---
3	Living	608	---	2	---	---	---	---	---	---	---	---
7	Living	580	3.0	---	28	160	4.3	---	16	262	---	---
11	Cut (salv.)	28	5.4	---	4	28	5.4	---	4	116	2.0	---
11	Left	536	4.6	28	61	---	---	---	---	---	---	---
12	Living	536	5.4	33	86	436	5.9	---	83	1,427	---	---
14	Living	532	6.1	45	108	460	6.5	---	105	1,839	---	---
15	Cut (thng.)	112	6.6	---	27	104	6.8	---	26	450	5.2	---
15	Left	412	6.4	---	91	360	6.7	---	89	1,520	17.4	---
19	Cut (thng.)	160	6.0	---	31	132	6.4	---	30	562	7.1	---
19	Left	236	7.9	57	81	232	8.0	---	81	1,605	19.5	5,260
24	Living	236	9.2	61	109	236	9.2	61	109	2,741	33.4	10,760
31	Living	232	10.2	69	132	232	10.2	69	132	3,955	46.7	17,480
	31-year production		---	---	---	---	---	---	---	5,083	61.0	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 24. SLASH PINE PLANTED AT 9½'×9½' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B7)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger						
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Merch. volume	
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	480	---	---	---	---	---	---	---	---	---	---
2	After re-	480	---	---	---	---	---	---	---	---	---	---
3	Living	400	---	2	---	---	---	---	---	---	---	---
7	Living	384	2.6	---	14	68	4.3	---	7	156	---	---
11	Cut (salv.)	16	5.2	---	2	16	5.2	---	2	36	0.4	---
11	Left	368	4.3	26	37	---	---	---	---	---	---	---
12	Living	368	5.4	32	59	304	5.9	---	57	919	---	---
14	Living	364	6.2	44	77	320	6.6	---	76	1,245	---	---
19	Cut (thng.)	96	7.8	---	31	92	7.9	---	31	655	8.0	---
19	Left	244	7.9	53	83	232	8.1	53	83	1,717	20.9	5,750
24	Living	228	9.1	59	103	224	9.1	60	102	2,536	30.4	10,100
31	Living	220	10.4	69	130	220	10.4	69	130	3,717	45.0	16,940
	31-year production		---	---	---	---	---	---	---	4,408	53.4	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 25. SLASH PINE PLANTED AT 9½'×9½' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C10)

Planta- tion age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp- wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	480	---	---	---	---	---	---	---	---	---	---
2	After re-	480	---	---	---	---	---	---	---	---	---	---
3	Living	460	---	2	---	---	---	---	---	---	---	---
7	Living	456	3.3	---	26	160	4.3	---	16	245	---	---
11	Cut (salv.)	52	4.8	---	7	52	4.8	---	7	100	1.2	---
11	Left	388	5.9	31	74	---	---	---	---	---	---	---
12	Living	388	6.2	33	80	356	6.4	---	79	1,312	---	---
14	Living	388	6.9	43	102	364	7.1	---	101	1,673	---	---
19	Cut (thng.)	156	7.3	---	49	152	7.4	---	46	928	11.5	---
19	Left	224	8.5	54	89	212	8.8	55	89	1,908	23.0	7,090
24	Living	224	9.3	59	106	212	9.6	61	106	2,607	31.6	10,900
31	Living	212	10.3	66	122	208	10.4	67	122	3,390	40.9	15,380
	31-year production	---	---	---	---	---	---	---	---	4,418	53.6	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 26. SLASH PINE PLANTED AT 12'×12' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C11)

Planta- tion age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp- wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	288	---	---	---	---	---	---	---	---	---	---
2	After re-	288	---	---	---	---	---	---	---	---	---	---
3	Living	288	---	3	---	---	---	---	---	---	---	---
7	Living	288	3.8	---	23	172	4.5	---	19	286	---	---
11	Cut (salv.)	36	6.3	---	8	36	6.3	---	8	128	1.6	---
11	Left	252	6.2	32	53	---	---	---	---	---	---	---
12	Living	252	7.1	34	70	252	7.1	34	70	1,148	---	---
14	Living	252	8.0	45	88	252	8.0	45	88	1,452	---	---
19	Cut (thng.)	88	9.1	---	40	88	9.1	---	40	899	10.6	---
19	Left	164	9.2	57	76	164	9.2	57	76	1,713	20.1	6,650
24	Living	156	10.7	63	97	156	10.7	63	97	2,504	30.5	10,800
31	Living	128	11.7	71	95	128	11.7	71	95	2,750	32.8	13,180
	31-year production	---	---	---	---	---	---	---	---	3,777	45.0	---

<sup>1</sup> International ¼" rule.



