Southern Forest Experiment Station

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Research Note

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Planted Loblolly and Slash Pine Response To Bedding and Flat Disking on a Poorly Drained Site -An Update

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SUMMARY

Early gains in loblolly and slash pine height growth achieved by bedding an imperfectly drained Beauregard-Caddo silt loam diminished somewhat by age 15. After age 8 there were no increases in growth response to site treatment for either species. For loblolly, yields on flat-disked and bedded plots were about 6 cords (500 ft^3) per acre greater than controls. Much of the difference is attributed to better first-year survival on mechanically treated plots. For slash, yield differences among treatments were small and relatively unimportant.

Additional keywords: Mound disking, bedding, flat disking, site modification, *Pinus taeda, Pinus elliottii.*

SITE PREPARATION

Southern pines planted on imperfectly drained soils in the western Gulf Coastal Plain often have poor survival rates and growth unless there is some degree of site improvement prior to planting. Soils on wet sites in this region are often saturated for long periods in winter but dry in summer. Bedding or mound disking usually improves the drainage characteristics of such sites. Seedlings are elevated 5 to 8 inches above the saturated zone in soil that is more adequately aerated.

This study is one of a series established in southwest Louisiana to test growth response of planted loblolly (*Pinus taeda* L.) and slash (*P. elliottii* var. *elliottii* Engelm.) pine on sites that were prepared mechanically before planting. Soils on the sites are classified as Beauregard-Caddo silt loams. Results should apply to similar soils in the western Gulf Coastal Plain.

The following data summarize results through age 15. Earlier results were reported by Mann and Derr (1970) and Derr and Mann (1977).

METHOQS

Soils on slopes are Beauregard silt loam and soils in lower flats are Caddo silt loam. Relief is level to slightly sloping, with a few natural pimple mounds present on the study area. The Caddo soil has slow surface and internal drainage; the Beauregard has medium drainage throughout.

The site was originally covered with longleaf pine and had not been cultivated. At study installation, cover species included *Andropogon* spp. and scattered post oak (*Quercus stellata* Wang.), blackjack oak (*Q. marilandica* Muench.), and southern bayberry *(Myrica cerifera* L.). The area was burned to eliminate grass rough and woody vegetation was removed.

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Treatments were: control, flat disking. and bedding (mound disking). Controls received no treatment except burning of grass rough to facilitate planting. Flat-disked plots were completely tilled with an offset disk to eliminate grass competition. Plots were disked in November to December 1960 and July 1961. Bedded plots were flat disked, then mounded by double disking with a bedding harrow in September 1961. Mounds were spaced 8 feet apart and averaged 20 inches in height (from furrow to crest) before settling (fig. 1). At age 15 beds were intact and averaged 10 inches in height (fig. 2).

All seedlings were from the Louisiana Forestry Commission nursery at Columbia. They were hand planted in February 1962 at a 6- x 8-foot spacing.

Although gross plots measure 108 x 144 feet, the center 100 planting spots comprise the measurement subplot of 60 x 80 feet. Plots are separated by 50-foot untreated and unplanted strips on four sides that facilitated equipment moving during site preparation. Treatments were replicated four times in a randomized complete block design.

Total heights of surviving pines were measured annually through age 10 and again at ages 13 and 15. Diameters were taken at the same frequency beginning at age 5. Incidence of fusiform rust (*Cronartium fusiforme* Hedgc. & Hunt ex. Cumm.) has been recorded periodically, and was last observed at age 15.

Plots were selectively thinned at age 13 during September and October, leaving an average of 345 trees per acre. Number of stems per acre for individual plots ranged from 335 to 354 after thinning. Thinning helped to equalize stocking among and within treatments, reduce incidence of fusiform bole cankers, and insure more precise height measurements. Thinning caused no apparent damage to the residual stand; no trucks or heavy equipment were allowed within the plots.

Total cubic-foot volume (o.b.) was calculated by prediction equations at ages 13 and 15 (Hasness and Lenhart 1972; Moehring and others 1973).

