

# *Nyssa sylvatica* Marsh.      **Black Tupelo**

Cornaceae      Dogwood family

## *N. sylvatica* Marsh. var. *sylvatica*      **Black Tupelo (typical)**

Charles E. McGee

## *N. sylvatica* var. *biflora* (Walt.) Sarg.      **Swamp Tupelo**

Kenneth W. Outcalt

Black tupelo (*Nyssa sylvatica*) is divided into two commonly recognized varieties, typical black tupelo (var. *sylvatica*) and swamp tupelo (var. *biflora*). They are usually identifiable by their differences in habitats: black tupelo on light-textured soils of uplands and stream bottoms, swamp tupelo on heavy organic or clay soils of wet bottom lands. They do intermingle in some Coastal Plain areas and in those cases are hard to differentiate. These trees have moderate growth rate and longevity and are an excellent food source for wildlife, fine honey trees, and handsome ornamentals.

### **BLACK TUPELO**

Black tupelo (*Nyssa sylvatica* var. *sylvatica*) is also widely known as blackgum; other common names include sourgum, Pepperidge, tupelo, and tupelogum.

### **Habitat**

#### **Native Range**

Black tupelo (figs. 1, 2) grows in the uplands and in alluvial stream bottoms from southwestern Maine to New York, to extreme southern Ontario, central Michigan, Illinois, and central Missouri, and south to eastern Oklahoma, eastern Texas, and southern Florida. It is local in central and southern Mexico. Optimum development is made on lower slopes and terraces in the Southeastern United States.

### **Climate**

Due to its wide distribution, black tupelo is found in a variety of climates with a wide range of temperatures. Rainfall throughout the range averages about

1270 mm (50 in) per year. In the South and Southeast, more than half of the rain falls during the growing season while in the northerly and westerly extremes of the range, substantially less than half of the rain falls during the growing period.

### **Soils and Topography**

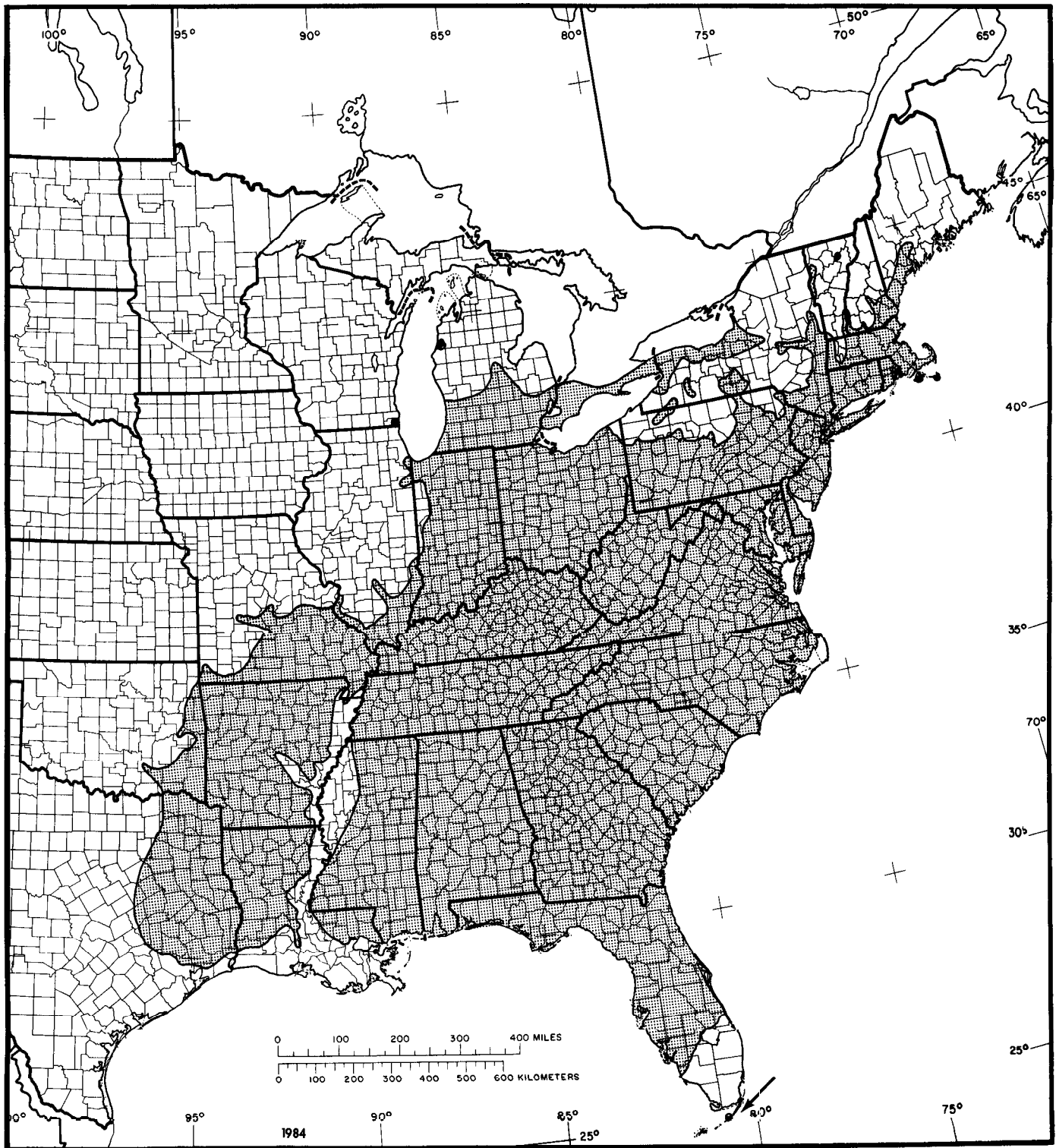
Black tupelo is found on a wide variety of sites from the creek bottoms of the southern coastal plains to altitudes of 910 m (3,000 ft) in North Carolina. The variety grows best on well-drained, light-textured soils on the low ridges of second bottoms and on the high flats of silty alluvium. In the uplands it grows best on the loams and clay loams of lower slopes and coves. When found on drier upper slopes and ridges, it is seldom of log size or quality (8). Approximately two-thirds of the species range is dominated by soils of the order Ultisols, with Udufts as the principal suborder.

