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SWEETGUM MANAGEMENT

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If your forest has conditions that favor sweetgum[1], this bulletin can help you manage your trees for their best returns. Sweetgum grows on many different sites and in association with many other species. It is a major component within many diverse stands in the South and several States elsewhere. Markets for sweetgum lumber and pulpwood fluctuate with the economy, but are well established. More than 90 percent of the sweetgum is in the South. See figure 1.

Growers will find available markets for their sweetgum in most areas where it grows well. Accordingly, annual production for sweetgum lumber has varied between about 1 billion board feet (1976) and 400 to 500 million board feet in most years during this century. Net annual growth is estimated at 600 million cubic feet.

Sweetgum has desirable characteristics that meet the demands of a variety of products. It is a valuable source of lumber, veneer, plywood, slack cooperage, railroad ties, fuel, and pulpwood. End products include boxes, crates, furniture and containers, among other products.

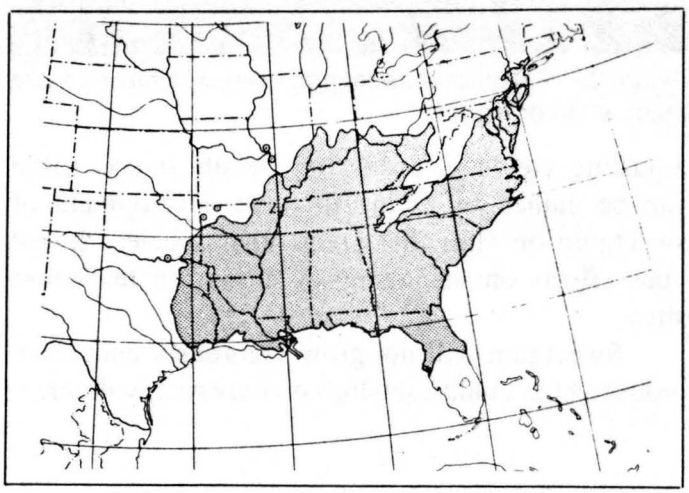


Figure 1.—Shaded area shows the range of sweetgum in North America.
The species may be found at elevations from sea level to 2,000 feet. Source: A. H. Fowells

SITES

Sweetgum will grow in about 100 soil types, but the productive limits of some of those soils will result in only a minimum pulpwood size. For commercial lumber markets, you should grow this species on land that has a site index of 80 (base age 50) or higher (figure 2). Best performance is on bottomland sites that have a high water table — 2 to 4 feet below the surface.

Like other species in natural stands, sweetgum will occupy the sites that are most favorable to it. If sweetgum is found on sites better suited to other species, the trees will usually be overtopped by competing species before the young trees get large enough to outgrow the competition.

Baker and Broadfoot[2] developed a guide that provides a simple method to select the best site for sweetgum. Their booklet, or the services of a soils scientist will help you make the best choices. Soil factors, site history, flooding, and man's influence are all considered in the booklet. These considerations will help match the proper species to the available site.

Another way to determine site index in forested areas is to get the age and total height of at least five dominant sweetgums. Match these values to the appropriate site index curve in figure 3. Another section of this guide offers a rule-of-thumb for

[1] *Liquidambar styraciflua* L.

[2] See References at the end.

Figure 2.—Example of sweetgum in an area having a site index of 80 or higher.

adjusting yields according to the site index. Little can be gained by trying to force development of sweetgum on sites that favor other species. Invest your efforts on managing sweetgum on the better sites.

Sweetgum will not grow vigorously enough to produce high quality sawlogs on excessively drained, upland sites where pines predominate. These unsuitable areas have a site index below 80 for sweetgum. Trees on adverse sites usually respond by producing small limbs along the bole (epicormic branches). They also exhibit a suppressed rate of growth. Maximum potential for sweetgum on these sites would be for pulpwood — and that would be at a low production level. These sites might be better suited to growing pine.

In the absence of sufficient numbers of sweetgum on a site to clearly show where they would grow well under natural conditions, look for other hardwood species that produce large, high-quality trees. The presence of these trees is evidence of the site quality desirable for sweetgum. Table 1 lists species that indicate site suitability for sweetgum.

NATURAL REGENERATION

Trees smaller than 16 inches d.b.h., will reproduce readily from stump and root sprouts. For best results, cut trees as low as possible, preferably no higher than 12 inches above the ground. Figure 4