Figure 1 .--*Bedded plot in October 1961, 10 days after treatment.*

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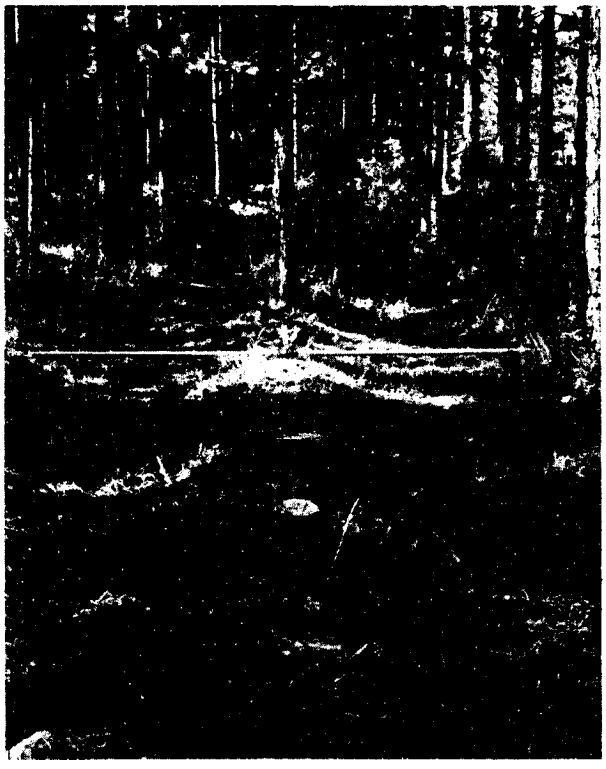

Figure 2.—*Bedded plot in June 1977, 15 years after treatment.*

Growth differences among treatments were tested for significance by analysis of variance at the 0.05 level.

RESULTS

Survival

First-year survival of loblolly pine was 16 percentage points higher on bedded plots than on controls; flat disking improved survival by 14 percentage points (table 1). At age 13, mortality on loblolly control plots was twice as great as on bedded plots, but these differences had developed by the end of the first year. For slash pine, differences in survival among treatments have been small and unimportant.

Table 1.—*Mean survival by species and treatment at three ages*

Site treatment	Loblolly pine			Slash pine		
	Age			Age		
	1	6	13	1	6	13
	Percent			Percent		
Control	74	73	72	87	86	76
Flat disked	88	87	81	82	81	74
Bedded	90	89	87	89	89	76
Mean	84	83	80	86	85	75

Survival by species differed by only 2 percentage points at the end of the first year. By age 13, loblolly survival excelled by 5 percentage points because more slash pines were lost to fusiform rust infection.

Mound disking was completed 5 months before February planting, allowing beds to stabilize, which no doubt contributed to the exceptional pine survival for that treatment. Flat disking has also improved pine survival in some studies, most likely because of reduced grass competition.

Height Growth

For loblolly, all trees and the 100 tallest per acre were significantly taller on flat-disked plots than on controls at age 15 (table 2). Heights of all trees on bedded plots did not differ significantly from controls. From age 2, bedded plots consistently produced taller pines than controls, but height difference declined from a 2.7-foot advantage at age 6 to a 2-foot advantage at age 15. The 100 tallest trees per acre on both flat-disked and bedded- plots were significantly taller than the 100 tallest controls, with differences ranging from 2.2 to 2.9 feet.

For slash, there were no significant height differences among treatments even though pines on bedded plots have consistently averaged about 2 feet taller than those on controls throughout the study.

Periodic annual height growth has been excellent for both species and has averaged over 3 feet per year. Peak annual height growth occurred between ages 6 and 6, averaging 5.15 feet for loblolly and 4.13 feet for slash (fig. 3).

Loblolly height growth excelled on bedded plots from ages 2 through 6; thereafter, growth has been less than or equal to that for other treatments. Similarly, slash pine height growth was best on bedded plots through age 6, but has subsequently ranked last.

Slash pines outgrew loblolly through age 4 but lagged behind between ages 4 and IO. Since age 10, slash pine has again held a slight height-growth advantage. However, at age 15, loblolly was significantly taller than slash.

