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Survival and Growth of Sweetgum, Shumard Oak, and Spruce Pine Planted on a Creek Bottom Site in the Carolina Coastal Plain

Abstract. Sweetgum (*Liquidambar styraciflua* L.) survival and growth was significantly superior to Shumard oak (*Quercus shumardii*) and spruce pine (*Pinus glabra*) in a cleared forest planting on a stream terrace site. After five growing seasons sweetgum had 91 percent survival and averaged 12.5 feet in height, whereas values for Shumard oak were 72 percent and 5.2 feet, and for spruce pine 48 percent and 7.7 feet. Sweetgum was also less seriously damaged by falling deadened culls and rapidly escaped competing vegetation. Shumard oaks and spruce pines both showed considerable variation in height and form in contrast to sweetgum's relative uniformity.

Sweetgum (*Liquidambar styraciflua* L.) is an important member of the species-rich, bottomland forests of lower Carolina coastal plain creeks. Shumard oak (*Quercus shumardii* Buckl.) and spruce pine (*Pinus glabra* Walt.) are less abundant, but all three are preferred species in the management of these woodlands. In a test of their reaction to several planting spacings (4×4, 6×6, and 8×8 feet) the effect of spacing is not yet evident after five growing seasons, but there are some striking differences in survival and height growth between the three species.

These results are from a study located on a second bottom or terrace site adjacent to a small stream in the Santee Experimental Forest, near Charleston, S. C. The soil is rather variable; on the higher portions of the terrace Coxville loam and silt loam occur, but as the stream is approached the soils grade into sandy loams intermediate in character between the Coxville and Chastain series. Thickness of the A horizon fluctuates, but as a rule it is 15 inches or more in depth over clay (Coxville series) or sandy clay loam-clay loam (intermediate soil).

Before study installation, the area supported a partially stocked stand of sweetgum, cherrybark oak (*Q. falcata* var. *pagodaefolia* Ell.), American beech (*Fagus grandifolia* Ehrh.), yellow-poplar (*Liriodendron tulipifera* L.) and Shumard oak, with scattered loblolly pine (*P. taeda* L.) and spruce pine. After the salable timber was logged, residual large trees were poisoned with ammate and the saplings and brush were basal sprayed with a mixture of 2,4,5-T in oil. Two planting blocks were installed, both three chains square, with each subdivided into nine equal plots. This enabled comparison of the three species at three spacings, randomized and replicated twice. The plots were planted in January

1955, with graded 1-0 seedlings raised from local seed. The conventional 10-inch planting bar was used.

An examination after the first growing season showed a survival of 92 percent for spruce pine, 96 percent for sweetgum, and 97 percent for Shumard oak. At that time each seedling was also classified according to a scale of general vigor, which showed little difference among species since almost all the seedlings seemed to be doing very well. After five years this initial uniformity no longer exists; the sweetgum shows outstanding superiority both in height growth and survival (Table 1).

Terrace hardwood sites are inherently rich and where openings are created, dense thickets of aggressive vegetation develop rapidly. If a planted species is to be successfully established on cleared sites, seedling growth must be very vigorous during the critical first few years. The planted sweetgum has this ability for fast initial growth and relatively few individuals are overtopped by competing vegetation (Fig. 1). Vines are the major offenders; they are supported by the saplings and have caused some stem deformation. The other two species are still struggling with blackberry canes (*Rubus* spp.), other brush, and vines. This severe competition apparently nullified any early effect of spacing on the form and growth of the planted trees.

TABLE 1.—SURVIVAL AND AVERAGE HEIGHT OF PLANTED SWEETGUM, SHUMARD OAK, AND SPRUCE PINE AFTER FIVE GROWING SEASONS

Species	Survival[1]	Stems overtopped	Average height[1]		Coefficient of variation of height for undamaged stems[2]
			All stems	Undamaged stems[2]	
	Percent		*Feet*		*Percent*
Sweetgum	91	36	12.5	13.4	26
Shumard oak	72	75	5.2	5.5	56
Spruce pine	48	70	7.7	7.8	50

[1]Significant difference between all species at the 5-percent level (analysis of variance, Q test).
[2]Saplings undamaged by falling debris from deadened overwood.