APPENDIX TABLE A 27. SLASH PINE PLANTED AT 12'×12' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31A2)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	288	---	---	---	---	---	---	---	---	---	---
2	After re-	288	---	---	---	---	---	---	---	---	---	---
3	Living	244	---	3	---	---	---	---	---	---	---	---
7	Living	240	3.2	---	14	84	4.4	---	9	139	---	---
11	Cut (salv.)	24	5.8	---	4	24	5.8	---	4	92	1.6	---
11	Left	212	5.3	32	32	---	---	---	---	---	---	---
12	Living	212	6.6	37	50	188	6.9	---	49	805	---	---
14	Living	208	7.3	46	61	192	7.6	---	60	983	---	---
19	Cut (thng.)	44	9.9	---	23	40	10.4	---	23	546	6.4	---
19	Left	152	8.8	57	64	152	8.8	57	64	1,422	16.9	5,330
24	Living	152	10.2	66	86	152	10.2	66	86	2,274	28.3	10,520
31	Living	128	12.0	80	98	128	12.0	80	98	3,268	39.3	16,600
	31-year production	---	---	---	---	---	---	---	---	3,906	47.3	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 28. SLASH PINE PLANTED AT 16'×16' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C12)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger					Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs
<i>Years</i>		<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Number</i>	<i>In.</i>	<i>Ft.</i>	<i>Sq. ft.</i>	<i>Cu. ft.</i>	<i>Cords</i>	<i>Bd. ft.<sup>1</sup></i>
0	Planted	168	---	---	---	---	---	---	---	---	---	---
2	After re-	168	---	---	---	---	---	---	---	---	---	---
3	Living	168	---	3	---	---	---	---	---	---	---	---
7	Living	168	3.7	---	12	104	4.3	---	10	156	---	---
11	Cut (salv.)	8	8.0	---	3	8	8.0	---	3	36	0.4	---
11	Left	156	6.4	30	35	---	---	---	---	---	---	---
12	Living	152	7.6	34	48	148	7.7	---	47	793	---	---
14	Living	152	8.6	44	61	152	8.6	44	61	1,000	---	---
19	Cut (thng.)	40	9.2	---	19	40	9.2	---	19	318	4.6	---
19	Left	112	10.5	56	67	112	10.5	56	67	1,071	17.0	5,990
24	Living	112	11.9	65	87	112	11.9	65	87	2,214	26.6	10,540
31	Living	100	13.0	75	93	100	13.0	75	93	2,818	33.4	14,200
	31-year production	---	---	---	---	---	---	---	---	3,172	38.4	---

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 29. SLASH PINE PLANTED AT 16'×16' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31A6)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger						Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs	
Years		Number	In.	Ft.	Sq. ft.	Number	In.	Ft.	Sq. ft.	Cu. ft.	Cords	Bd. ft. <sup>1</sup>	
0	Planted	168	---	---	---	---	---	---	---	---	---	---	
2	After re-	168	---	---	---	---	---	---	---	---	---	---	
3	Living	152	---	3	---	---	---	---	---	---	---	---	
7	Living	144	3.1	---	8	52	4.2	---	5	104	---	---	
11	Cut (salv.)	4	5.0	---	1	4	5.0	---	1	8	0.1	---	
11	Left	128	5.6	30	22	---	---	---	---	---	---	---	
12	Living	128	6.8	34	32	120	7.0	---	32	524	---	---	
14	Living	128	7.9	42	44	124	8.0	---	44	723	---	---	
19	Cut (thng.)	20	11.6	---	15	20	11.6	---	15	332	3.8	---	
19	Left	108	9.6	54	54	104	9.8	54	54	1,157	13.5	4,460	
24	Living	104	11.1	66	70	104	11.1	66	70	1,942	23.2	9,140	
31	Living	100	12.5	74	86	100	12.5	74	86	2,651	31.6	13,420	
	31-year production	---	---	---	---	---	---	---	---	2,991	35.5	---	

<sup>1</sup> International ¼" rule.