Diameter Growth

Diameter differences among treatments at age 15 were not significant for either species (table 2). Throughout the study, diameters have generally followed the same pattern as heights among treatments. From ages5 through 6, pines of both species had largest diameters on bedded plots. Bedding was also the superior treatment for slash pine at age 10. From age 10 through 15, bedding no longer ranked first (fig. 4 and 5). For both species, periodic annual

Table 2 -*Average tree size at age 15* [1]

Site treatment	Average total height				Average dbh	
	All trees[2]		100 tallest per acre		all trees[3]	
	Loblolly	Slash	Loblolly	Slash	Loblolly	Slash
	Feet				*Inches*	
Control	50.6a	48.7a	53.8a	52.4a	7.49a	7.16a
Flat disked	*53.4* b	48.6a	*56.7* b	52.2a	7.38a	*7* 07a
Bedded	52.6ab	50.4a	*56.0* b	54.0a	7.18a	7.08a
Mean	*52.2*	*49.2*	*55.5*	*52.9*	*7.35*	*7.10*

[1] Within-column means not followed by the same letter are significantly different.
[2] Includes only those trees not damaged by ice in January 1977.
[3] All surviving trees.

diameter growth from age 6 has been less on bedded plots than for other treatments.

Volume Production

At age 15 total production for loblolly was greatest on bedded and flat-disked plots and surpassed controls by about 500 cubic feet per acre (table 3). Difference in yields between bedded and flat-disked plots was not significant. Volume differences among treatments were not significant for slash. On a per-tree basis, volume production among treatments varied by less than 1 cubic foot for both species and differences were not significant.

Although volume growth of residual trees (after thinning) from age 13 to 15 ranked last on bedded plots, growth differences among treatments were not significant. Volume of surviving trees at age 15 averaged well over 2,000

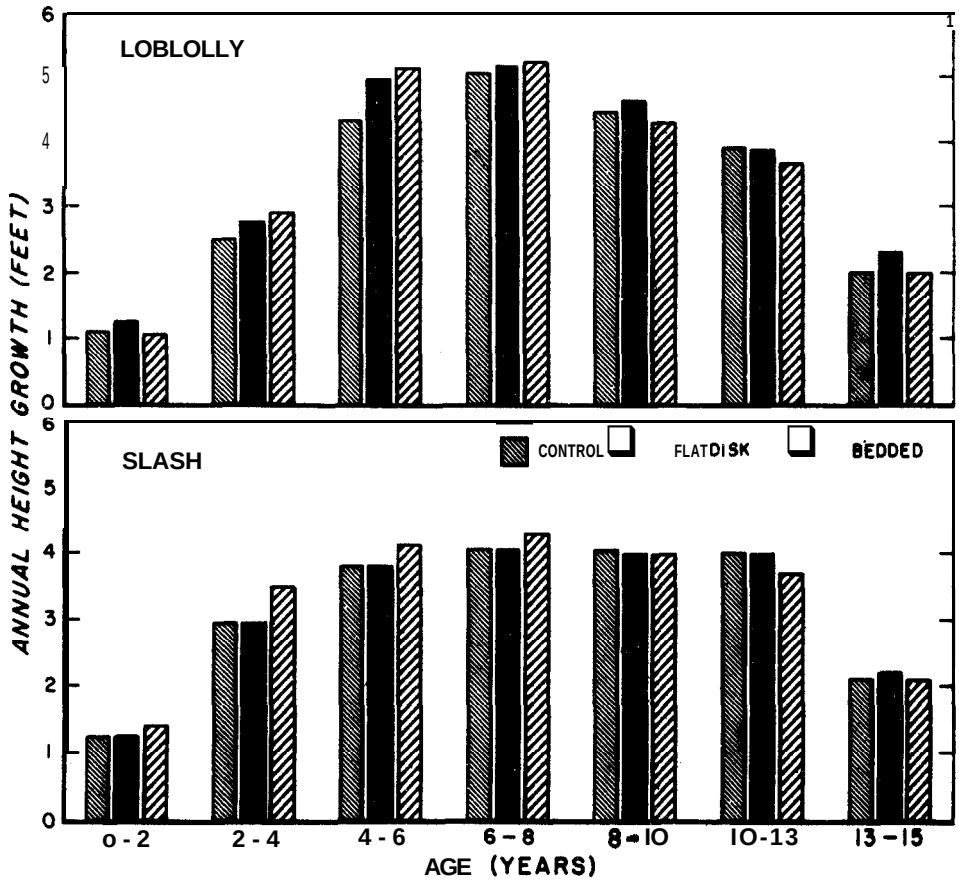

Figure 3.--Periodic annual height growth of all trees *by* site treatment.

