CULTIVATION AND FERTILIZATION SPEED EARLY GROWTH OF PLANTED SOUTHERN PINES

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Before a landowner in the Gulf Coastal Plain plants southern pines, he normally prepares a site by burning to remove the grass rough. There is interest, however, in additional treatments that will further reduce competition from native vegetation and improve soil fertility. This paper describes the effects of cultivation and fertilization on survival and height growth of longleaf *(Pinus palustris* Mill.), slash *(P. elliottii* Engelm.), and lobolly *(P. taeda L.)* pines in southern Mississippi.

Methods

The study area, about 20 miles north of the gulf coast, has been stocked with second-growth longleaf pines before it was clearcut in 1958-59. Slope is less than 5 percent. Soils are upland fine sandy loams in the Bowie and Shubuta series. They are low in nitrogen, phosphorus, and potassium. Soil samples taken at depths of 4 to 6 inches averaged 0.027 percent N, 2.23 p.p.m. $P_2 0_5$, and 0.043 meq. K per 100 g. of soil.

Four site treatments, i.e., cultivation with and without three rates of fertilizer application, were compared with an untreated control. Cultivated areas were cleared of all stumps and slash, then plowed and disked. On control areas, stumps, soil, and competing vegetation were not disturbed.

The low fertilization rate was 100 pounds N, 50 pounds $P_2 0_5$, and 50 pounds $K_2 0$ per acre. The medium rate was twice the low rate, and the high rate twice the medium.

Seeds from 5 to 10 parent trees of each species were mixed and sown in the nursery in 1959. In February and March 1960, 1-year-old seedlings were planted at 10- by 10-foot spacing on 60 plots. Plots were arranged in four randomized blocks for replication. Each plot consisted of two /-acre squares, and each square contained 100 trees of a single species; the squares were surrounded by two rows of border trees.

The fertilizer was distributed in May 1961 with an agricultural spreader and disked into the soil. In 1961 and 1962, all trees were sprayed periodically with bordeaux mixture and DDT to control needle disease and tip moths. Disking was done three times each year for 3 years after planting; the plots were mowed in the fourth and fifth growing seasons.

Survival and heights were determined annually at the end of the growing season. Survival percents were transformed to arc sines of percents for analysis. Means of treatments were compared by Duncan's multiple range test, and differences that exceeded the 0.05 level were considered significant.

Results and Discussion

In all species, seedling mortality was heaviest in the first year (table 1). Since the fertilizer had not yet been applied, the only valid comparison is between control and cultivated plots. Slash and loblolly pine survival was significantly lower on control plots.

After the first year, very little mortality occurred in slash and loblolly pines, and differences between treatments were nonsignificant. Survival of longleaf pines after the first year was lower than that of the other species, particularly on untreated plots.

Cultivation alone increased heights at age 5 by about 2 feet in the slash and loblolly pines and by more than 1 foot in longleaf.

The application of NPK fertilizer substantially increased the height growth of all species (table 2). Differences in height growth between fertilizer treatments were small and were statistically significant only in the slash pine.

At 5 years, loblolly pines on fertilized plots were the tallest of the three species. Height growth averaged 5.5 feet in the final year. By that time the loblolly crowns had closed and the slash pine crowns had almost closed. Weeds and grasses no longer

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TABLE 1.—*Survival after 1 and 5 years*

Plots	1st year[1]	5th year
	Percent	*Percent*
[LONGLEAF]		
Cultivated:		
No fertilizer	83.4	80.5
200 pounds	82.8	77.3
400 "	84.3	78.2
800 "	81.1	70.6
Control	74.8	63.8
[LOBLOLLY]		
Cultivated:		
No fertilizer	86.5	85.8
200 pounds	87.1	86.4
400 "	90.5	88.4
800 "	90.1	87.6
Control	77.3*	76.5
[SLASH]		
Cultivated:		
No fertilizer	80.5	77.3
200 pounds	79.5	77.0
400 "	81.8	78.4
800 "	77.8	76.0
Control	65.4*	64.3

[1] First year survival was analyzed by a "t" test contrasting cultivated with uncultivated. Starred control values differ significantly from the cultivated means at the 0.05 level.

offered serious competition except on check plots.