APPENDIX TABLE A 30. SLASH PINE PLANTED AT 19'×19' SPACING AND NOT THINNED (PLOT 31A7)

Plantation age	Operation or status	Total stand				Stand 3.6 inches d.b.h. and larger						Merch. volume	
		Trees	Av. diam.	Av. ht.	Basal area	Trees	Av. diam.	Av. ht.	Basal area	Total vol.	Pulp-wood	Sawlogs	
Years		Number	In.	Ft.	Sq. ft.	Number	In.	Ft.	Sq. ft.	Cu. ft.	Cords	Bd. ft. <sup>1</sup>	
0	Planted	120	---	---	---	---	---	---	---	---	---	---	
2	After re-	120	---	---	---	---	---	---	---	---	---	---	
3	Living	104	---	2	---	---	---	---	---	---	---	---	
7	Living	92	2.4	---	3	12	4.4	---	1	18	---	---	
11	Cut (salv.)	4	7.3	---	1	4	7.3	---	1	20	0.4	---	
11	Left	76	4.2	23	7	---	---	---	---	---	---	---	
12	Living	76	5.8	30	14	64	6.3	---	14	222	---	---	
14	Living	72	6.9	37	19	68	7.1	---	19	303	---	---	
19	Living	72	9.4	47	35	72	9.4	47	35	669	7.8	2,760	
24	Living	68	11.1	60	46	68	11.1	60	46	1,116	13.0	5,120	
31	Living	68	12.8	71	61	68	12.8	71	61	1,778	21.0	8,800	
	31-year production	---	---	---	---	---	---	---	---	1,798	21.4	---	

<sup>1</sup> International ¼" rule.

## APPENDIX B

Stand tables are presented for the individual plots in the slash pine spacing plantings at plantation age 31 years. Age from seed was 32 years.

APPENDIX TABLE B 1. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 4'×4' SPACING AND NOT THINNED (PLOT 31A3)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	84	7.3	43
5	0	.0	---	76	10.3	55
6	8	1.6	68	132	25.9	63
7	64	17.1	69	104	27.8	67
8	84	29.3	70	104	36.3	70
9	100	44.2	72	112	49.5	72
10	68	37.1	73	72	39.3	74
11	24	15.8	76	24	15.8	76
Total	348	145.1	---	708	212.2	---
Average	---	.417	71	---	.300	64
Site index <sup>1</sup>	88					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 2. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT PLANTATION AGE 19 YEARS (PLOT 32C4)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	20	1.7	33
5	0	.0	---	12	1.6	38
6	0	.0	---	32	6.3	59
7	12	3.2	70	44	11.7	63
8	20	7.0	68	32	11.2	66
9	48	21.2	71	48	21.2	71
10	48	26.1	71	48	26.1	71
11	48	31.7	74	48	31.7	74
12	16	12.6	76	16	12.6	76
13	4	3.7	80	4	3.7	80
14	4	4.3	75	4	4.3	75
Total	200	109.8	---	308	132.1	---
Average	---	.549	72	---	.429	65
Site index <sup>1</sup>	89					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 3. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED TWICE—PRE-COMMERCIAL THINNING AT AGE 8 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C5)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
5	0	0.0	---	4	0.6	47
6	0	.0	---	4	.8	62
7	8	2.2	71	36	9.6	66
8	36	12.6	70	48	16.8	68
9	56	24.7	73	72	31.8	72
10	48	26.2	73	52	28.3	74
11	24	15.8	75	24	15.8	75
12	24	18.8	77	24	18.8	77
13	8	7.4	84	8	7.4	84
Total	204	107.7	---	272	129.9	---
Average	---	.528	74	---	.478	71
Site index <sup>1</sup>	91					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 4. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED TWICE—PRE-COMMERCIAL THINNING AT AGE 8 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B4)

