Eighteen-Year Development of Sweetgum *(Liquidambar styraciflua* L.) Plantings on Two Sites

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Average diameter and height of planted sweetgum at age 18 were 5.7 inches and 37 feet on a fine-textured soil compared to 10.1 inches and 65 feet on a medium-textured soil.

Sweetgum (*Liquidambar styraciflua* L.) has a wider distribution than any southern hardwood species. Regeneration may occur from either stump and root sprouts or from seed. Planting of bare rooted seedlings is also feasible, with sweetgum being one of four hardwood species used in intensive plantation management in the Southeast (6). This paper compares the growth of two 18-year-old planted stands of similar genetic makeup on two different soils in Mississippi.

Methods

The two sweetgum plantations were established in the winter of 1964-65 growing season at 10- by 10-foot spacing. One planting was at Huntington Point (HP), Bolivar County, MS, on medium-textured Commerce silt loam soil in the Mississippi River floodplain. The other was on the Delta Experimental Forest (DEF), Washington County, MS, on a fine-textured Sharkey clay soil. Sweetgum occurs frequently on both soils and is rated as a species that should be favored in management and is suitable for planting (1). Sharkey is a member of the very fine, montmorillonitic, nonacid thermic family of Vertic Haplaquepts, and Commerce is a member of the fine-silty, mixed, nonacid thermic family of Aeric Fluvaquents. Each planting consisted of 100 seedlings from each of 81 open-pollinated families. Seeds were obtained from six areas: one each in Arkansas and Tennessee and two each in Alabama and Mississippi.

The sites were kept mostly weed free by cultivation the first 2 years. Mowing was used for weed control the following years. At HP, alternate diagonal row thinning was done on part of the planting at age 6 and on the remainder of the planting at age 8. Similar thinning was done on the DEF at age 12.

After the 18th year, all trees in two east-west randomly selected rows at each site, other than border trees at each end of the rows, were measured for diameter at breast height (d.b.h.) and height. After trees leafed out the following growing season, clear bole length and height to live crown were measured on HP trees.

Cubic volume estimations were obtained from Barr and Stroud dendrometer measurements of 22 trees at HP and 10 at DEF. Equations were developed for stem volume (outside bark) from a 1-foot stump to the tip of the stem (VOB) or to a 4-inch outside bark diameter (VOB4) (table 1). Stem weights were calculated from cubic volumes, with an assumed dry density of 28.7 pounds per cubic foot.

Results and Discussion

The better site (HP) sweetgum was about 75 percent larger in both d.b.h. and height and had three times greater basal area and nearly five times more volume and weight in the main stem from a 1-foot stump to the top than the poorer site (DEF) sweetgum with the same stocking at age 18 (table 2). Outside bark volume to a flinch top was 94 percent (HP) and 69 percent (DEF) of total stem volume outside bark. Assuming 90 cubic feet per cord, volume mean annual increment to a flinch top was 1.6 and 0.2 cords per acre per year on the two sites, exclusive of thinned trees.

Clear bole length of HP trees averaged 10 feet (range 4 to 17 feet) and was unrelated to d.b.h. or total height ($r^2 < 0.01$). Live crown ratio of HP trees averaged 54 percent, and was more closely related to d.b.h. ($r^2=0.43$) than to total height ($r^2 = 0.33$).

Early height development of these two plantings, after 1, 3, and 6 years, was 1.5, 5.8, and 12.7 feet at DEF and 2.3, 10.8, and 27.1

Table 1—*Cubic volume estimations for sweetgum grown at two sites in Mississippi*

Huntington Point (Commerce silt loam soil)	
VOB = 1.383 + 0.001876 D^2H	
r^2 = 0.95	
$S_{y \cdot x}$ = 1.28	
$\bar{V}$ = 15.9	
VOB4 = 0.002 + 0.001945 D^2H	
r^2 = 0.95	
$S_{y \cdot x}$ = 1.41	
$\bar{V}$ = 15.1	
Delta Experimental Forest (Sharkey clay soil)	
VOB = 0.285 + 0.002099 D^2H	
r^2 = 0.95	
$S_{y \cdot x}$ = 0.27	
$\bar{V}$ = 4.1	
VOB4 = -0.729 + 0.002189 D^2H	
r^2 = 0.92	
$S_{y \cdot x}$ = 0.35	
$\bar{V}$ = 3.2	

VOB = stem volume (outside bark) from a 1-foot stump to the tip of the stem, VOB4 = 4-inch outside bark diameter, D = diameter at breast height, H = total height.

feet at HP.[1] Other sweetgum planting studies on the same soils on these two areas gave similar results, with sweetgum height at age 4 of 12.0 feet at HP (3) and heights of 1.4, 5.4, and 12.5 feet at ages 1, 3, and 6 on the DEF (4).