Treatments increased the period of active growth and the number of annual internodes. Flushing began about the same date in all treatments but continued later in the fall on fertilized plots. Slash and loblolly pines developed two or three flushes annually on the check plots and five or six on the fertilized plots.

Coefficients of variation in 5-year heights differed among treatments in the three species (table 3). Variation was largest in longleaf pine, mostly because of the distinctive juvenile growth habit of that species. In slash and loblolly pines, height variation was about twice as large on the unfertilized and control plots as on those fertilized. In those two species, coefficients for all three fertilizer treatments were about equal. Apparently, fertilizing reduced microsite differences.

Early initiation of height growth is important in the successful establishment of longleaf plantations. Seedlings in the grass stage are susceptible to brown spot defoliation but develop beyond the range of infection soon after height growth begins.

Only 7 percent of the longleaf controls had begun height growth after 3 years in the field, compared

TABLE 2.—*Average tree heights after 5 years* [1]

Species	Control plots	Cultivated plots			
		No fertilizer	200 pounds	400 pounds	800 pounds
	Feet	*Feet*	*Feet*	*Feet*	*Feet*
Longleaf	1.16	2.40	7.07	8.15	8.05
Slash	6.16	8.86	13.15	14.80	14.93
Loblolly	6.84	8.67	16.59	17.04	17.75

[1] Differences in height were analyzed by Duncan's multiple range test; means above the same line do not differ at the 0.05 level of significance.

TABLE 3.—*Coefficients of variation of 5-year heights*

Species	Control plots	Fertilizer on cultivated plots			
		None	200 pounds	400 pounds	800 pounds
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
Longleaf	103	58	35	35	34
Slash	32	26	16	15	16
Loblolly	33	33	16	14	13

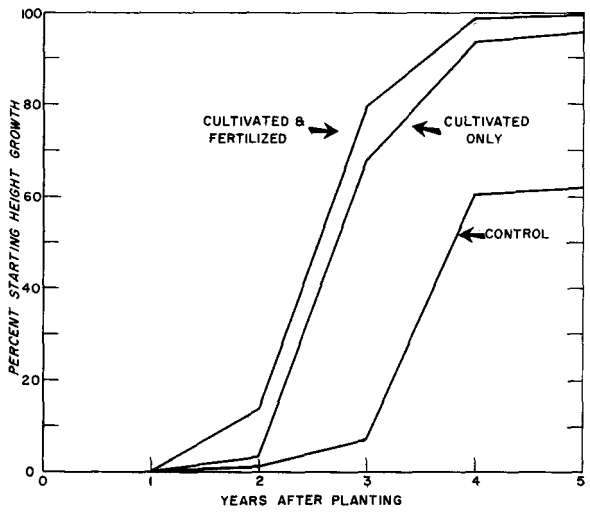

Figure 1.—Percent of surviving longleaf pines that had started height growth by different ages. Only longleaf with a stem height of 0.3 foot or more are included.

with 67 percent or more for the other treatments (fig. 1.) About 40 percent of the surviving check seedlings remained in the grass stage at 5 years, and those that had begun height growth varied widely in height. Final stocking on most check plots is expected to be unsatisfactory. In contrast, longleaf on the fertilized treatments began height growth in the second or third year and attained an annual growth rate of about 4 feet in the fifth year.

In central Louisiana, Derr (1) found that spraying with bordeaux mixture to reduce brown-spot infection was more effective than site preparation treatments in increasing early longleaf height growth. In this study, all longleaf were sprayed periodically in the second and third growing seasons, but brown spot heavily infected control seedlings through the fifth year. In contrast, the disease was light on all cultivated plots, possibly because of the early initiation of height growth.

Results from the present study are in agreement with two other studies of height growth in slash pine plantations. Hughes and Jackson (3) found that cultivation stimulated height growth of these pines in Georgia. Gilmore and Livingston (2) reported that applications of NPK on cultivated soils for the first three seasons increased height growth in Alabama.

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