Diameter class	Dominants and Codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
5	0	0.0	---	4	0.5	60
6	0	.0	---	8	1.6	61
7	16	4.3	63	20	5.3	63
8	44	15.3	69	60	20.9	67
9	64	28.3	68	80	35.4	68
10	44	24.0	72	44	24.0	72
11	36	23.8	76	36	23.8	76
12	4	3.1	79	4	3.1	79
13	0	.0	---	0	.0	---
14	4	4.3	75	4	4.3	75
Total	212	103.1	---	260	118.9	---
Average	---	.486	71	---	.457	69
Site index <sup>1</sup>	88					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 5. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED TWICE—PRE-COMMERCIAL THINNING AT AGE 8 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B3)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
6	4	0.8	72	12	2.4	62
7	12	3.2	65	28	7.5	65
8	20	7.0	68	48	16.7	68
9	84	37.1	70	100	44.2	69
10	60	32.7	74	60	32.7	74
11	28	18.5	75	28	18.5	75
Total	208	99.3	---	276	122.0	---
Average	---	.477	72	---	.442	70
Site index <sup>1</sup>	89					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 6. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 4'×4' SPACING AND THINNED TWICE—PRE-COMMERCIAL THINNING AT AGE 8 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C6)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
5	0	0.0	---	8	1.1	53
6	8	1.5	58	40	7.8	55
7	28	7.5	64	56	15.0	62
8	92	32.1	66	100	34.9	65
9	72	31.8	67	72	31.8	67
10	44	24.0	68	44	24.0	68
11	20	13.2	67	20	13.2	67
12	8	6.3	69	8	6.3	69
Total	272	116.4	---	348	134.1	---
Average	---	.428	67	---	.385	64
Site index <sup>1</sup>	82					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 7. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND NOT THINNED (PLOT 32C13)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	4	0.4	81	52	4.5	46
5	4	.5	73	72	9.8	60
6	36	7.1	72	80	15.7	63
7	24	6.4	72	52	13.9	70
8	80	27.9	74	100	34.9	72
9	104	46.0	75	120	53.0	74
10	64	34.9	77	68	37.1	76
11	44	29.0	76	44	29.0	76
12	4	3.1	76	4	3.1	76
13	4	3.7	74	4	3.7	74
14	4	4.3	81	4	4.3	81
15	4	4.9	80	4	4.9	80
Total	376	168.2	---	604	213.9	---
Average	---	.447	75	---	.354	68
Site index <sup>1</sup>	92					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 8. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING ON EXCEPTIONAL SITE AND NOT THINNED (PLOT 31A1)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
6	0	0.0	---	4	0.8	70
7	0	.0	---	0	.0	---
8	4	1.4	80	12	4.2	72
9	16	7.1	78	40	17.7	76
10	12	6.5	84	28	15.2	81
11	32	21.1	83	32	21.1	83
12	24	18.9	81	28	22.0	80
13	4	3.7	85	4	3.7	85
14	28	29.9	85	28	29.9	85
15	20	24.5	84	20	24.5	84
16	4	5.6	90	4	5.6	90
17	0	.0	---	0	.0	---
18	4	7.1	90	4	7.1	90
Total	148	125.8	---	204	151.8	---
Average	---	.850	83	---	.744	81
Site index <sup>1</sup>	102					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 9. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C1)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	28	2.4	31
5	0	.0	---	4	.5	43
6	0	.0	---	4	.8	45
7	16	4.3	59	32	8.6	56
8	36	12.5	61	48	16.8	61
9	28	12.4	63	28	12.4	63
10	44	24.0	67	52	28.3	67
11	24	15.8	68	24	15.8	68
12	40	31.4	68	40	31.4	68
Total	188	100.4	---	260	117.0	---
Average	---	.534	65	---	.450	59
Site index <sup>1</sup>	80					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 10. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 18 YEARS (PLOT 35C3, "6'×6'D")