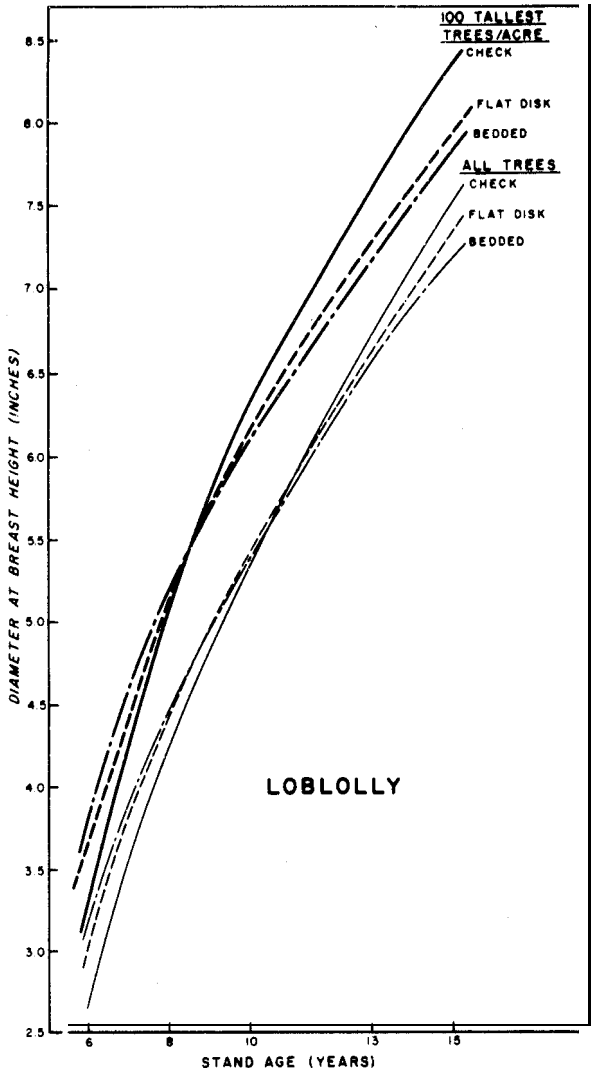

Figure *4.-Average diameters by site treatment at selected ages, 6 to 15 years.*

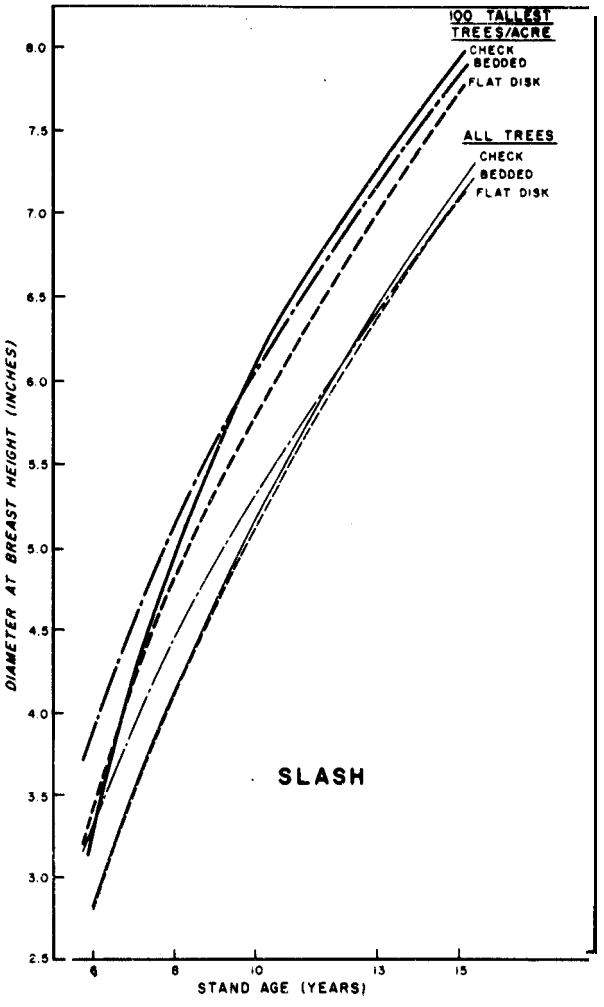

Figure 5.—*Average diameters by site treatment at selected ages, 6 to 15* years.

cubic feet per acre. For both species volumes on bedded plots lagged behind other treatments by more than 100 cubic feet (about 1 cord) per acre, but differences were not significant.

