SOUTHERN FOREST EXPERIMENT STATION

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DIAMETER GROWTH AND PHENOLOGY OF TREES ON SITES WITH HIGH WATER TABLES

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SOUTHERN FOREST EXPERIMENT STATION

On a site where the water table always was within the root zone, thinning had little effect on diameter growth of white ash or sweetgum but increased the growth of baldcypress. Thinning did not extend duration of growth into the fall, nor was growth related to seasonal fluctuations in the water table. In ash and sweetgum, growth initiation seemed related to soil temperature; in baldcypress, to day length.

Previous studies with pines *(1, 4, 8, 9, 10)*[1] had indicated that tree diameter growth is related to soil moisture depletion on upland sites that are well above any water table. The current study examined seasonal growth of hardwoods and cypress on a bottom-land site where free water was present in the rooting zone during much of the growing season.

THE STUDY AREA

Two plots were laid out in pure stands of each of three species: baldcypress *(Taxodium distichum* (L.) Rich.), white ash *(Fraxinus americana* L.), and sweetgum *(Liquidambar styraciflua* L.). One plot of each species had been thinned in 1958, prior to study installation, and the other left unthinned. Ash plots were 1 acre in size, baldcypress ½ acre, and sweetgum 1/10 acre.

The site was a minor botton on the Tallahatchie Experimental Forest near Oxford, Mississippi. The soil is moderately deep, permeable loam to silty clay with fairly good internal drainage. The bottom is fed by numerous temporary springs and is bounded on one side by a small permanent stream. Plot elevations above the stream bed for the thinned and unthinned treatments respectively were: sweetgum—6.3 and 5.5 feet; ash—6.0 and 8.7 feet; baldcypress—6.9 and 6.4 feet. During heavy winter and spring rains, the bottom is subject to brief overflow. The gum plots were on land farmed as recently as the early 1940's, and furrows are still visible in places.

PROCEDURE

Ten dominant or codominant trees in each plot were instrumented with dendrometer stations *(3, 11)*. In the center of each plot, a ground-water well made of 3-inch galvanized

[1] Italic numbers in parentheses refer to Literature Cited, p. 4.

downspout pipe was sunk to a depth of about 6 feet. On the thinned sweetgum plot—the one at the highest elevation—a stack of six fiber glass units *(2)* was installed at intervals from the surface to 42 inches.

Observations on moisture, growth, temperature, and phenology were made from March through September each year from 1959 through 1962. Readings were taken twice weekly but never on the day following a rain. Dendrometers were read with a dial gage, the fiber glass units with a Colman moisture meter, and the ground-water wells with a dip stick.

Diameter growth rates tend to change with age. Hence, to facilitate comparisons, growth increments were converted into cross-sectional wood accrued per stem per year.

Initial stand conditions are given in table 1. Two increment cores were taken from each tree to determine average diameter growth for the 5 years prior to thinning. The cores indicated that, in baldcypress and sweetgum, trees on the thinned and unthinned plots had been growing at equal rates. In ash, the older and larger trees on the thinned plot had been growing faster than the trees on the unthinned plot (table 2).

Table 1.—*Initial stand conditions, 1958*

Species and treatment	Age [1]	D.b.h. [2]	Basal area per acre [3]	
			Before thinning	After thinning
	Years	*Inches*	– *Sq. ft.* –	
Sweetgum				
Thinned	16	6.0	96	80
Unthinned	16	5.6	92	
White ash				
Thinned	40	13.3	93	62
Unthinned	35	9.3	100	
Baldcypress				
Thinned	85	14.7	258	199
Unthinned	85	15.9	265	

[1] Age and d.b.h. values are the averages of the 10 dendrometer trees per plot.

[2] D.b.h. of the baldcypress was measured at 6 feet.

[3] Basal area computations include all trees 4 inches in d.b.h. and larger.

RESULTS

Growth in 1959-62 on all plots except the unthinned ash was considerably faster than in 1954-58, when several severe droughts had occurred (table 2). Baldcypress responded the most to thinning, ash the least.

Comparisons between thinned and unthinned plots were clouded by site differences, probably those related to heights of the water table. Thus the increase on the thinned sweetgum, though appreciable, was less than on the unthinned.

Diameter growth curves on the two sweetgum plots were almost identical each year until early July, at which time the thinned gum began to lag (fig. 1). The water table on the thinned plot was almost exactly 1 foot lower than on the unthinned plot throughout the measurement period; the difference corresponded roughly to the difference in plot elevations. When the growth curves began to diverge, there still were 5 to 12 inches of available water in the top 4 feet of soil.

For each species, thinned and unthinned trees began growth at the same time in the spring. On no plot did thinning appear to extend growth into the late summer or early autumn.