### **Associated Forest Cover**

Black tupelo is not predominant in any major forest type; however, it is a component of 35 forest cover types (3). In New England it is associated with Black Ash-American Elm-Red Maple (Society of American Foresters Type 39). In the central and southern forest regions, it is found in the following types:

---

The authors are Project Leader (retired), Southern Forest Experiment Station, New Orleans, LA, and Research Forester, Southeastern Forest Experiment Station, Asheville, NC.



**Figure 1**—The native range of black tupelo (*Nyssa sylvatica*).

## *Nyssa sylvatica*

- 40 Post Oak-Blackjack Oak
- 43 Bear Oak
- 44 Chestnut Oak
- 45 Pitch Pine
- 46 Eastern Redcedar
  
- 51 White Pine-Chestnut Oak
- 52 White Oak-Black Oak-Northern Red Oak
- 53 White Oak
- 55 Northern Red Oak
- 57 Yellow-Poplar
  
- 58 Yellow-Poplar-Eastern Hemlock
- 59 Yellow-Poplar-White Oak-Northern Red Oak
- 65 Pin Oak-Sweetgum
- 70 Longleaf Pine
- 75 Shortleaf Pine
  
- 76 Shortleaf Pine-Oak
- 78 Virginia Pine-Oak
- 79 Virginia Pine
- 80 Loblolly Pine-Shortleaf Pine
- 81 Loblolly Pine
- 82 Loblolly Pine-Hardwood
- 83 Longleaf Pine-Slash Pine
- 85 Slash Pine-Hardwood
- 87 Sweetgum-Yellow-Poplar
- 91 Swamp Chestnut Oak-Cherrybark Oak
  
- 93 Sugarberry-American Elm-Green Ash
- 97 Atlantic White-Cedar
- 100 Pondcypress
- 104 Sweetbay-Swamp Tupelo-Redbay
- 110 Black Oak



Figure 2—*Black tupelo* (center).

## Life History

### Reproduction and Early Growth

**Flowering and Fruiting**—Black tupelo is polygamo-dioecious and flowers from April through June. The fruit of black tupelo ripens in September and October and drops from September through November. The flowers are small and greenish white, borne singly or in capitate clusters. The fruit, an oblong drupe, is about 13 mm (0.5 in) long and is blue-black; the pit is indistinctly ribbed (2).

