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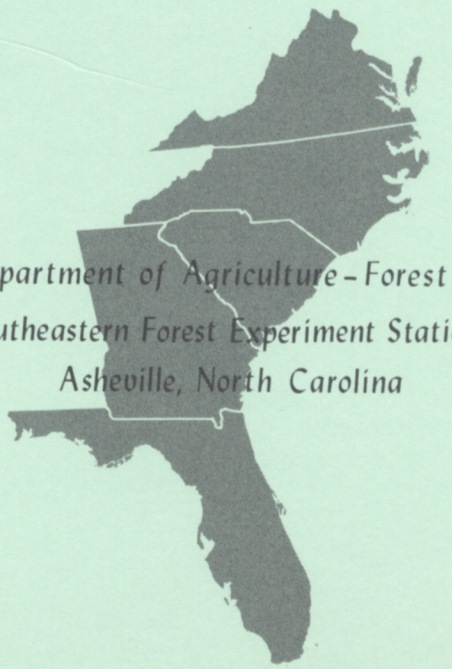

U.S. Department of Agriculture–Forest Service
Southeastern Forest Experiment Station
Asheville, North Carolina

Growth of Two Varieties of Slash Pine on Prepared Sites in South Florida: 10-Year Results

by

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INTRODUCTION

Mechanical site preparation prior to planting pines is a commonly employed silvicultural practice in the southeastern Coastal Plain. As site preparation is a costly part of plantation establishment and maintenance, land managers are interested in knowing how varying levels of site disturbance affect such important factors as survival and timber growth.

In January of 1958, 1959, and 1960, the Southeastern Forest Experiment Station, in cooperation with the Alico Land Development Company and Agrico, Inc., established a study in south Florida to evaluate the influence of selected site treatments on the survival and growth of typical slash pine (Pinus elliottii var. elliottii) and South Florida slash pine (Pinus elliottii var. densa Little & Dorman). A second objective was to compare the performance of these varieties under conditions of the study. McMinn[2] reported the results of the study through the fifth year after planting. This report presents findings through the tenth year.

METHODS

This study was established on flatwoods sites near Corkscrew, Frostproof, and Pierce, Florida (fig. 1). The flatwoods soils are characterized by nearly level, acid sands with poor surface drainage and are underlain either by marl or an organic pan. They are subject to both drought and flooding. The predominant shrub is saw-palmetto (Serenoa repens (Bartr.) Small), and the most common herbaceous cover is pineland threeawn (Aristida stricta Michx.).

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[1] Now located at Asheville, North Carolina.

[2] McMinn, J. W. Preparing sites for pine plantings in south Florida. Southeast. For. Exp. Stn., USDA For. Serv. Res. Note SE-117, 5 pp. 1969.

Mention of trade names in this paper is for identification only and does not imply endorsement by the U. S. Department of Agriculture.

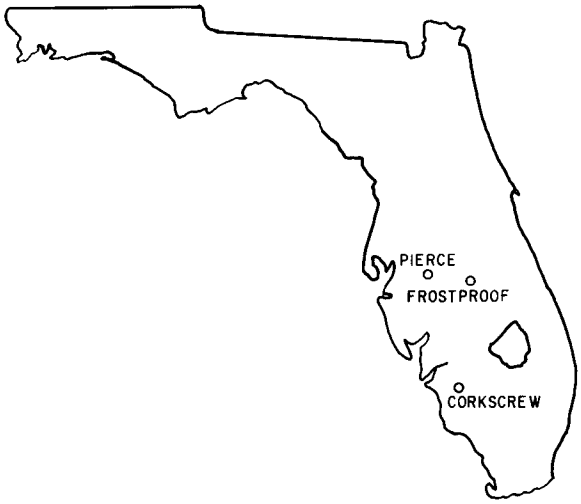

Figure 1.--Location of study sites in Florida.

Site preparations included burning, strip-chopping, double-chopping, clearing, and bedding. Control plots were untreated.

Burning consisted of a prescribed burn with no additional treatment.

Strip-chopping was accomplished by drawing a Marden L-7 Duplex Light Brush Cutter on 10-foot centers over unburned plots with a crawler tractor. The effect was to cut and mix vegetation into the soil with some scarification, but no inversion, of the topsoil (fig. 2).

Double-chopping consisted of chopping the plot twice with the Marden L-7, the second chopping immediately after the first and perpendicular to it.