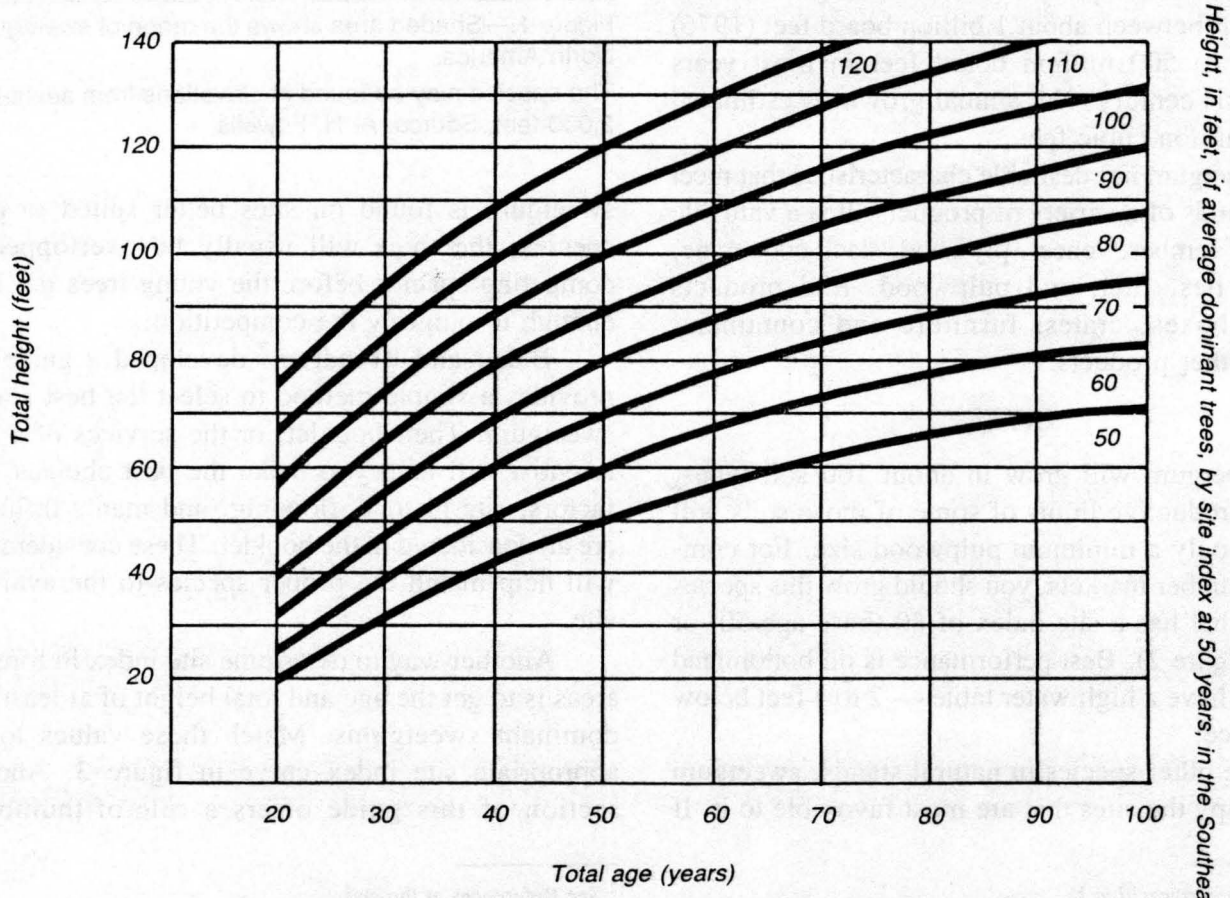


Figure 3.—Site index curves for sweetgum in fully stocked stands. Source: F. E. Hampf

Table 1.—Trees that serve as indicator species in site selection

Good sites *(site index = 105-120)*	Medium-quality sites *(site index = 90-105)*	Poor sites *(site index = 80-90)*	Unsuitable sites *(site index = less than 80)*
American beech	oaks:	black willow	cypress
boxelder	chinkapin	overcup oak	oaks:
magnolia	laurel	pecan	blackjack
oaks:	nutall		post
cherrybark	willow		southern red
shumard	water		
	sugarberry		

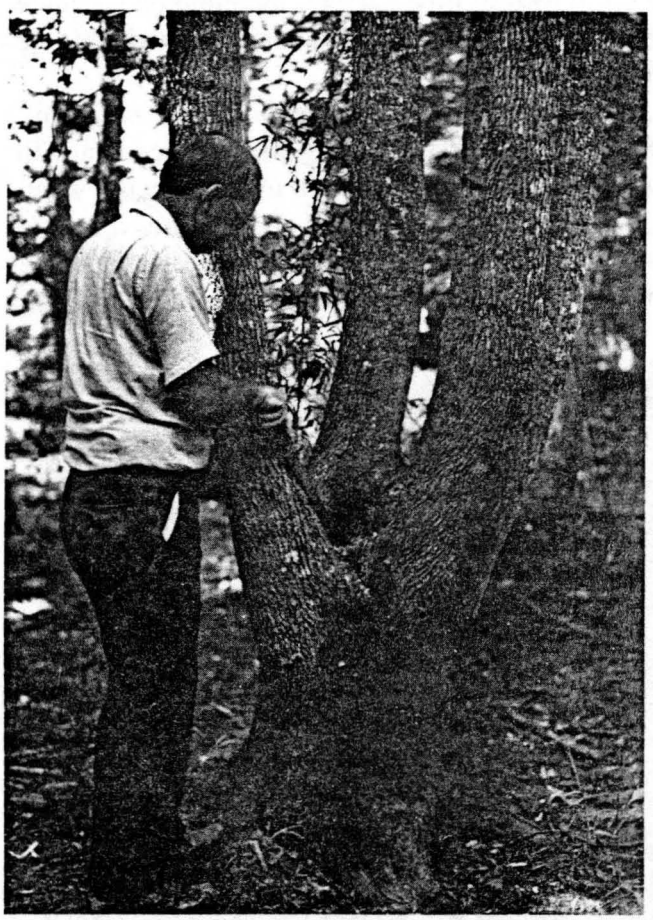


Figure 4.—This tree produced four trunks, which arise from a stump that was cut too high.

illustrates a stump that was cut too high, resulting in multiple stems of high stump origin. High-origin stems are more likely to inherit decay from the parent stump.