**Seed Production and Dissemination**—Seed production in black tupelo is highly variable. Seeds are disseminated by gravity, animals, and birds (2).

**Seedling Development**—Under natural conditions, seeds over-winter on cool moist soil and germinate in the spring. Germination is epigeal (2). Black tupelo requires nearly full light for optimum development. In a mature hardwood forest on a good site in Tennessee, 830 black tupelo/ha (337/acre)

were well distributed over a 24/ha (60/acre) area. Two years following clearcutting there were 1,880 black tupelo/ha (760/acre) less than 1.37 m (4.5 ft) in height, and 375/ha (150/acre) more than 1.37 m (4.5 ft) tall. In four good young hardwood stands in northern Alabama, black tupelo ranged from 1,790 to 2,965 stems/ha (725 to 1,200/acre) 5 or 6 years after clearcutting. When three of the areas were burned as part of a controlled experiment, the number of small tupelo per hectare approximately doubled the first year; the number of stems taller than 1.37 m (4.5 ft) decreased by about 50 percent (5).

**Vegetative Reproduction**—Smaller black tupelo stumps sprout readily and larger stumps sprout occasionally. Root suckering can occur in profusion around some trees. Layering has been used to produce black tupelo stock.

### Sapling and Pole Stages to Maturity

**Growth and Yield-**Black tupelo can achieve heights of 36 m (120 ft) and diameters up to 122 cm (48 in) at breast height on the most favorable sites. Diameter growth on medium sites where the tree has good stand position may reach 10 to 20 cm (4 to 5 in) in 10 years. On poorer sites or where the tree is crowded, diameter and height growth can be very slow (7). Black tupelo growing on good sites that have not been burned can produce veneer logs. Most logs suitable for veneer are about 50 cm (20 in) in d.b.h. Black tupelo produces a pronounced ribbon figure and is often quarter sliced (6). The light, uniform-textured wood of tupelo makes excellent containers. Much of the merchantable upland black tupelo is used for crossties and pallets. A majority of stems are not considered desirable growing stock and are often left standing following commercial timber sales. These stems are usually moderately easy to control with herbicides.

**Rooting Habit-**No information available.

**Reaction to Competition-**Black tupelo is usually found in mixture with other species. It is classed as tolerant of shade. Only rarely does it attain a dominant crown position within its age group; it usually occupies an intermediate crown position on most sites. Some intermediate black tupelo stems respond favorably to release from overtopping vegetation. Seedlings grow slowly under a fully stocked stand. When the canopy is removed, about 25 percent or more can be expected to respond with relatively rapid height growth. Large numbers of new seedlings can become established at the time of cutting.

**Damaging Agents-**Black tupelo, particularly where it grows on dry sites, is often affected by fire. Hot fires can cause serious mortality and cull. Fire scars often serve as entry courts for large numbers of heart rot fungi. Ten of 25 black tupelo samples in a study of the central hardwood region had heart rot (1).

The tupelo leafminer (*Antispila nysaefoliella*) and the forest tent caterpillar (*Malacosoma disstria*) attack the tupelos.

### Special Uses

Because of its wide range, frequency of occurrence, and the palatability of its fruit and sprouts, black tupelo is an important wildlife species (4). The fruit, high in crude fat, fiber, phosphorus, and calcium, are

eaten by many birds and animals. Young sprouts are relished by white-tailed deer but lose palatability with age. Because it is a prolific producer of cavities, black tupelo is usually ranked as one of the more dependable den tree species. Black tupelo is a good honey tree and is often planted as an ornamental.