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	8	0.7	38
5	0	.0	---	4	.6	53
6	0	.0	---	32	6.3	56
7	12	3.2	62	72	19.2	59
8	40	14.0	61	104	36.3	60
9	56	24.8	64	84	37.1	62
10	56	30.5	66	64	34.9	66
11	24	15.8	68	24	15.8	68
12	12	9.4	66	12	9.4	66
13	4	3.7	65	4	3.7	65
Total	204	101.4	---	408	164.0	---
Average	---	.497	64	---	.402	61
Site index <sup>1</sup>	79					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 11. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B1)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	4	0.3	29
5	0	.0	---	4	.5	48
6	0	.0	---	8	1.6	67
7	0	.0	---	28	7.5	68
8	4	1.4	68	52	18.2	69
9	16	7.1	77	36	15.9	71
10	32	17.4	78	48	26.2	75
11	36	23.7	80	44	29.0	79
12	24	18.8	78	24	18.8	78
13	8	7.4	82	8	7.4	82
14	8	8.6	79	8	8.6	79
Total	128	84.4	---	264	134.0	---
Average	---	.660	78	---	.507	72
Site index <sup>1</sup>	96					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 12. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31A5)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	8	0.7	43
5	0	.0	---	20	2.7	53
6	0	.0	---	28	5.5	57
7	12	3.2	66	28	7.5	64
8	32	11.2	66	40	13.9	65
9	36	15.9	67	48	21.2	66
10	56	30.5	69	56	30.5	69
11	40	26.4	71	40	26.4	71
12	24	18.8	74	24	18.8	74
13	12	11.1	72	12	11.1	72
14	8	8.6	78	8	8.6	78
Total	220	125.7	---	312	146.9	---
Average	---	.571	69	---	.471	66
Site index <sup>1</sup>	85					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 13. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C7)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	8	0.7	36
5	0	.0	---	0	.0	---
6	4	.8	59	28	5.5	53
7	20	5.3	60	36	9.6	59
8	52	18.1	62	72	25.1	61
9	44	19.5	65	60	26.5	63
10	40	21.8	66	40	21.8	66
11	32	21.1	69	32	21.1	69
12	16	12.6	72	16	12.6	72
13	4	3.7	68	4	3.7	68
Total	212	102.9	---	296	126.6	---
Average	---	.485	65	---	.428	62
Site index <sup>1</sup>	80					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 14. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C2)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
6	0	0.0	---	4	0.8	42
7	4	1.1	64	8	2.1	61
8	24	8.4	65	32	11.2	64
9	44	19.4	70	44	19.4	70
10	48	26.1	68	52	28.4	68
11	36	23.8	73	36	23.8	73
12	28	22.0	76	28	22.0	76
13	16	14.7	70	16	14.7	70
Total	200	115.5	---	220	122.4	---
Average	---	.578	70	---	.556	69
Site index <sup>1</sup>	86					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 15. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—HEAVY, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C3)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
8	0	0.0	---	12	4.2	63
9	32	14.2	72	48	21.2	69
10	16	8.7	68	28	15.3	67
11	28	18.5	71	32	21.1	70
12	24	18.8	73	24	18.8	73
13	28	25.8	76	28	25.8	76
14	8	8.6	82	8	8.6	82
Total	136	94.6	---	180	115.0	---
Average	---	.695	73	---	.639	70
Site index <sup>1</sup>	90					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 16. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—HEAVY, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B5)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
7	0	0.0	---	8	2.1	62
8	48	16.8	67	52	18.2	67
9	56	24.8	71	56	24.8	71
10	32	17.4	69	32	17.4	69
11	32	21.1	72	32	21.1	72
12	44	34.5	73	44	34.5	73
13	16	14.8	77	16	14.8	77
Total	228	129.4	---	240	132.9	---
Average	---	.567	71	---	.554	70
Site index <sup>1</sup>	88					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 17. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×6' SPACING AND THINNED TWICE—HEAVY, EARLY COMMERCIAL THINNING AT AGE 12 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B2)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
7	0	0.0	---	4	1.0	65
8	4	1.4	69	12	4.2	66
9	28	12.4	70	40	17.7	71
10	52	28.3	72	56	30.5	71
11	60	39.6	74	60	39.6	74
12	32	25.1	75	32	25.1	75
13	4	3.7	74	4	3.7	74
14	8	8.6	76	8	8.6	76
Total	188	119.1	---	216	130.4	---
Average	---	.633	73	---	.604	72
Site index <sup>1</sup>	90					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 18. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'×8' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 14 YEARS AND LATER COMMERCIAL THINNING AT AGE 18 YEARS (PLOT 35A7)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
6	0	0.0	---	20	3.9	53
7	0	.0	---	20	5.3	55
8	32	11.2	62	60	20.9	61
9	68	30.0	63	84	37.1	63
10	72	39.2	66	76	41.5	65
11	20	13.2	69	24	15.8	69
12	16	12.6	71	16	12.6	71
13	0	.0	---	0	.0	---
14	4	4.3	75	4	4.3	75
Total	212	110.5	---	304	141.4	---
Average	---	.521	65	---	.465	63
Site index <sup>1</sup>	80					

<sup>1</sup> Based on total height of dominants and codominants.