From soil series, for natural stands, the estimated site index range is from 80 to 100 feet at age 50 for Sharkey and from 100 to 120 feet for Commerce (1). Dominant tree heights at age 18, based on the 5 tallest trees per sample row or 26 tallest trees per acre, of 72 feet at HP and 43 feet at DEF may be used to calculate site indices from two different sets of natural stand curves. From curves based on plots in Alabama (5), the DEF heights equated to site index 75 at age 50; the HP heights were beyond the curves but calculated as site index 110, a reasonable figure. Extending site index curves based on plots from the lower Mississippi River Valley (2) produced site values of 80 and an unrealistic 135 for the two areas. Therefore, sweetgum site index, whether from planted or natural stands, is probably around 80 on Sharkey and 110 on Commerce. Each additional foot of height, as estimated by site index, amounted to an increase of 74 cubic feet of volume or 13 percent more growth.

That Sharkey clay is a poorer site for planting than Commerce has also been found for cottonwood (*Populus deltoides* Bartr. ex Marsh.), and sycamore (*Platanus occidentalis* L.), where 10-year height growth has only been 55 to 60 percent as good (4). Similarly, sweetgum height growth at age 18 was only 57 percent as good on Sharkey as it was on Commerce.

These sweetgum plantings have shown good survival, and thus plantations are a good means for establishing the species (figs. 1 and 2). However, planting is an intensive and expensive management alternative. As clearing costs are generally similar regardless of sites, planting on better sites represents a much better investment. Natural regeneration may be preferred to planting, especially on poorer sites.

[1] Unpublished data on file at Southern Hardwoods Laboratory, Stoneville, MS.

Table 2—*Eighteen-year values for sweetgum grown at two sites in Mississippi*

Variable	Huntington Point (Commerce soil)	Delta Experimental Forest (Sharkey soil)
Trees per acre	192	194
Diameter (in)		
Average	10.1	5.7
Range	5.5–14.7	4.6–7.3
Height (ft)		
Average	65	37
Range	48–75	30–46
Basal area (ft^2/acre)	111	35
Cubic volume (ft^3/acre)	2780	565
Dry weight (tons/acre)	39.91	8.08

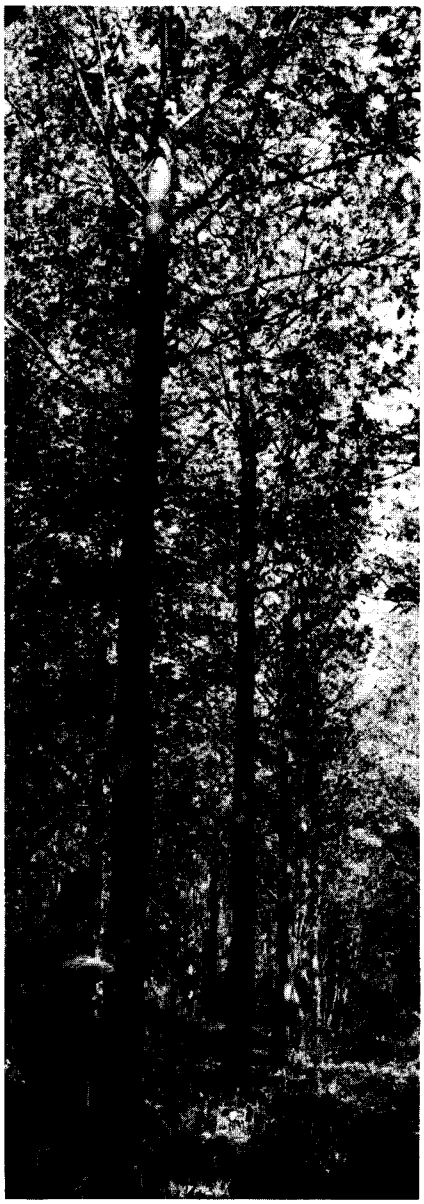

Figure 1—*General view of 20-year-old planted sweetgum on Sharkey clay soil.*

Figure 2—*General view of 20-year-old planted sweetgum on Commerce silt loam soil.*

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