Table 2.—*Average cross-sectional growth per tree per year*

Year	Baldcypress		White ash		Sweetgum	
	Thinned	Unthinned	Thinned	Unthinned	Thinned	Unthinned
	– – – – – –	– – – – – –	– – – *Square inches*	– – –	– – – – – –	– – – – – –
1954-1958 (av. annual)	3.45	3.45	4.03	2.25	3.26	3.27
1959	5.59	3.26	4.62	2.20	4.11	4.62
1960	5.43	4.80	3.83	2.07	4.30	4.71
1961	5.28	4.87	4.96	2.26	4.68	5.28
1962	4.36	3.89	3.74	2.14	4.33	4.77
Av., 1959-1962	5.16	4.20	4.29	2.17	4.36	4.83

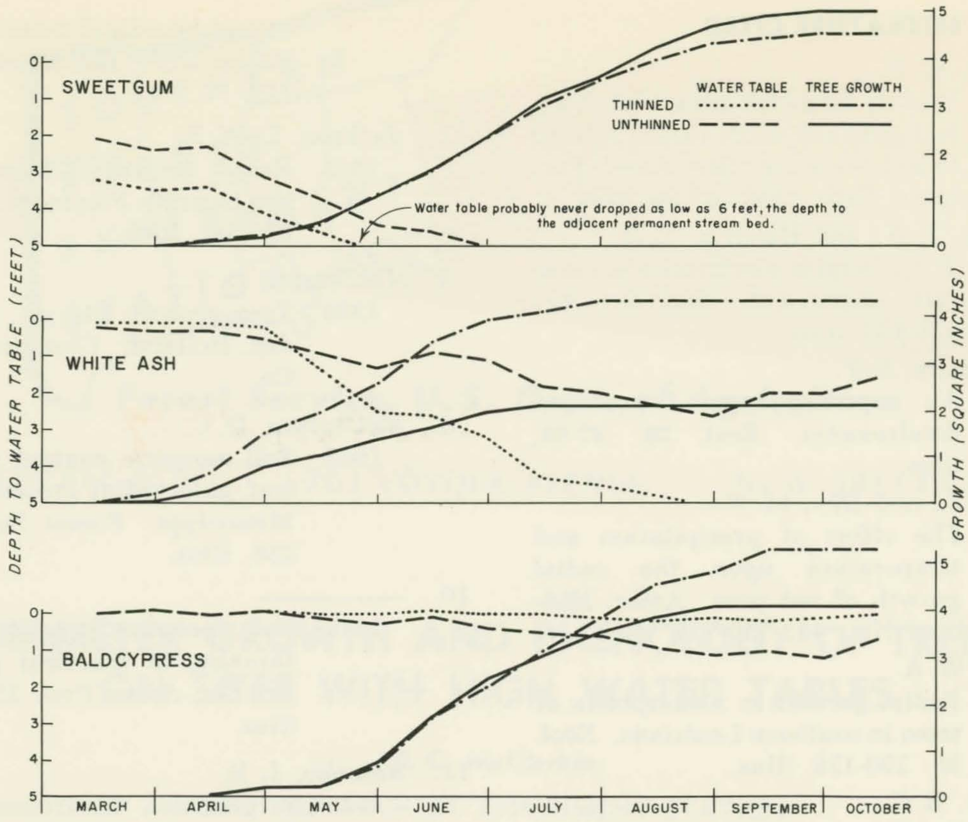

Figure 1.—*Mean basal area growth per tree and water-table fluctuations. Values are averaged for the 4-year period.*

Ash trees consistently began diameter growth several weeks in advance of sweetgum and baldcypress and several weeks before leafing out. They typically were leafed out by the first week in May. Ash also concluded growth weeks or even months ahead of the others. Possibly the prolonged high summer temperature and photoperiodic responses cause early cessation of growth even though soil moisture is still abundant *(5)*.

Sweetgum trees began diameter growth near the time of full leaf, usually in late April. Baldcypress were in full leaf several weeks before growth began, a characteristic that has been reported previously *(7)*; the trees typically began leafing out near April 1, and were in full leaf before May.

If soil temperature helped regulate the onset of growth *(6, 8)*, it varied with species. Ash began growing when soil in the 6- to 12-inch layer neared 50°F., while sweetgum began about the time soil reached 60°. Baldcypress performance appeared unrelated to temperature, since growth began after the soil had been in or near the 60's for several weeks. In this species, day length may be the critical factor, for growth began about the same calendar date each year.

Growth in baldcypress and ash trees began each year with water standing on the surface or within an inch or two of it, and continued steadily throughout the season without regard to fluctuations of the water table.

The performance of the ash plots does not appear to be related to water. Though the unthinned plot was the wetter, trees grew only about half as fast on it as on the thinned plot. Nor does it seem likely that water was a deterrent: both ash plots were totally saturated during the first few weeks of the season, during which time the thinned ash made rapid growth.

No relationships were observed for any species between proximity of water table to the surface and duration of growth. Differences in diameter or volume accrued per year were related to velocity rather than duration of growth.

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