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Growth of 31-Year-Old Baldcypress Plantation

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SUMMARY

Survival of baldcypress (*Taxodium distichum* (L.) Rich.) planted on clay soil at 6- by 10-foot spacing decreased from 41 percent at age 21 to 26 percent at age 31. In the 10-year period, average diameter increased from 6.1 to 8.6 inches, basal area from 72 to 90 square feet per acre, and total volume outside bark, for trees ≥3.0 inches d.b.h., from 1,288 to 2,333 cubic feet per acre. The 30 largest cypress trees per acre averaged 14.2 inches d.b.h. and 72 feet tall at age 31.

Additional keywords: *Taxodium distichum,* artificial regeneration, diameter increment.

INTRODUCTION

Baldcypress (*Taxodium distichum* (L.) Rich.) is one of the better adapted species for flood-prone sites where many other species cannot survive. While baldcypress is valuable because of its ecological niche, few mills now process its lumber and less than 200 million board feet is produced annually (Williston et al. 1980). However, a ready market exists for the lumber. Cypress growing stock volume, mostly second growth, approximates 5.5 billion cubic feet. Planting cypress on sites subject to flooding is one method of stocking areas where natural regeneration does not provide sufficient numbers of desirable species to produce a commercial stand of timber. Little information is available, though, on development of cypress plantings and growth of individual cypress trees. This note presents 10 years of additional growth data and stand changes from age 21 to age 31 in a cypress plantation (Krinard and Johnson 1976) on Mississippi River clayey alluvium.

METHODS

The cypress plantation was established in February 1955 on a Sharkey clay soil site on the Delta Experimental Forest in Washington County, Mississippi. The 1.23-acre area represented five micro-sites of ridge (0.27 acre), slope (0.23 acre), and three flat-sloughs (0.23, 0.23, and 0.27 acre) over a 3-foot elevation change, with water generally covering the slough 1 to 2 feet in winter. The site had been cleared, planted to cottonwood (*Populus deltoides* Bartr. ex Marsh.) and lost to flooding three times, starting in the late 1930's. The development of heavy vine competition and annual water problems precluded the establishment of desirable commercial species.

The cypress planting consisted of 64 rows of 14 seedlings per row (896 total seedlings) at 6- by 10-foot spacing to test regular and deep plantings with and without top clipping. Cultural treatments consisted of three or four cultivations per year for 4 years and annual mowing for the next 6 years. Most of the seedlings were vine bent during that period.

Heights of all cypress were measured at age 4 and diameters at ages 21 and 31. Where natural regeneration of other species had become established in a cypress planting spot, the d.b.h. of the largest stem was measured if, at age 21, the stem was ≥3.0 inches d.b.h. and not in a suppressed crown position. Heights of 89 cypress, 21 green ash (*Fraxinus pennsylvanica* Marsh.), and 9 boxelder (*Acer negundo* L.) were measured to establish height-diameter relationships for those species.

Outside bark volume information was obtained from cut trees and from standing trees measured with a denrometer for 25 cypress, 10 ash, and 9 boxelder. Volume

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estimates for those three species and combined other species, excluding black willow *(Salix nigra* Marsh.) and cottonwood, were obtained from volume equations using 1-inch diameter classes and heights from height-diameter curves (table 1). Volume is for the main bole outside bark from a 1-foot stump to the top.

RESULTS AND DISCUSSION

No statistically significant differences were found between planting treatments in cypress height or survival by age 4 (Krinard 1959). Average survival was 62 percent (450 trees/acre) and average height was 6.6 feet (range 2.7 to 11 feet). Average survival decreased to 41 percent (296 trees/acre) at age 21 and to 26 percent (191 trees/acre) at age 31. Survival on ridge, slope, and three flat-sloughs, in that order, was 58, 64, 67, 62, and 60 percent at age 4; 48, 47, 45, 33, and 31 percent at age 21; and 29, 32, 27, 21, and 23 percent at age 31.

Average diameter of the cypress increased from 6.1 inches at age 21 to 8.6 inches at age 31. Survivor diameter growth during the last 10 years was 1.3 inches (table 2). From highest to lowest site, average diameter at age 21 was 5.5, 7.2, 6.3, 5.9, and 5.8 inches; at age 31 corresponding diameters were 7.7, 9.7, 8.8, 8.9, and 8.2 inches. Ninety-five percent of the mortality in the last 10 years occurred in trees <6.0 inches d.b.h. Thus, the number of cypress trees per acre ≥6.0 inches d.b.h. only increased from 141 to 147 in 10 years, but the number of trees ≥10.0 inches d.b.h. more than doubled from 28 to 65. Cypress on the ridge site had lowest average diameter and least 10 years' diameter growth both for all surviving trees and for the seven or eight largest trees per site.

At age 31 the 37 largest cypress over the whole planting area (30 largest trees per acre) averaged 14.2 inches d.b.h. with 10 years average growth of 3.3 inches. Heights averaged 72 feet and ranged from 64 to 78 feet. Eight of the 37 trees were also measured for height at age 21, and by age 31 these trees had averaged 15 feet of height growth in the 10 years.

The two largest trees in the area were a black willow and a cottonwood. The black willow grew from 15.4 inches and 77 feet to 19.5 inches and 94 feet. The cottonwood grew from 15.3 inches and 70 feet to 20.0 inches and 86 feet. The largest ash tree grew from 10.3 to 16.4 inches and was 82 feet tall; the fastest growing ash went from 4.6 to 12.4 inches d.b.h.

Considering all measured trees, basal area per acre increased from 95 square feet at age 21 to 124 square feet at age 31. By species, basal area in square feet per acre at ages 21 and 31 were 72 and 90 for cypress, 11 and 11 for boxelder, 7 and 15 for ash, and 5 and 8 for other species.