Residual shade must be removed to stimulate growth of new trees following final commercial harvest. If more than 20 percent of the ground is shaded by the remaining trees after harvest, then these trees should be cut to facilitate regeneration of the new stand. This can be accomplished by hand or mechanical methods. Mechanical shearing is an option if many 2- to 3-inch trees and culls remain after harvest. Of course, soil conditions must be able to support heavy equipment.

Stump sprouts grow rapidly, as much as 5 feet per year for the first 5 years. Thus, they will outgrow most competing trees and other plants that are at ground level. Codominant trees should grow to 2 inches in d.b.h. in 5 to 7 years. To increase the number of sweetgums in a postharvest stand, favor the sprouting of roots and stumps.

Sprouting of stumps and roots is most prolific when logging is done during domancy in the fall. However, satisfactory sprouting will also occur at other times of the year. Sprouting may be delayed as long as 2 years after a harvest. Roots up to 200 years old will resprout, with most sprouts growing from roots located within 5 inches of the soil surface.

Most root sprouts will remain attached to the roots of the parent tree, even though all will eventually have individual, completely-developed root systems. Remember this trait if you apply a herbicide to kill undesirable trees. The herbicide may be carried through the roots of the injected trees into adjacent trees, injuring or killing them as well as the target trees. See figure 5.

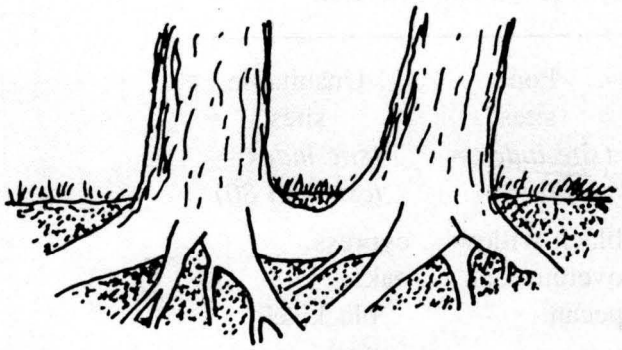


Figure 5.—Root connection between two sweetgums of sucker origin.

Source: John B. Francis, Southern Forest Experiment Station, USDA Forest Service.

Bare, mineral soil will favor germination of the seeds. The seed of sweetgum is dispersed abundantly for distances of up to 200 feet from the parent tree. Sweetgum does not become established from seed that falls on sod. Provide a seedbed free of grass and herbaceous plants for natural seeding from late September to early November.

Because sweetgum is shade-intolerant its seedlings will not persist more than a few weeks under a closed canopy. If new seedlings get started, they usually die before they can grow more than 6 inches tall, unless the canopy is opened.

Sprouts or seedlings need 6 to 8 hours of daily sunlight for good growth. During the first 20 years on good sites, they will outgrow most associates. It is not necessary to leave seed trees on harvested areas.

Sweetgum is not as persistent or competitive as red oaks, which often grow in mixed stands with the sweetgum. Although sweetgum will grow faster than red oaks in the early years, the oaks that have not been directly overtopped by the sweetgums will be as tall as, or taller than, the sweetgums in 20 to 30 years.

Sweetgum of sprout or seed origin may occur singly or in nearly pure, even-aged stands. The latter are most common on old fields and offer an option to either grow pulpwood alone or to combine it with sawtimber.

MANAGEMENT CHOICES FOR NATURAL STANDS

Sawtimber Rotations

Best growth and development of sweetgum occurs on moist, well-drained soils. These are the sites best suited for commercial timber production (figure 6). Rotations of 60 to 80 years are recommended for producing sawtimber suitable for factory lumber. Longer rotations might be needed to produce highest-quality veneer products, but in some areas there is a risk of stand deterioration after age 80. Regardless of rotation age, the highest quality trees should be featured in management to final harvest.

Generally, the rotation you use will be dictated by market demands, distance of those markets from the stand, and the competition from other sources of timber.

Thinning for sawtimber rotations should normally be considered when trees reach a commercial size — 6 inches d.b.h. in about 20 years on a site 90. From then to final harvest, the thinning schedule proposed by Putnam, Furnival and McKnight (figure 7) is recommended.

Stagnation can be a problem on some sweetgum sites. Precommercial thinning may be necessary to avoid this problem. Stagnation usually occurs when the stand is about 20 years old and 6 inches d.b.h. If precommercial thinning is attempted, it should be done early when codominant trees are about 2 inches