### Literature Cited

1. Berry, F. H. 1977. Decay in yellow-poplar, maple, blackgum, and ash in the central hardwood region. USDA Forest Service, Research Note NE-242. Northeastern Forest Experiment Station, Broomall, PA. 4 p.
2. Bonner, F. T. 1974. *Nyssa L. Tupelo*. In Seeds of woody plants in the United States. p. 554-557. C. S. Schopmeyer, tech. coord. U.S. Department of Agriculture, Agriculture Handbook 450. Washington, DC.
3. Eyre, F. H., ed. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC. 148 p.
4. Halls, Lowell K. 1977. Black tupelo (*Nyssa sylvatica* var. *sylvatica* Marsh.); swamp tupelo (*Nyssa sylvatica* var. *biflora* (Walt.) Sarg.). In Southern fruit-producing woody plants used by wildlife. p. 62-64. USDA Forest Service, General Technical Report SO-16. Southern Forest Experiment Station, New Orleans, LA.
5. Huntley, J. C., and C. E. McGee. 1981. Timber and wildlife implications of fire in young upland hardwoods. In Proceedings, Southern Silvicultural Research Conference, Nov. 6-7, 1980, Atlanta, GA. p. 56-66. USDA Forest Service, General Technical Report SO-34. Southern Forest Experiment Station, New Orleans, LA.
6. Lutz, J. F. 1972. Veneer species that grow in the United States. USDA Forest Service, Research Paper FPL-167. Forest Products Laboratory, Madison, WI. 127 p.
7. Putnam, J. A. 1951. Management of bottom land hardwoods. USDA Forest Service, Occasional Paper 116. Southern Forest Experiment Station, New Orleans, LA. 60 p.
8. Putnam, John A., George M. Furnival, and J. S. McKnight. 1960. Management and inventory of southern hardwoods. U.S. Department of Agriculture, Agriculture Handbook 181. Washington, DC. 102 p.

### SWAMP TUPELO

Swamp tupelo (*Nyssa sylvatica* var. *biflora*) is also called blackgum; another common name is swamp blackgum.

### Habitat

### Native Range

Swamp tupelo (fig. 3) grows chiefly in the Coastal Plains from Delaware, eastern Maryland, and southeastern Virginia, south to southern Florida and west to eastern Texas. Its range extends north up the



**Figure 3-A** swamp tupelo in the lower Coastal Plain of South Carolina.

Mississippi Valley to southern Arkansas and west and south Tennessee (17).

### Climature

Swamp tupelo grows in a warm humid climate. Summers are long and hot; winters are short and mild. The frost-free period ranges from 7 months in the northern area to 11 months in the South. Average July temperature is 26° C (78° F). The average January temperature varies from 2° C (35° F) in the North to 18° C (65° F) in the South. Average annual precipitation varies from 1020 to 1650 mm (40 to 65 in) and is lowest at the northern and western edges of the range.

In the Atlantic Coastal Plain, summer usually is wettest and autumn driest. Precipitation is more uniformly distributed along the gulf coast. Periodic summer droughts occur in the western portion of its range.

### Soils and Topography

Swamp tupelo grows on a variety of wet bottom-land soils including organic mucks, heavy clays, and wet sands. It occurs mainly on soils in the orders Ultisols, Inceptisols, and Entisols.

Swamp tupelo not only tolerates flooding but actually thrives under those conditions (16). It is seldom found on sites that are not inundated much of the growing season. Swamp tupelo grows in head-water swamps, strands, ponds, river bottoms, bays, estuaries, and low coves. Normally it does not grow in the deeper parts of swamps or overflow river bottoms.

The type of water regime is more important to growth of swamp tupelo than the soil type (11). Best growth is achieved on sites where the soil is continuously saturated with very shallow moving water. Growth can be reduced as much as 50 percent when the water is stagnant, as in ponds. Intermittent flooding, with periodic drying cycles, or continuous deep flooding even by moving water, also reduces growth.

### Associated Forest Cover

Swamp tupelo is a major component of the forest cover types Baldcypress-Tupelo (Society of American Foresters Type 102), Water Tupelo-Swamp Tupelo (Type 103), and Sweetbay-Swamp Tupelo-Redbay (Type 104) (9). In the following cover types it is a minor component: Cabbage Palmetto (Type 74), Loblolly Pine-Hardwood (Type 82), Slash Pine (Type 84), Slash Pine-Hardwood (Type 85), Atlantic White-Cedar (Type 97), Pond Pine (Type 98), Pondcypress (Type 100), and Baldcypress (Type 101).