Clearing included prescribed burning, bulldozing the stumps, collecting the debris with a root rake and burning it, and harrowing the plots with a heavy-duty, offset-disk harrow (fig. 3).

Bedding consisted of plowing fireline furrows at 10-foot intervals on unburned plots so that the ridges thrown to each side of a furrow abutted the ridges of adjacent furrows. These abutting ridges, or "furrow slices," were then chopped to prepare smooth beds for planting. Bedding was not included in the study until the second year.

All treatments for a given planting were applied at about the same time. Site treatment generally preceded planting by 6 to 8 months, although the range was from 1 to 12 months.

Seedlings were planted during late December or in January of 1958, 1959, and 1960. Four replications of each site treatment were established for each location and year. Plots were established near Pierce only during the last 2 years. Each plot measured 4.2 acres and was planted to both typical slash pine and South Florida slash pine in a split-plot arrangement. Seedlings were planted with a drag-type tree planter at a spacing of 6 by 10 feet. Measurements and observations were made on 100 trees near the center of each subplot.

Figure 2. --The strip-chopping treatment.

Figure 3. --Cleared plot receiving final harrowing.

RESULTS

Height Growth

Site preparation significantly improved tenth-year height at five of eight plantings of typical slash pine and at six of eight plantings of the South Florida variety (table 1).

Table 1.--Heights of typical and South Florida slash pines 10 years after planting

Year planted	Location	Site treatment					
		Control	Burning	Strip-chopping	Double-chopping	Clearing	Bedding
		Feet					
TYPICAL SLASH PINE							
1958	Corkscrew	18.7	18.6	19.1	19.4	19.4	--
1958	Frostproof	14.1	18.0*	16.1	19.0*	22.3*	--
1959	Corkscrew	19.2	21.3	21.4	20.2	23.2*	23.7*
1959	Frostproof	15.0	15.9	15.4	18.1	17.9	19.3*
1959	Pierce	33.8	27.2	28.8	28.2	25.2	28.0
1960	Corkscrew	22.2	21.4	22.9	22.9	22.4	22.9
1960	Frostproof	19.5	19.8	21.7	23.8	24.6*	23.4
1960	Pierce	26.8	27.4	28.7	30.4*	31.3*	33.2*
	Average (1959-60)[1]	22.8	22.2	23.2	23.9	24.1	25.1
SOUTH FLORIDA SLASH PINE							
1958	Corkscrew	14.2	12.2	12.2	14.0	14.4	--
1958	Frostproof	10.3	13.0	10.4	15.6*	15.3*	--
1959	Corkscrew	17.4	20.0	19.0	21.2*	24.2*	26.0*
1959	Frostproof	11.3	12.7	12.4	16.2*	15.7*	13.7
1959	Pierce	23.2	30.8	22.4	25.0	23.8	27.0
1960	Corkscrew	15.9	15.2	15.8	19.1*	19.2*	18.1
1960	Frostproof	13.3	16.1	15.8	16.3	18.4*	18.9*
1960	Pierce	20.0	20.4	21.6	23.0*	25.0*	28.0*
	Average (1959-60)[1]	16.9	19.2	17.8	20.1	21.1	22.0

*Significantly different from the control at 0.05 level by Duncan's test.
[1] Years which included all locations and treatments.

Generally, growth response was related to the degree of disturbance or reduction in competing vegetation. Clearing and bedding produced the best improvement in growth. Double-chopping significantly improved growth at several locations, but the response was not as great nor as consistent as that achieved with bedding and clearing. Strip-chopping produced no significant improvement in height growth, and burning resulted in improvement at only one location and in a single year.

Many of the height differences developed the first 5 years after planting,[3] but growth from the fifth through the tenth year was also significantly increased by site preparation (table 2).

[3] Ibid.

Table 2.--Height growth of typical and South Florida slash pines from the fifth through the tenth years after planting