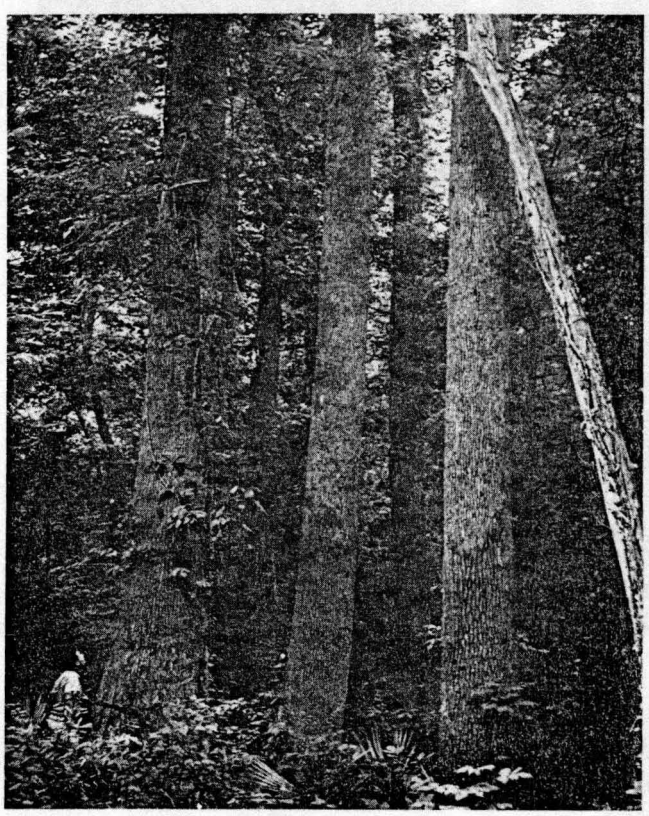


Figure 6.—Tall, vigorously growing sweetgums thrive in moist, well-drained soils.

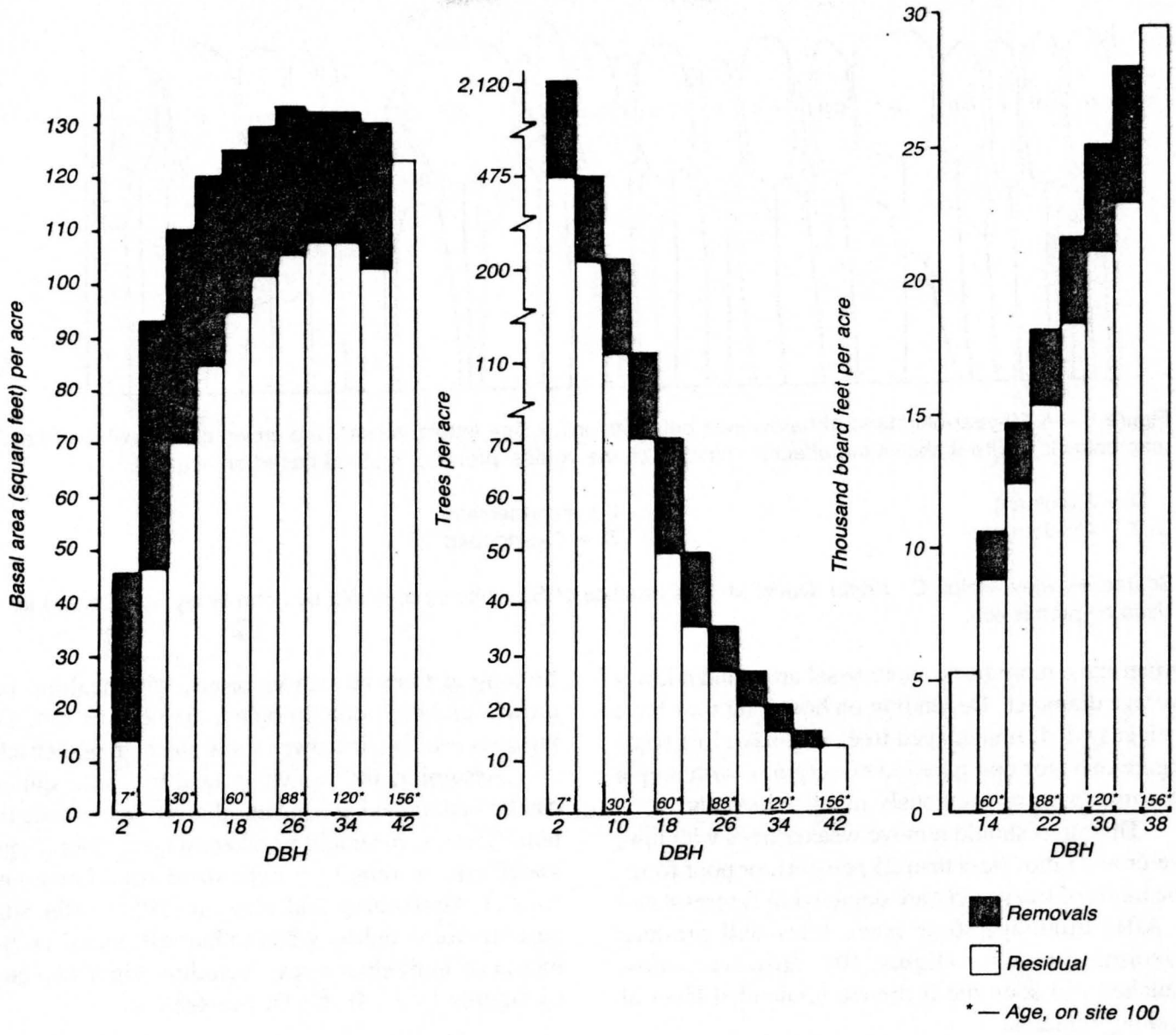


Figure 7.—Hypothetical stocking and yields per acre for well-managed, even-aged sweetgum on average or better sites.[1]

[1]Adapted from Krinard, Roger M. Management and Inventory of Southern Hardwoods. Agriculture Handbook No. 181. Washington: U.S. Department of Agriculture; 1960. p. 80-81.

d.b.h. and 20 feet tall. One possibility is using a bulldozer with a K-G blade. Eight-foot swaths should be made through the stand, leaving 2-foot strips of trees.