Other trees and shrubs commonly associated with swamp tupelo are red maple (*Acer rubrum*), button-bush (*Cephalanthus occidentalis*), buckwheat-tree (*Cliftonia monophylla*), dogwood (*Cornus* spp.), swamp cyrilla (*Cyrilla racemiflora*), swamp-privet (*Forestiera acuminata*), Carolina ash (*Fraxinus caroliniana*), loblolly-bay (*Gordonia lasianthus*), dahoon (*Ilex cassine*), inkberry (*I. glabra*), yaupon (*I. vomitoria*), fetterbush lyonia (*Lyonia lucida*), and bayberry (*Myrica* spp.).

### Life History

#### Reproduction and Early Growth

**Flowering and Fruiting-**The minute greenish-white flowers appear in the spring with the leaves, usually in late April in South Carolina. Flowers are polygamo-dioecious, or swamp tupelo may bear

staminate and pistillate flowers on separate trees (22). Insects, primarily bees, are the major pollinating vector, but pollen is also spread by wind. The fruit, a drupe, changes from green to a dark blue as it ripens, usually in early November in South Carolina.

**Seed Production and Dissemination**-Most years swamp tupelo is a prolific seed producer. Over a 4-year period in a 90-year-old stand in South Carolina seed production was as follows:

Year	Seeds/ha	Seeds/acre
1963	135,900	55,000
1964	0	0
1965	1,697,600	687,000
1966	2,058,400	833,000
Average	972,970	393,750

Seed viability, which averaged 60 percent, increased as the season progressed. The seed crop failure in 1964 was probably the result of a late frost.

In South Carolina seedfall begins in early September (6). About 50 percent of the seeds are shed from late October through November. By early December, seedfall is 90 to 95 percent complete. Dissemination is fairly uniform over an entire area. The principal dissemination agents are gravity and birds, mostly robins. The birds consume the fleshy fruits and the seeds are passed through the digestive tract. In southern Carolina, the arrival of large flocks of migratory robins often coincides with peak ripening. Under these conditions birds can disseminate about 55 percent of the total seed crop. These seeds are evenly distributed and have an average viability of 44 percent. Unlike those of water tupelo, fruits of swamp tupelo do not float.

**Seedling Development**-The seeds normally over-winter and germinate the following spring. Germination is epigeal (22). It does not take place under water, but submerged seeds germinate once the water subsides below the soil surface (7). Germination is rapid in moist, drained conditions at 21° C (70° F) and higher. After germination, seedlings must grow rapidly to keep the apex and leaves above water, because prolonged submergence during active growth will kill them. Submergence during the dormant season, however, has no adverse effect.

Swamp tupelo types are stable and usually regenerate following harvest, although species such as willow (*Salix* spp.) may temporarily dominate some cutover sites (21). Initial seedling establishment is related to seed production, but variation in water table is more important in most years. Environmental conditions under an overstory of 75 to

620 trees per hectare (30 to 250/acre) are favorable for germination and early growth (5). Thus, the shelter-wood method can be used to establish seedlings. Regeneration can also be accomplished by clearcutting if it is done following a good seedfall or if, as often happens, advanced reproduction is already established.

**Vegetative Reproduction**-Stump sprouting is very common following logging (4,12,19). Sprouts arise from suppressed buds and are concentrated near the top of the stump. High stumps, the normal condition since trees are usually cut above the butt swell, have many more sprouts than low-cut stumps. Harvesting trees just before the growing season can increase the growth rate of sprouts.

Stump sprouts can produce seed at 2 years of age. Thus, if the seed crop fails or if unfavorable water conditions prevent a good crop of seedlings from becoming established, sprouts can provide a seed source. However, sprout growth is often so rapid and profuse that all competing vegetation, including natural or planted seedlings, is soon overtopped. Whether or not these sprouts develop into good quality stands is not known.

#### Sapling and Pole Stages to Maturity

**Growth and Yield**-On good sites swamp tupelo can attain heights of 37 m (120 ft) and diameters exceeding 122 cm (48 in) (2). Average stand d.b.h. at age 85 is 25 cm (10 in) (1). The average height of dominants at different ages is as follows:

Years	Meters	Feet
20	11	36
30	15	50
40	18	59
50	20	65
60	21	70
70	22	73
80	23	76
90	24	78
100	24	80

Pure, even-aged stands produce an average of 9 m<sup>3</sup>/ha (1 cord/acre) per year through age 85. Representative normal yields by age and site index are given in table 1.