Year planted	Location	Site treatment					
		Control	Burning	Strip-chopping	Double-chopping	Clearing	Bedding
		Feet					
TYPICAL SLASH PINE							
1958	Corkscrew	13.9	13.8	14.3	14.0	14.0	--
1958	Frostproof	10.2	13.2	11.9	13.3	15.1	--
1959	Corkscrew	12.4	13.9	13.5	13.9	14.6*	14.9*
1959	Frostproof	10.3	10.8	10.6	12.2	11.6	11.8
1959	Pierce	21.6	18.8	20.8	20.0	17.9	19.0
1960	Corkscrew	13.5	13.3	14.0	14.6	14.6	14.4
1960	Frostproof	12.2	12.7	13.7	15.1*	15.1*	12.4
1960	Pierce	18.0	18.8	19.2	19.9*	19.6*	18.0
	Average (1959-60)[1]	14.7	14.7	15.3	16.0	15.5	15.1
SOUTH FLORIDA SLASH PINE							
1958	Corkscrew	10.5	9.8	9.8	11.3	11.5	--
1958	Frostproof	8.1	9.6	8.0	11.5	11.9	--
1959	Corkscrew	12.9	15.0*	14.5	15.6*	16.9*	17.9*
1959	Frostproof	8.1	9.0	9.0	11.4	9.7	8.6
1959	Pierce	16.6	17.2	17.2	17.8	17.9	17.6
1960	Corkscrew	11.4	11.1	12.0	14.5*	13.9*	12.9
1960	Frostproof	9.4	11.5	11.3	12.1	12.6*	11.1
1960	Pierce	15.6	15.8	16.2	16.9*	17.3*	17.6*
	Average (1959-60)[1]	12.3	13.3	13.4	14.7	14.7	14.3

*Significantly different from the control at 0.05 level by Duncan's test.
[1]Years which included all locations and treatments.

Five years after planting, bedding had significantly improved growth at four of six plantings of typical slash pine and at five of six plantings of the South Florida variety. From the fifth through the tenth year, however, significant increases in growth on bedded plots occurred on only one of six plantings of typical slash pine and on two of six plantings of South Florida slash pine. Response to the clearing treatment also decreased during the fifth- through tenth-year growth period, but the decrease was not as great as that for bedding. Response to double-chopping was similar during both measurement periods, but the cumulative effect at 10 years was not as great as that from either clearing or bedding. Figure 4 presents a general picture of treatment effects 5 and 10 years after planting.