APPENDIX TABLE B 19. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 6'x8' SPACING AND THINNED TWICE—HEAVY, EARLY COMMERCIAL THINNING AT AGE 14 YEARS AND LATER COMMERCIAL THINNING AT AGE 18 YEARS (PLOT 35B7)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	8	0.7	30
5	0	.0	---	0	.0	---
6	0	.0	---	4	.8	48
7	4	1.1	56	16	4.3	54
8	4	1.4	55	28	9.8	57
9	40	17.7	62	48	21.2	61
10	40	21.8	61	44	24.0	61
11	44	29.0	67	44	29.0	67
12	24	18.8	67	24	18.8	67
13	4	3.7	62	4	3.7	62
Total	160	93.5	---	220	112.3	---
Average	---	.584	63	---	.510	60
Site index <sup>1</sup>	77					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 20. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 8'x8' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C9)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
5	4	0.5	54	20	2.7	45
6	0	.0	---	20	3.9	53
7	20	5.3	59	32	8.5	58
8	24	8.4	58	40	14.0	58
9	68	30.1	65	68	30.1	65
10	40	21.8	64	40	21.8	64
11	4	2.6	64	4	2.6	64
12	20	15.7	68	20	15.7	68
13	4	3.7	68	4	3.7	68
Total	184	88.1	---	248	103.0	---
Average	---	.479	63	---	.415	61
Site index <sup>1</sup>	77					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 21. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 8'x8' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C8)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
5	0	0.0	---	8	1.1	52
6	4	.8	59	16	3.1	57
7	12	3.2	64	24	6.4	60
8	32	11.2	63	44	15.4	61
9	64	28.3	66	64	28.3	66
10	40	21.8	66	40	21.8	66
11	20	13.2	70	24	15.9	69
12	4	3.1	67	4	3.1	67
Total	176	81.6	---	224	95.1	---
Average	---	.464	66	---	.424	64
Site index <sup>1</sup>	80					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 22. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 8'×8' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31A4)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
5	0	0.0	---	12	1.6	55
6	0	.0	---	12	2.3	58
7	0	.0	---	4	1.1	68
8	12	4.2	64	20	7.0	64
9	28	12.4	72	28	12.4	72
10	48	26.2	70	48	26.2	70
11	44	29.0	72	48	31.7	72
12	20	15.7	76	20	15.7	76
13	20	18.4	78	20	18.4	78
Total	172	105.9	---	212	116.4	---
Average	---	.616	72	---	.549	70
Site index <sup>1</sup>	89					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 23. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 8'×8' SPACING AND THINNED TWICE—LIGHT, EARLY COMMERCIAL THINNING AT AGE 15 YEARS AND LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B6)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
5	0	0.0	---	4	0.6	55
6	0	.0	---	4	.8	61
7	0	.0	---	8	2.1	57
8	28	9.8	67	44	15.4	65
9	24	10.6	70	24	10.6	70
10	56	30.5	68	56	30.5	68
11	36	23.8	71	36	23.8	71
12	32	25.1	75	32	25.1	75
13	20	18.4	77	20	18.4	77
14	0	.0	---	0	.0	---
15	4	4.9	78	4	4.9	78
Total	200	123.1	---	232	132.2	---
Average	---	.616	71	---	.570	69
Site index <sup>1</sup>	88					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 24. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 9½'×9½' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31B7)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
6	0	0.0	---	12	2.4	59
7	0	.0	---	8	2.1	57
8	16	5.6	64	32	11.2	62
9	20	8.8	67	24	10.6	65
10	28	15.2	71	32	17.4	70
11	48	31.7	70	48	31.7	70
12	52	40.8	73	52	40.8	73
13	4	3.7	79	4	3.7	79
14	4	4.3	75	4	4.3	75
15	0	.0	---	0	.0	---
16	4	5.6	82	4	5.6	82
Total	176	115.7	---	220	129.8	---
Average	---	.658	71	---	.590	69
Site index <sup>1</sup>	88					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 25. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 9½'×9½' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C10)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	4	0.3	29