**Rooting Habit**-Swamp tupelo normally develops a taproot and has a swollen base to the mean height of the growing season water level. Water roots, which develop under flooded conditions, help support the tree and capture nutrients. These specialized roots tolerate high carbon dioxide concentrations, oxidize

**Table 1**-Normal yield for swamp tupelo in southeastern Georgia<sup>1</sup>

Stand age	Site index at base age 50 years		
	15.2 m or 50 ft	22.9 m or 75 ft	30.5 m or 100 ft
<i>yr</i>	<i>m<sup>3</sup>/ha</i>		
30	142	209	357
40	198	292	499
50	243	357	611
60	278	408	699
70	306	449	769
80	328	482	826
90	347	510	873
100	363	533	913
<i>yr</i>	<i>ft<sup>3</sup>/acre</i>		
30	2,030	2,980	5,105
40	2,835	4,170	7,135
50	3,470	5,100	8,725
60	3,965	5,830	9,980
70	4,365	6,415	10,980
80	4,690	6,890	11,795
90	4,960	7,290	12,475
100	5,185	7,620	13,045

<sup>1</sup>Merchantable volume for trees 14 cm (5.5 in) and larger in d.b.h

the rhizosphere, and carry on anaerobic respiration. Thus, they are the key to the species ability to thrive under flooded conditions (14,15).

**Reaction to Competition**-Swamp tupelo is classed as intolerant of shade and is best suited to even-age management (18,211). Although seedlings become established under an existing stand they do not develop unless released. Swamp tupelo grows well in stands with relatively high basal areas of 39 to 46 m<sup>2</sup>/ha (170 to 200 ft<sup>2</sup>/acre). Many harvested sites develop sapling densities far in excess of optimum. Natural thinning in these overstocked stands is quite slow and, although individual trees respond to thinning, difficult access and damage to sites during logging operations, coupled with low returns, makes thinning undesirable.

**Damaging Agents**-Swamp tupelo sites are normally quite wet, but during extended drought they do dry out. If the peat that accumulates on many of the sites becomes dry enough to burn, severe fires can cause high mortality and cull in the stand (3).

The forest tent caterpillar (*Malacosoma disstria*) defoliates trees, reducing growth. Severe damage can result in dieback and mortality (23). Various wood-boring insects cause significant degrade in swamp tupelo veneer logs. Tupelo lesion caused by *Fusarium*

*solani* develops on the stem, killing the cambium, which causes swelling and roughened bark (2). Although this is seldom lethal it can cause significant degrade in logs. *Fomes* spp., *Polyporus* spp., *Daedalea ambigua*, *Hydnum erinaceum*, *Lentinus tigrinus*, and *Pleurotus ostreatus* fungi all cause heartrot in swamp tupelo.

Swamp tupelo is very susceptible to sapsucker injury and is readily damaged by salt spray. Sulfate-enriched water can cause seedling mortality (20).

### Special Uses

The foliage and twigs of swamp tupelo are browsed by deer (10). Birds and small mammals consume the fruit. The flowers are a source of nectar for bees kept by commercial honey producers. Certain locations, such as the Apalachicola River bottoms of west Florida, produce significant quantities of swamp tupelo honey.

### Genetics

Tests with seedlings indicate that there are local populations that are adapted to different habitats (13). The three habitats identified were blackwater rivers, headwater swamps, and ponds.

A shrubby form of swamp tupelo found in the panhandle of Florida may be a local race. Some authors (8) consider swamp tupelo a separate species (*Nyssa biflora*) rather than a variety of black tupelo (*N. sylvatica* var. *sylvatica*), while others suggest it is a variety which will hybridize with black tupelo.