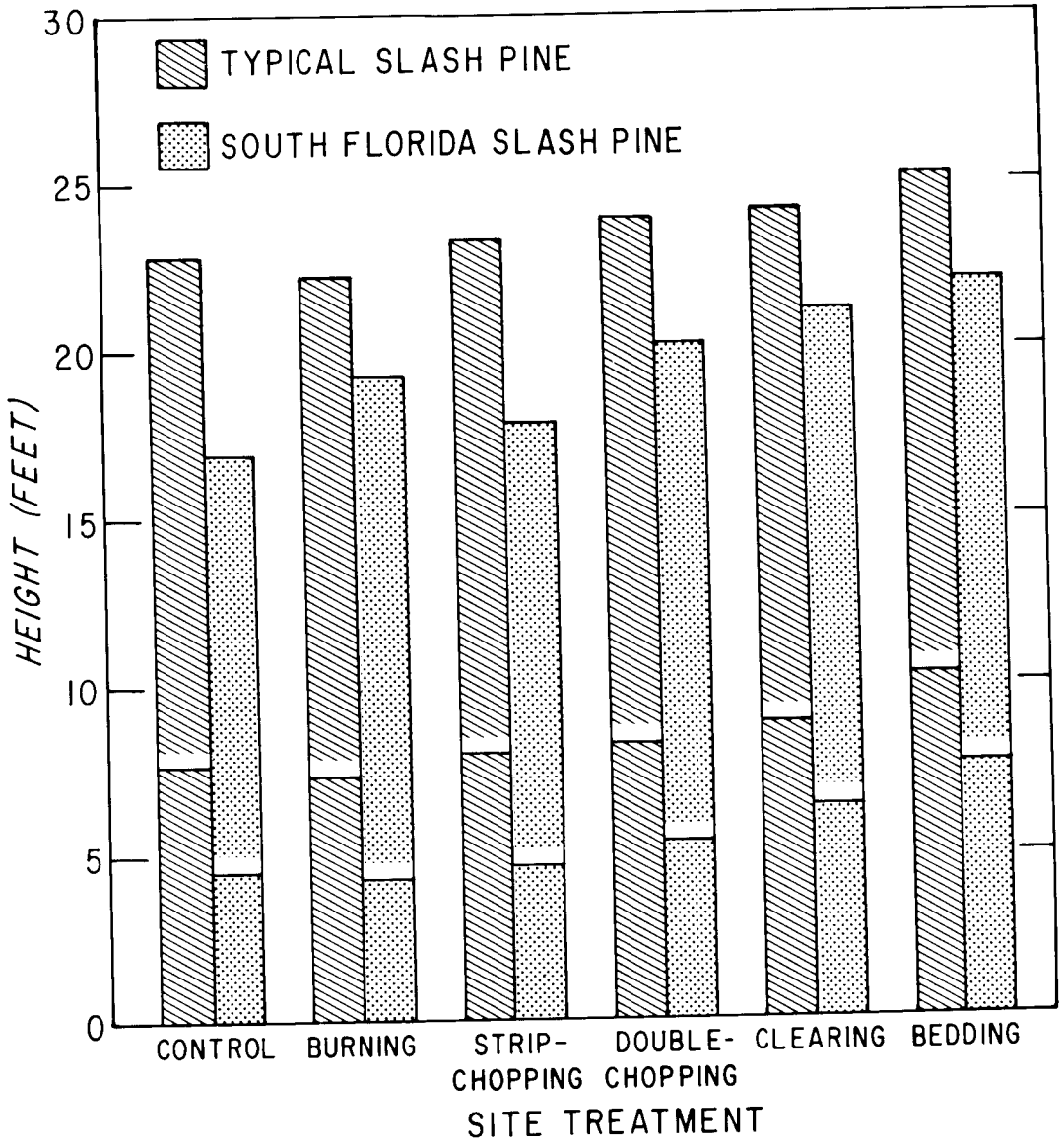

Figure 4.--Ten-year heights of typical and South Florida slash pines averaged for those years (1959-1960) which included all treatments and locations. (Breaks in bars indicate 5-year heights.)

Diameter

Site preparation also produced a significant response in diameter growth (table 3). At four of eight plantings of typical slash pine and five of eight plantings of the South Florida variety, site preparation resulted in significant improvement in growth over that of the control plots. Again, response appeared to be related to degree of site disturbance or reduction in competing vegetation. Generally, growth was best on cleared or bedded plots. Double-chopping resulted in significantly improved diameter increment at several locations, but the response was not as con-

Table 3.--Diameters of typical and South Florida slash pines 10 years after planting

TYPICAL SLASH PINE

Year planted	Location	Site treatment					
		Control	Burning	Strip-chopping	Double-chopping	Clearing	Bedding
		Feet					
1958	Corkscrew	3.2	3.3	3.6	3.5	3.6	--
1958	Frostproof	2.6	3.5*	3.1	3.5*	4.3	--
1959	Corkscrew	3.0	3.6*	3.8*	3.4	4.1	3.9
1959	Frostproof	2.6	2.8	2.7	2.9	3.1	3.0
1959	Pierce	4.8	4.4	4.6	4.5	4.1	4.8
1960	Corkscrew	3.6	3.4	3.8	3.9	3.8	4.0
1960	Frostproof	3.1	3.1	3.3	3.7	3.9*	3.6
1960	Pierce	3.9	4.2	4.2	4.4*	4.4*	4.6*
	Average (1959-60)[1]	3.5	3.6	3.7	3.8	3.9	4.0
	SOUTH FLORIDA SLASH PINE						
1958	Corkscrew	3.0	2.9	2.9	3.5	3.3	--
1958	Frostproof	2.6	3.1	2.5	3.3*	3.7*	--
1959	Corkscrew	3.2	3.8*	3.2	4.0*	4.8*	4.1
1959	Frostproof	2.4	2.7	2.9	3.4	3.3	2.9
1959	Pierce	5.1	5.8	4.4	4.8	5.0	5.3
1960	Corkscrew	3.1	3.3	3.0	4.0*	3.9	3.9
1960	Frostproof	2.8	3.2	3.1	3.4	3.8*	3.6
1960	Pierce	3.9	4.1	4.2	4.6*	4.7*	4.9
	Average (1959-60)[1]	3.4	3.8	3.5	4.0	4.3	4.2

*Significantly different from the control at 0.05 level by Duncan's test.
[1] Years which included all locations and treatments.

sistent as that for clearing and bedding. Strip-chopping improved growth at only one location, and burning resulted in significant responses in only three cases.

Survival

Site preparation had not significantly improved survival at 5 years after planting,[4] and there was little change in percentage of survival at 10 years (table 4).

[4] Ibid.

Table 4.--Percentage of survival of typical and South Florida slash pines 5 and 10 years after planting

Location	Variety[1]	1958 planting		1959 planting		1960 planting	
		5 yr.	10 yr.	5 yr.	10 yr.	5 yr.	10 yr.
		Percent					
Corkscrew	TS	69	68	93	93	84	83
	SFS	38	33	77	76	36	35
Frostproof	TS	31	30	82	72	81	68
	SFS	18	17	65	49	34	31
Pierce	TS	--	--	81	81	77	77
	SFS	--	--	67	64	46	46

[1] TS = Typical slash pine. SFS = South Florida slash pine.