5	0	.0	---	0	.0	---
6	0	.0	---	0	.0	---
7	0	.0	---	4	1.1	52
8	16	5.6	63	28	9.8	61
9	24	10.6	64	40	17.7	64
10	40	21.8	67	44	24.0	67
11	36	23.8	72	36	23.8	72
12	24	18.8	70	24	18.8	70
13	24	22.1	72	24	22.1	72
14	4	4.3	74	4	4.3	74
Total	168	107.0	---	208	121.9	---
Average	---	.637	69	---	.586	67
Site index <sup>1</sup>	84					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 26. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 12'×12' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C11)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
8	8	2.8	70	8	2.8	70
9	8	3.5	72	16	7.1	66
10	16	8.7	73	16	8.7	73
11	20	13.2	70	24	15.8	68
12	12	9.4	73	16	12.6	70
13	24	22.1	75	32	29.5	73
14	8	8.6	73	8	8.6	73
15	8	9.8	76	8	9.8	76
Total	104	78.1	---	128	94.9	---
Average	---	.752	73	---	.741	71
Site index <sup>1</sup>	90					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 27. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 12'×12' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31A2)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
6	0	0.0	---	4	0.8	60
7	0	.0	---	0	.0	---
8	4	1.4	74	4	1.4	74
9	4	1.8	79	8	3.5	75
10	24	13.1	76	24	13.1	76
11	12	7.9	81	12	7.9	81
12	20	15.7	85	24	18.8	84
13	32	29.5	82	32	29.5	82
14	8	8.6	79	8	8.6	79
15	12	14.7	83	12	14.7	83
Total	116	92.7	---	128	98.3	---
Average	---	.878	81	---	.787	80
Site index <sup>1</sup>	100					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 28. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 16'×16' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 32C12)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
10	0	0.0	---	12	6.6	67
11	8	5.3	77	8	5.3	77
12	28	22.0	73	28	22.0	73
13	16	14.8	75	16	14.8	75
14	12	12.8	78	12	12.8	78
15	12	14.7	79	12	14.7	79
16	12	16.7	77	12	16.7	77
Total	88	86.3	---	100	92.9	---
Average	---	.981	76	---	.929	75
Site index <sup>1</sup>	94					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 29. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 16'×16' SPACING AND THINNED ONCE—LATER COMMERCIAL THINNING AT AGE 19 YEARS (PLOT 31A6)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
4	0	0.0	---	4	0.3	44
5	0	.0	---	0	.0	---
6	0	.0	---	0	.0	---
7	0	.0	---	0	.0	---
8	0	.0	---	4	1.4	68
9	0	.0	---	0	.0	---
10	8	4.4	72	8	4.4	72
11	12	7.9	72	16	10.6	70
12	16	12.6	74	16	12.6	74
13	12	11.1	79	12	11.1	79
14	24	25.6	78	24	25.6	78
15	16	19.6	82	16	19.6	82
Total	88	81.2	---	100	85.6	---
Average	---	.923	77	---	.856	74
Site index <sup>1</sup>	95					

<sup>1</sup> Based on total height of dominants and codominants.

APPENDIX TABLE B 30. STAND PER ACRE AT PLANTATION AGE 31 YEARS, SLASH PINE PLANTED AT 19'×19' SPACING AND NOT THINNED (PLOT 31A7)

Diameter class	Dominants and codominants			Stand 3.6 in. d.b.h. and larger		
	Trees	Basal area	Average height	Trees	Basal area	Average height
<i>Inches</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>	<i>Number</i>	<i>Sq. feet</i>	<i>Feet</i>
8	0	0.0	---	12	4.2	61
9	0	.0	---	0	.0	---
10	4	2.2	68	4	2.2	68
11	8	5.3	67	8	5.3	67
12	8	6.3	70	8	6.3	70
13	12	11.0	73	12	11.0	73
14	8	8.5	75	8	8.5	75
15	4	4.9	73	4	4.9	73
16	8	11.2	80	8	11.2	80
17	0	.0	---	0	.0	---
18	4	7.1	82	4	7.1	82
Total	56	56.5	---	68	60.7	---
Average	---	1.009	73	---	.892	71
Site index <sup>1</sup>	90					

<sup>1</sup> Based on total height of dominants and codominants.