Acceptable levels of stocking, following the precommercial thinning, can vary considerably. Maximum stocking should be no more than 2,000 trees per acre and the minimum should be no less than 500.

In practice, too many owners miss the first good opportunity to improve their stands. The owners let their trees grow past the time most suitable for early thinnings. Although subsequent growth and yields of residuals will not match those of stands thinned earlier, the thinning schedule outlined by Putnam, Furnival and McKnight is still suggested.

Major differences between older, uncut stands and managed stands are that, for a given age, the

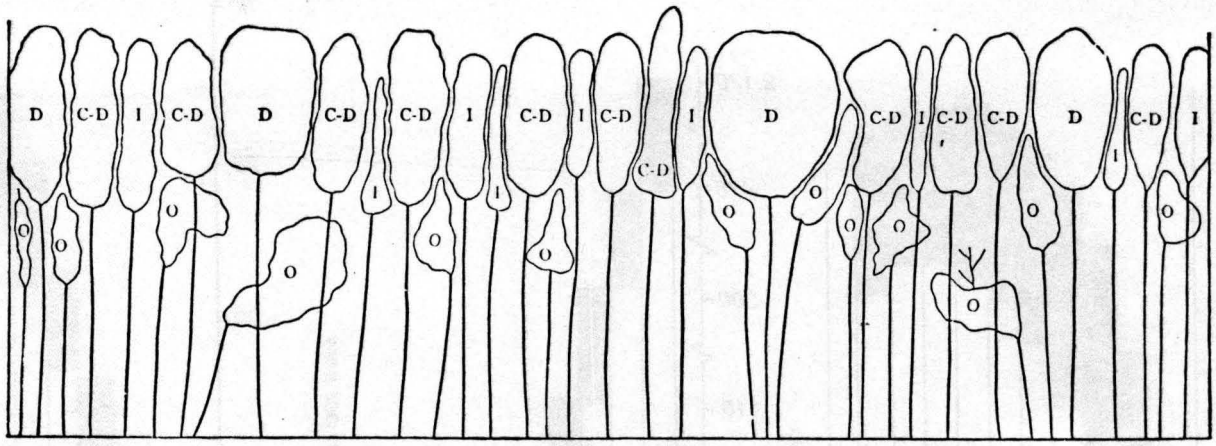


Figure 8.—A 50-year-old stand of hardwoods before thinning. The letters indicate the crown classes of the trees (see below). Figure 9 shows the effect of thinning on the vertical profile of a stand based on figure 8.

D = Dominant
C-D = Co-dominant
I = Intermediate
O = Overtopped

Source: Hawley, Ralph C.; Smith, David M. The Practice of Silviculture; copyright by John Wiley and Sons, Inc. Used by permission.

former have more trees, more basal area, and a lower average diameter. Depending on how long they have been crowded, unmanaged trees will have lost some degree of vigor compared to sweetgums with ample growing space in previously managed stands.

Thinnings should remove weaker trees with low, live-crown ratios (less than 25 percent), or poor form. The kinds of trees to cut are depicted in figures 8 and 9. After thinning, some leave trees will produce epicormic branches (figure 10). However, most branches will soon die if the recommended level of stocking remains.

Individual trees scattered through the forest are handled as part of the total stand of mixed hardwoods. So long as trees remain vigorous, with healthy, full crowns and high-quality boles, they can be left. Cut the trees when their crowns show any sign of dieback.

Assuming the crown is healthy, bole quality can be maintained as long as adjacent trees shade the bole. Thus, care should be taken to keep older, larger sweetgums in relatively tight stand conditions until harvest. Guttenberg and Putnam (1951) offer suggestions for deciding when to harvest, based on the merits of individual trees, including vigor depicted by figures 11 A, B, C, D. See table 2.

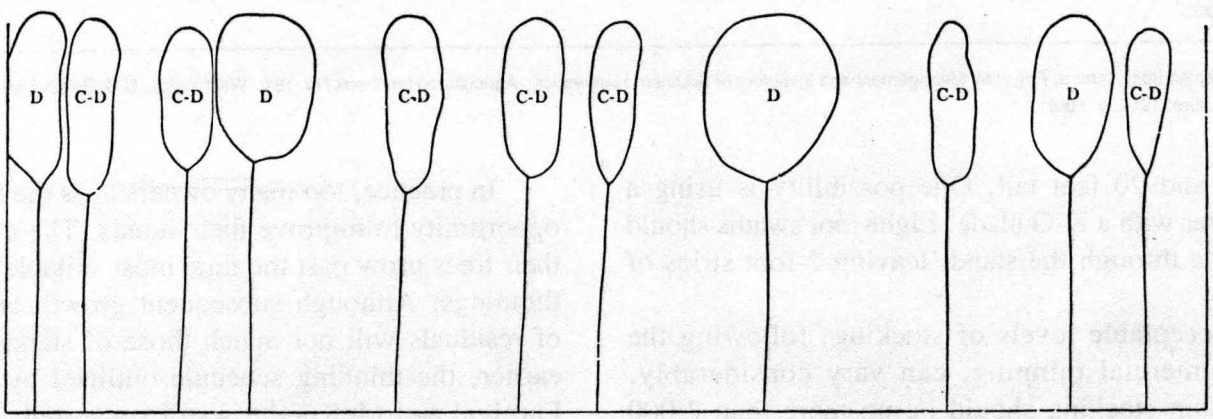


Figure 9.—Same stand as in figure 8. A conservative thinning has been made by removing overtopped, intermediate, and some co-dominant trees. Source: Same as figure 8. Used by permission.