### Literature Cited

1. Applequist, M. B. 1959. Soil studies on southern hardwoods. Proceedings Louisiana State University Forestry Symposium 8:49-63.
2. Beaufait, W. R., and L. F. Smith. 1965. Black tupelo (*Nyssa sylvatica* Marsh.) In Silvics of forest trees of the United States. p. 278-280. H. A. Fowells, comp. U.S. Department of Agriculture, Agriculture Handbook 271. Washington, DC.
3. Cypert, E. 1961. The effect of fire in the Okefenokee swamp in 1954 and 1955. American Midland Naturalist 66(2):485-503.
4. DeBell, D. S. 1971. Stump sprouting after harvest cutting in swamp tupelo. USDA Forest Service, Research Paper SE-83. Southeastern Forest Experiment Station, Asheville, NC. 6 p.
5. DeBell, D. S., and I. D. Auld. 1971. Establishment of swamp tupelo seedlings after regeneration cuts. USDA Forest Service, Research Note SE-164. Southeastern Forest Experiment Station, Asheville, NC. 7 p.
6. DeBell, D. S., and D. D. Hook. 1969. Seeding habits of swamp tupelo. USDA Forest Service, Research Paper SE-47. Southeastern Forest Experiment Station, Asheville, NC. 8 p.

7. DeBell, D. S., and A. W. Naylor. 1972. Some factors affecting germination of swamp tupelo seeds. *Ecology* 53(3):504–506.
8. Eyde, R. H. 1963. Morphological and paleobotanical studies of the Nyssaceae I. Survey of the modern species and their fruits. *Journal of the Arnold Arboretum* 44:1–59.
9. Eyre, F. H., ed. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC. 148 p.
10. Harlow, R. F. 1976. Plant response to thinning and fencing in a hydric hammock and cypress pond in central Florida. USDA Forest Service, Research Note SE-230. Southeastern Forest Experiment Station, Asheville, NC. 7 p.
11. Harms, W. R. 1973. Some effects of soil type and water regime on growth of tupelo seedlings. *Ecology* 54(1):188–193.
12. Hook, D. D., and D. S. DeBell. 1970. Factors influencing stump sprouting of swamp and water tupelo seedlings. USDA Forest Service, Research Paper SE-57. Southeastern Forest Experiment Station, Asheville, NC. 9 p.
13. Hook, D. D., and J. Stubbs. 1967. Physiographic seed source variation in tupelo gums grown in various water regimes. *In* Proceedings, Ninth Southern Conference on Forest Tree Improvement, June 8-9, 1967, Knoxville, TN. p. 61-64. Committee on Southern Forest Tree Improvement Sponsored Publication 28. Eastern Tree Seed Laboratory, Macon, GA.
14. Hook, D. D., C. L. Brown, and P. P. Kormanik. 1970. Lenticel and water root development of swamp tupelo under various flooding conditions. *Botanical Gazette* 131(3):217–224.
15. Hook, D. D., C. L. Brown, and P. P. Kormanik. 1971. Inductive flood tolerance in swamp tupelo. *Journal of Experimental Botany* 22(70):78–79.
16. Hook, D. D., O. G. Langdon, J. Stubbs, and C. L. Brown. 1970. Effect of water regimes on the survival, growth, and morphology of tupelo seedlings. *Forest Science* 16(3):304–311.
17. Little, Elbert L., Jr. 1979. Checklist of United States trees (native and naturalized). U.S. Department of Agriculture, Agriculture Handbook 541. Washington, DC. 375 p.
18. McGarity, R. W. 1979. Ten-year results of thinning and clearcutting in a muck swamp timber type. *Southern Journal of Applied Forestry* 3(2):64–67.
19. Priester, David S. 1979. Stump sprouts of swamp and water tupelo produce viable seeds. *Southern Journal of Applied Forestry* 3(4):149–151.
20. Richardson, J., K. C. Ewel, and H. T. Odum. 1983. Sulfate-enriched water effects on a floodplain forest in Florida. *Environmental Management* 7(4):321–326.
21. Stubbs, J. 1973. Atlantic oak-gum-cypress. *In* Silvicultural systems for the major forest types of the United States. p. 89-92. U.S. Department of Agriculture, Agriculture Handbook 445. Washington, DC.
22. U.S. Department of Agriculture, Forest Service. 1974. Seeds of woody plants in the United States. C. S. Schopmeyer, tech. coord. U.S. Department of Agriculture, Agriculture Handbook 450. Washington, DC. 883 p.
23. U.S. Department of Agriculture, Forest Service. 1985. Insects of eastern forests. A. T. Drooz, ed. U.S. Department of Agriculture, Miscellaneous Publication 1426. Washington, DC. 608 p.