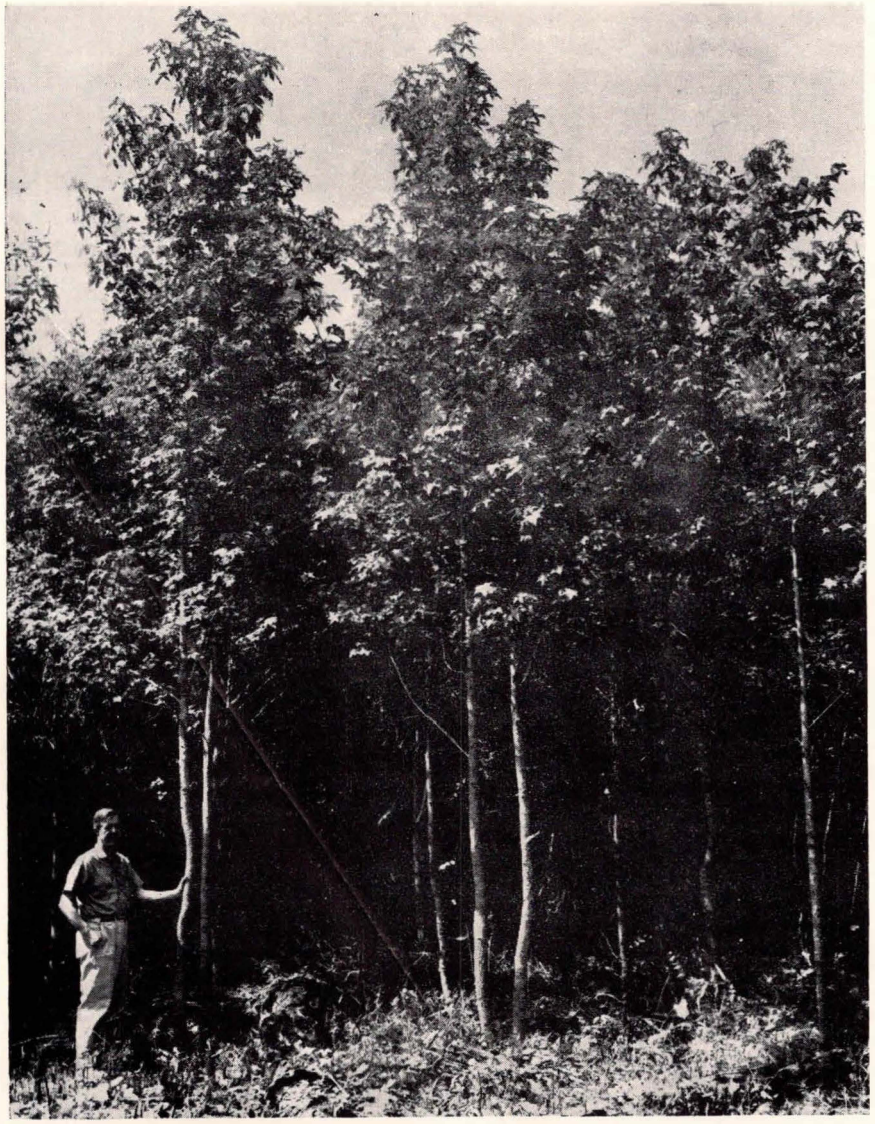

FIG. 1.—A typical sweetgum plot during the sixth growing season after planting. Most of crook was caused by vines which were cut away for picture-taking purposes.

The breaking up of dead overwood trees, especially the large, heavy-limbed beech, caused considerable damage to the planted trees, amounting to 11 percent of the surviving spruce pine, 18 percent of the Shumard oak, and 20 percent of the sweetgum. Spruce pine had the least ability to endure mechanical injury; about half of those damaged died, while many others were badly malformed. Sweetgum suffered the highest percentage of damaged trees because of a higher survival rate and much larger average size. However, sweetgum was quite tolerant of damage, and often survived even when crowns were broken away.

The sweetgum show more uniformity in height than do the other two species. This is illustrated by the coefficient of variation values in Table 1, wherein standard deviation of height is expressed as a percentage of respective average height. In proportion to their much larger average size, sweetgum height variation is about half that of Shumard oak and spruce pine. Some of the oak seedlings are only a few inches taller than when planted, others have grown rapidly —the largest is 21 feet tall, nearly matching the best sweetgum. This growth phenomenon has been observed in other oak plantings and may be due to genetic variation. Marked height growth differences also exist among the spruce pines, along with conspicuous natural variation in tree form. Some

spruce pine are very straight, whereas others have a pronounced spiral-shaped crook.

Based on the previous stand and uncut stands on similar topographic positions and soils, there is no reason to believe these plots are especially good sweetgum sites or poor sites for the other two species; they appear to be good sites for all three. Unless there is further treatment, however, it appears that only the sweetgum plantings will result in well-stocked, homogeneous stands. Plots of the other two species have a ragged appearance; patches of natural sweetgum, yellow-poplar, and oak of both seedling and sprout origin have often outgrown the planted trees. If an acceptable stand of Shumard oak or spruce pine is to be realized, a cleaning or weeding operation is needed. Aside from excellent survival and growth, sweetgum is a species admirably suited to planting in these respects:

1. Large quantities of seed are easily collected most years (as opposed to the difficulties of acorn collection).
2. The seed has good viability, 70 percent or better.
3. Nursery stock is easily grown.
4. Planting is not difficult; the stock is not excessively large and cumbersome to handle.

Sweetgum sawtimber continues to be in demand, and the growing market for gum pulpwood makes intermediate cutting feasible in sawlog rotations, or allows short rotations solely for pulpwood production. All these desirable features make sweetgum particularly amenable to management.

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