At both ages 21 and 31, cypress comprised about 72 percent of the total outside bark volume for all measured trees (table 3). For trees ≥3.0 inches d.b.h. cubic volume mean annual increment (m.a.i.) for all species increased from 85 to 106 cubic feet per acre per year, while cypress increased from 61 to 75. For trees ≥6.0 inches d.b.h., all species' m.a.i. increased from 69 to 100 cubic feet per acre per year and cypress increased from 51 to 71.

Volume m.a.i. of planted cypress and accompanying other species other than large cottonwood and black willow after 31 years on Sharkey clay was similar to 29-year-old natural regeneration which developed following seed tree cutting in two minor bottoms of southeastern Arkansas (manuscript in process): 98 vs. 93 cubic feet per acre per year in trees ≥5.0 inches d.b.h. Average dominant heights were 72 feet for both cypress on Sharkey and the major species, sweetgum, on the Coastal Plains' soils.

The cypress trees were still very limby (fig. 1). As a measure of limbiness, a limb count of the 30 largest cypress per acre was made to a height of 15.5 feet. There were an average of 23 limbs per tree, with a range from 7 to 44 limbs.

Table 1.—*Height-diameter equations and volume equations for cypress, ash, and boxelder*

Cypress

$$\text{Log } H = 2.073355 - 3.412764(1/A) - 0.847855(1/D) - 18.669395(1/AD)$$
$$FI = 0.92,\ S_e = 3.6,\ CV = 5.9\%$$

$$V = 0.000533\ D^{1.548744}\ H^{1.588621}$$
$$FI = 0.99,\ S_e = 1.9,\ CV = 7.9\%$$

Ash

$$\text{Log } H = 2.150234 - 6.328654(1/A) - 0.914316(1/D)$$
$$FI = 0.92,\ S_e = 3.9,\ CV = 6.3\%$$

$$V = 0.000217\ D^{1.159686}\ H^{2.019012}$$
$$FI = 0.98,\ S_e = 1.2,\ CV = 7.6\%$$

Boxelder

$$\text{Log } H = 1.925858 - 4.128692(1/A) - 0.453021(1/D)$$
$$FI = 0.87,\ S_e = 2.3,\ CV = 4.6\%$$

$$V = 0.000866\ D^{1.868471}\ H^{1.339688}$$
$$FI = 0.97,\ S_e = 1.0,\ CV = 11.5\%$$

H = total height, V = volume (outside bark) from a 1-foot stump to the tip of the stem, A = age, D = d.b.h., FI = fit index, S_e = standard error of estimate in actual units, CV = coefficient of variation.

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Table 2.—*Number of trees per acre at ages 21 and 31, and intervening mortality and average d.b.h. growth of survivors by 1-inch d.b.h. classes*

	Cypress				Other species			
	Trees/acre			10 yrs.	Trees/acre			10 yrs.
D.b.h. class	Age 21	Mort.	Age 31	d.b.h. growth	Age 21	Mort.	Age 31	d.b.h. growth
Inches				*Inches*				*Inches*
1.0/1.9	0.8	0.8	.....	.....	....	....	....	.....
2	17.0	15.4	.....	1.6	....	....	....	.....
3	42.9	37.3	4.1	0.3	11.3	0.8	0.8	1.4
4	47.8	29.2	21.9	0.1	19.5	0.8	8.9	1.8
5	46.2	17.0	18.6	0.5	23.5	4.1	13.8	1.9
6	38.9	4.1	24.3	0.9	26.7	4.9	13.8	2.3
7	29.2	0.8	21.9	1.1	6.5	0.8	13.8	2.1
8	28.4	....	21.1	1.5	6.5	1.6	11.3	3.2
9	16.2	....	14.6	2.3	4.1	2.4	4.1	3.0
10	13.8	....	18.6	2.5	1.6	0.8	7.3	6.1
11	10.5	....	14.6	2.6	0.8	....	4.1	4.0
12	0.8	....	8.9	2.1	0.8	0.8	4.8	.....
13	1.6	....	11.3	4.4	....	....	....	.....
14	1.6	....	6.5	7.0	....	....	....	.....
15	.....	....	0.8	.....	1.6	....	0.8	4.4
16	.....	....	0.8	.....	....	....	0.8	.....
17	.....	....	0.8	.....	....	....	....	.....
18	.....	....	1.6	.....	....	....	....	.....
19	.....	....	.....	.....	....	....	0.8	.....
20	.....	....	.....	.....	....	....	0.8	.....
23	.....	....	0.8	.....	....	....	....	.....
Total	295.7	104.5	191.2	.....	102.9	17.0	85.9	.....
Avg.				1.3				2.1

Figure 1.—*General view of planted cypress in 31st growing season.*

Table 3.—*Cubic volume by species and diameter thresholds at ages 21 and 31*

Species	Trees ≥3.0 inches		Trees ≥6.0 inches	
	Age 21	Age 31	Age 21	Age 31
	Cubic feet/acre			
Cypress	1,288	2,333	1,079	2,214
Ash	149	459	112	439
Boxelder	238	277	156	216
Sugarberry and persimmon	33	62	16	54
Black willow and cottonwood	82	163	82	163
Total	1,790	3,294	1,445	3,086

Results of the last 10 years—age 22 through age 31—have shown a slight decline in cypress diameter growth, with the 30 largest trees per acre decreasing from a diameter m.a.i. of 0.52 to 0.46 inch per year and a periodic annual increment of 0.33 inch per year. Also, butt swell tends to increase as tree size increases, which tends to inflate diameter growth. But diameter growth of these plantation trees still exceeds that of natural stand trees (Putnam et al. 1960).

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