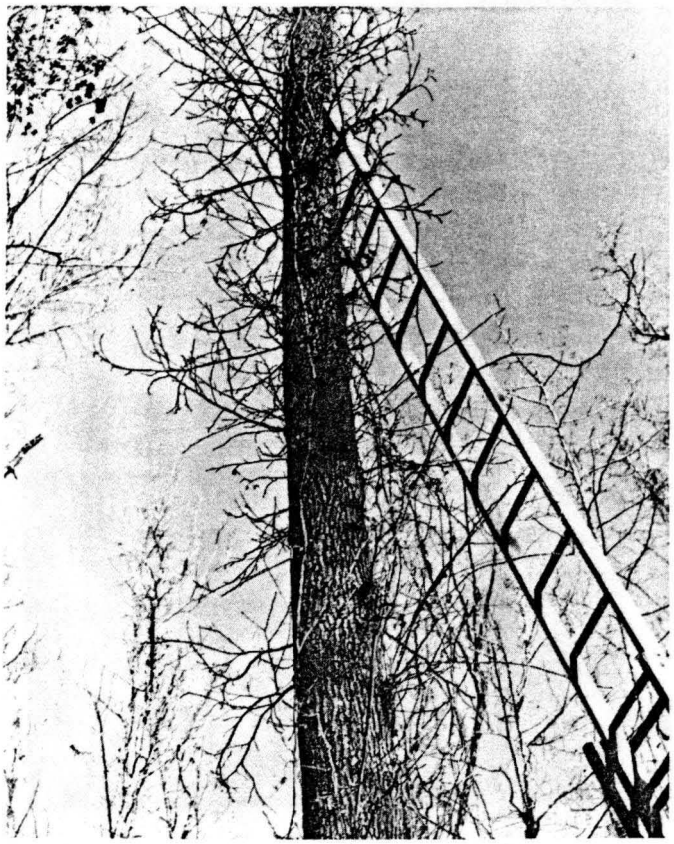


Figure 10.—An over-abundance of branching (epicormic branching) may occur on sweetgums after thinning.

Pulpwood Rotations

Although sweetgum stands are normally very dense and have a tendency to stagnate, intermediate thinnings generally do not give higher, total-cubic-foot volume production. Over a 30-year rotation anticipated yields on a site 90 without thinning is about 2,300 cubic feet per acre, according to Putnam, Furnival and McKnight. You can estimate yields for other sites by adjusting this figure up or down at the rate of 3 percentage points for each foot of site index. For example, a site 80 might produce 1,610 ft^3 in 30 years whereas a site 105 could grow 3,335 ft^3.

Final harvest of a pulpwood-sized sweetgum stand normally will be followed in a year or two by numerous sweetgum root and stump sprouts. Make sure the sprouts are of high quality by leaving stumps no taller than 1 foot.

Understocked Stands

The stands discussed earlier were, for all practical purposes, fully stocked. The following guidelines apply to stands that are stocked at a lower rate. These stands may have been cut too severely before the owner had an opportunity to manage them, but 50 percent or more of the remaining growing-stock trees still consist of sweetgum. In less than fully-stocked stands, follow the guidelines in figure 12, applied with good judgment.

For example, the guide suggests that a 20-year-old stand with less than 20 square feet of basal area should be regenerated. This is probably a good decision; however, good judgment suggests that you first look for deep-rooted problems when such a condition exists. Adequate regeneration may be difficult to obtain.

PLANTATIONS

Sweetgum plantings perform better on sites cleared of natural forest, but the cost of clearing plus plantation establishment is usually prohibitive. Most managers would consider planting sweetgum only in fields that have been previously farmed.

The guide developed by Baker and Broadfoot (1979) gives a useful, simple method to select sites suitable for sweetgum in plantations. The guide considers soil factors, site history, flooding, and man's influence. These considerations will help match the proper species to the available site, and ensure the best chances of success for one of the most expensive stages of forest mangement.

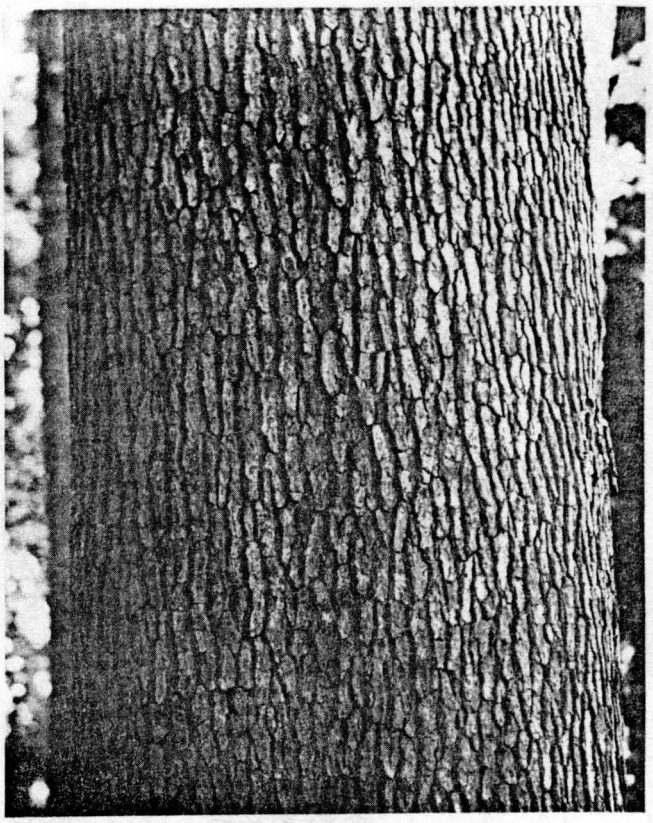
The seedlings, supplies, and use of other equipment involved in establishing and maintaining weed control in old-field plantations may cost more than $150 per acre — all of which will produce disappointing results if you choose an inappropriate site.