Fusiform Rust Infection

At age 8, 44 percent of the slash pines were diseased; infection of loblolly was modest, averaging 9 percent (table 4). Thinning reduced the proportion of stem-infected pines 4 percentage points for loblolly and 7 percentage points for slash, but the disease is still a serious problem for the slash pines. Site treatments did not significantly influence the incidence of trunk infections for either species.

DISCUSSION

Both species excelled in height and diameter growth on bedded plots for the first 6 to 8 years. Thereafter, periodic annual growth response (height and dbh) on bedded plots has generally fallen behind control and flat-disked plots, but differences have been relatively small. Early height gains achieved by bedding were maintained through age 15. Early response to that treatment is attributed to improved soil moisture and aeration.

Improved growth response on both control and flat-disked plots after age 8 may have been caused by improvement of soil moisture conditions on the site from drying out. With crown closure, pines probably act as pumps to substantially reduce saturated soil conditions through transpiration. In contrast, bedding on relatively flat sites can impound water, especially during winter, which may suppress root development between bedded rows. Lack of inter-bed root systems may therefore inhibit a tree's ability to absorb enough moisture to sustain growth during dry summers. These effects

Table 3.—*Average volume production by species and site treatment*

Species and treatment	Volume			
	Total per acre[1]	Per tree[2]	Growth per tree[3]	Residual per acre[4]
	Cubic feet(o.b.)			
Loblolly				
Control	3,707a [5]	5.28a	1.70a	2,589a
Flat disked	4,122 b	5.08a	1.78a	2,520a
Bedded	4,209 b	4.77a	1.52a	2,405a
Mean	4,013	5.04	1.67	2,505
Slash				
Control	3,687a	4.99a	1.75a	2,460a
Flat disked	3,566a	4.89a	1.78a	2,422a
Bedded	3,684a	5.07a	1.68a	2,313a
Mean	3,646	4.98	1.74	2,398

[1] 13th-year cut volume plus 15th-year standing volume of all surviving trees.

[2] Based on the 13th-year cut volume plus 15th-year standing volume of trees not damaged by ice in January 1977.

[3] From age 13 to 15, based on the same number of trees.

[4] All surviving trees at age 15.

[5] Within-column means followed by the same letter are not significantly different.

Table 4.-*Proportion of living trees with fusiform rust bole cankers at ages 8 and 15, by treatment*

Treatment	Loblolly		Slash	
	Age 8	Age 15	Age 8	Age 15
	Percent			
Control	9.0	4.6	42.6	28.6
Flat disked	7.9	5.4	39.2	37.9
Bedded	10.6	6.6	49.8	44.2
Mean	9.2	5.5	43.9	36.9

may be more critical after trees reach the sapling stage.

Bedding increased total loblolly volume production over controls by about 6 cords per acre after 15 years, but on a per-tree basis the difference among treatments was less than 1 cubic foot. Flat disking was as effective as bedding for increasing loblolly volume growth. Much of the difference in total production among loblolly treatments was probably due to higher survival on bedded and flat-disked plots.

Although slash pines have averaged consistently taller on bedded plots, volume production at age 15 was practically the same for all treatments. It appears that the soil modification treatments gave marginal economic benefits at best, especially for slash pine.

Derr and Mann (1977) reported that gains in pine growth on six bedding studies in southwest Louisiana were modest and inconsistent. They found that loblolly did not respond as well as slash to bedding treatments, especially on the poorest sites. Their largest recorded response to bedding was 2.6 feet in height growth by age 5 for slash pine on a poor site with a Caddo silt loam soil. The site tested in this study has proved to be excellent for pine growth. Since Beauregard silt loam is usually capable of supporting pine without mechanical modification, it may be that the gains in height and volume that were achieved by bedding and flat disking in this study occurred on the Caddo silt loam.

As a general rule, landowners should bed only those sites where the water table is at or near the surface for several consecutive weeks (Derr and Mann 1977). Also, beds should be oriented perpendicular to land contour to facilitate natural surface drainage.

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