Although the 1959 and 1960 plantings at Frostproof showed a marked decline in survival from age 5 through age 10 for both slash pine varieties, the differences were spread evenly over the treatments, and no statistical analysis was conducted.

Varietal Differences

Overall height at 10 years averaged for all treatments at all locations varied significantly by variety. Typical slash pine averaged 22.2 feet, and South Florida slash pine averaged 17.9 feet:

Growth period	Typical	South Florida
(years from planting)	(height growth in feet)	
1 - 5	7.2	4.7
5 - 10	15.0	13.2
1 - 10	22.2	17.9

McMinn[5] noted in 1969 that "...observations of several 8- to 15-year-old plantations indicate the early lead established by typical slash may not be maintained for a full rotation." Ten-year results of this study lend little support to this conjecture, but it is still too early to tell.

At 5 years, height growth of typical slash pine was significantly greater than that of the South Florida variety at all locations. From the fifth through the tenth year, however, growth of typical slash pine was significantly greater at seven locations and that of South Florida slash

[5] Ibid.

pine was significantly greater at one. Whether or not growth of South Florida slash pine will actually meet or surpass that of typical slash pine later in the rotation remains to be determined.

There was no significant difference in diameter growth between the two slash pine varieties. At 10 years, both varieties averaged 3.7 inches in diameter. However, considering the initial density and the uniformly lower survival of the South Florida variety, the d.b.h. comparison may well be biased in favor of this variety.

DISCUSSION AND CONCLUSIONS

Site preparation resulted in significant improvement in both height and diameter growth of both varieties of planted slash pine in south Florida. Generally, improved growth was related to degree of disturbance or reduction in competing vegetation. Bedding provided the most favorable site for early growth (through 5 years), whereas clearing appears to have provided the most favorable environment for growth from the fifth through the tenth years. Clearing more drastically reduces competing vegetation, but bedding produces the additional effect of altering soil-water relations.[6] [7] It is possible that the improvements in soil moisture and aeration attributed to bedding have their greatest effect on tree growth during early stages of development or until root systems become fully developed. Then, as root mass increases to more fully utilize the site, competition with other vegetation may become the more important factor. When one views the differences in response between the strip-chopping, double-chopping, and clearing treatments, it appears that the degree of disturbance or reduction in competing vegetation is certainly an important factor in improving growth.

Because it is still too early to predict how the plantations will develop through rotation age, only the most tentative of recommendations can be made at this time. Under the conditions of this study, typical slash pine exhibited superior survival and height growth relative to the performance of the South Florida variety and, if present height differences are maintained, will produce more merchantable volume at rotation age. However, it does not appear that site preparation would be a profitable venture when planting typical slash pine. On the other hand, if the South Florida variety is to be planted, site preparation should be considered. If the height advantage demonstrated on the bedded plots is maintained over the rotation, the increase in merchantable volume will probably prove bedding to be a profitable practice in planting South Florida slash pine.

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[6] Ibid.

[7] McKee, W. H., Jr., and Shoulders, Eugene. Depth of water table and redox potential of soil affects slash pine growth. For. Sci. 16: 399-402. 1970.

As always, there are factors other than wood yield to be considered. Among them are degree of fire protection to the young plantation, ease of planting, multiple-use considerations, and improved working conditions during later cultural operations. The woodlands manager should carefully determine expected costs and returns for his specific situation prior to deciding for or against site preparation.

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1973. Growth of two varieties of slash pine on prepared sites in south Florida: 10-year results. Southeast. For. Exp. Stn., USDA For. Serv. Res. Pap. SE-103, 10 pp.

Site preparation improved height and diameter growth but did not improve survival in plantations of typical slash pine (_Pinus elliottii_ var. _elliottii_) and South Florida slash pine (_Pinus elliottii_ var. _densa_ Little & Dorman) established in south Florida. Bedding provided the most favorable site for early growth (through 5 years), whereas clearing appears to have provided the most favorable environment for growth from the fifth through the tenth years. Although South Florida slash pine showed the most marked response to site preparation, typical slash pine exhibited superior survival and height growth relative to the performance of the South Florida variety.

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The Forest Service, U. S. Department of Agriculture, is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.