Nine steps to the establishment and management of a sweetgum plantation should be included in your plans:

1. Prepare old-field sites without pan by disking.[3] Let the field lie fallow for a year before planting.
2. Plant good-quality, dormant seedlings between December and April. Signs of good quality include a root collar that measures 1/2 inch or larger, and a total height of seedlings of about 18 inches, with seven or more lateral roots.

[3] Pans consist of a compacted layer of subsoil that retards drainage and hinders root growth. If a restrictive pan is present, deep plowing may be necessary.

A



B

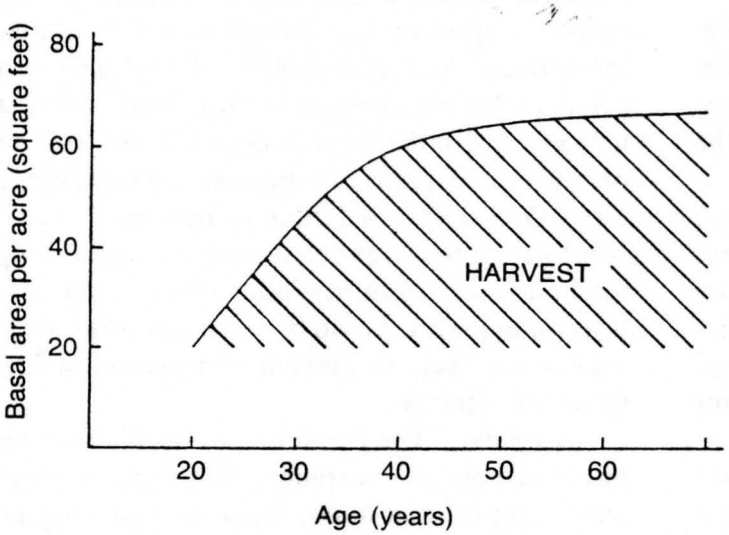
C

D

Figure 11.—The trunks of these sweetgums display differing degrees of vigor: **A** = good, **B** = medium, **C** = poor, **D** = declining

Table 2.—Bark and Crown Characteristics of Sweetgum, by Vigor Class

High vigor	Medium vigor	Low vigor
0.3 to 0.4 inch annual d.b.h. growth	0.2 to 0.3 inch annual d.b.h. growth	0.1 to 0.2 inch annual d.b.h. growth
Bark: Light ash-gray, corky, thick, with pronounced rounded ridges. Bottoms of fissures display streak of very light inner bark.	**Bark:** Gray, thick, somewhat corky (or at least with ridges slightly rounded), and free of scales or plates. Bottoms of fissures narrow, only occasionally displaying thin streak of inner bark.	**Bark:** Compared with medium vigor, darker, thinner, flatter. No display of inner bark. May be scaly.
Crown: 3/4 or more without close competition. Full and healthy, composed preponderantly of small, ascending leaders and twigs. Foliage abundant and lustrous. Other things being equal, high ratio of crown length to stem length indicates high vigor.	**Crown:** 1/2 or more well formed and without close competiton. Some crowns are small because of competition, but have preponderence of small twigs and abundant foliage; others are large, but heavy-limbed and with thin foliage. Foliage always of deep green in main growing season. Little sign of dry-topping.	**Crown:** Compared with medium vigor, smaller or more preponderantly heavy-limbed, and with thinner foliage. Foliage may be pale. Some trees may be stag-headed or dry-topped.



NOTE.—The decision of when to time a harvest must be based on a combination of economic and biological factors. Based on economic factors, hardwood stands older than 20, 30 and 40 years are candidates for harvest when the basal area of desirable trees is less than 20, 40 and 60 square feet per acre, respectively.

Source: Kellison, R. C.; Frederick, D. J.; Gardner, W. E.

Figure 12.—Relationship between stand age and basal area per acre of desirable hardwood species for determining stand fate.

3. Get seed to produce planting stock from a local seed source.
4. Plant the seedlings as soon as possible, after they are lifted from the nursery. Never store seedlings in a dry, open area exposed to the sun. Keep the seedlings at 30° to 40°F, and water if necessary to keep the roots moist.
5. Plant the seedlings so that the root collars will be at or below the ground level. The root collar can be planted as deep as 6 inches below the surface and still produce a vigorous seedling.
6. Prune large roots that cannot fit normally in the planting hole without balling, twisting or J-rooting. Remove the curved tip of a J-shaped taproot.
7. Intensive weed control is applied on most plantations. Usually, the ground is disked around the trees or is cultivated five or six times during the first growing season and perhaps two or three times during the second and third growing seasons. This treatment prevents overtopping of the young trees by other plants, and promotes friable, well-aerated soil that stimulates faster growth of the trees. A less intensive cultivation plan is needed when the plantation is on recently cultivated cropland that is mostly free of heavy weed cover. If the seedlings face competition from herbaceous plants use a bush hog to mow the site once or twice a year. If the equipment and funds are available, a full weed-control system will produce better results.
8. Space the seedlings at a distance of 12 by 12 feet. If pulpwood is your objective, the average diameter of dominant/co-dominant trees will be 8 inches d.b.h., in 15 to 25 years and yields will range from 1/2 to 2 cords annually depending on the site. Do not thin the trees if your objective is pulpwood. If sawtimber is your final objective or if you want to sell both pulpwood and sawtimber, plant the seedlings at a rate of 12 by 12 feet or up to 16 feet. If a pulpwood market is readily available, use the 12 by 12 foot spacing with thinnings. Selective thinning is also needed for wider-spaced sawtimber plantings.
9. If pruning is economically feasible, to improve the trunk quality, the treatment should not begin until the trees average 5 inches d.b.h. At this stage of development, be sure to maintain 50 percent of the total height of the tree in live crown. Even at the widest spacings, some natural pruning will occur in the side stems. The canopy will close when the trees are 10 to 15 years old.

DAMAGING INFLUENCES

Water: Too much or too little.—Sweetgum is considered moderately tolerant of water, but tolerance among individual trees may vary considerably. Mature trees withstand winter flooding and should survive standing water for half of an occasional growing season. Established seedlings usually won't tolerate more than a couple of months of growing-season inundation. Floodwaters carry sediment. A flood that deposits 4 or more inches of sediment will kill sweetgum seedlings. Sweetgum is also susceptible to drought and is one of the first trees to die back from extended dry periods.

Fire.—Sweetgum is susceptible to wildfire. Prescribed burning of adjacent pine stands needs to be confined to avoid damage to sweetgum. Fire-scarred sweetgums should be harvested as soon as possible. If wounds are less than 2 inches in width, resulting rot will be minor. Little volume in timber yields will be lost during the first 4 years after a fire regardless of wound size, so long as the trees are not killed.

Logging Damage.—When intermediate cuts are carried out, take steps to prevent damage to the remaining trees. Skidders and other moving equipment should be kept away from the bole and shallow roots of the remaining trees. Skinned places may callus over, but rot continues to spread under the callused area. Hold a prelogging conference with the logger to agree on specific protective measures for leave trees. A signed contract should also specify penalties for any damage to these trees. Such steps help assure that the logger's crew will be made aware of, and employ, practices needed to protect the leave trees. Operations for felling or moving timber, and constructing roads, should be pre-planned to employ the best practices to minimize soil erosion. Use of heavy equipment should be restricted when soils are excessively wet, to prevent compaction and other structural damage.

Insects.—The forest tent caterpillar is a major insect enemy of sweetgums. These pests strip the leaves and flowers just as trees start growing in the spring. Few trees are killed by this insect, but tree growth is reduced. Stress from drouth subjects trees to increased damage from attack by insects. Control

measures for the forest tent caterpillar are available, but are not economical under most circumstances and therefore are not recommended at this time.

Wildlife.—Beavers prefer sweetgum and will frequently girdle the trees. Once wounded, and rot enters, decay will move into the tree at the rate of about 6 inches in 10 years. Such trees should be cut within 10 years after wounding.

Cattle.—Maintain good fencing to protect the trees if cattle are stocked on the same land or adjacent to sweetgum stands. Seedlings and trees less than 5 feet tall can be killed by browsing cattle.

Grapevines.—In parts of eastern Georgia and South Carolina, and the upland hardwood portions of the Carolinas, Virginia, and West Virginia, grapevines may be more of a problem than in other parts of the South. If grapevines are not controlled at the time of final harvest or earlier, they can result in total failure of regeneration efforts. Cut the vines at the ground level 3 years before final harvest. The root systems will then die without further treatment. If these steps are not taken before the final harvest, the vines must be injected with an appropriate herbicide to kill them.

WILDLIFE AND OTHER CONSIDERATIONS

Sweetgum is of minor value to most wildlife for shelter or as a source of food. Sweetgum provides 2 percent or less of the diet of deer, black bears, rabbits, squirrels, turkeys, doves, and most songbirds. Catbirds and crested flycatchers may depend on sweetgum for up to 5 percent of their diets. Beavers prefer sweetgum when available.

The selection of sweetgum over other hardwoods would not be desired if a major objective is to attract wildlife. Other species of trees often abound within a short distance of sweetgum stands and provide ample food and shelter to wildlife in the general area.

SUGGESTED READING

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Metric Conversions

1 inch = 2.54 cm
1 foot = 27.94 cm
1 foot^2 = 0.0929 m^2
1 foot^3 = 0.283 m^3
1 acre = 0.4047 ha

1 board foot (12 X 12 X 1 inch thick without bark, 1/4-inch Int. Scale) = 0.00348 m^3

1 cord (4 x 4 x 8 feet) = 128 feet^3 = 3.62 m^3

Degrees Celcius = (degrees Fahrenheit - 32) X 5/9