SOUTHERN FOREST EXPERIMENT STATION

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SOIL SUITABILITY FOR HARDWOODS IN THE MIDSOUTH

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SOUTHERN FOREST EXPERIMENT STATION

This note brings together information gathered by the Southern Hardwoods Laboratory as to the suitability of soils in the Midsouth for growing hardwood timber.

Most of the soils that support commercial hardwoods are found in the five soil areas mapped in figure 1. These groups, or land resource areas, differ importantly in parent material, age, texture, and drainage. Within areas, physiographic position, stratigraphy, and landforms influence local moisture conditions.

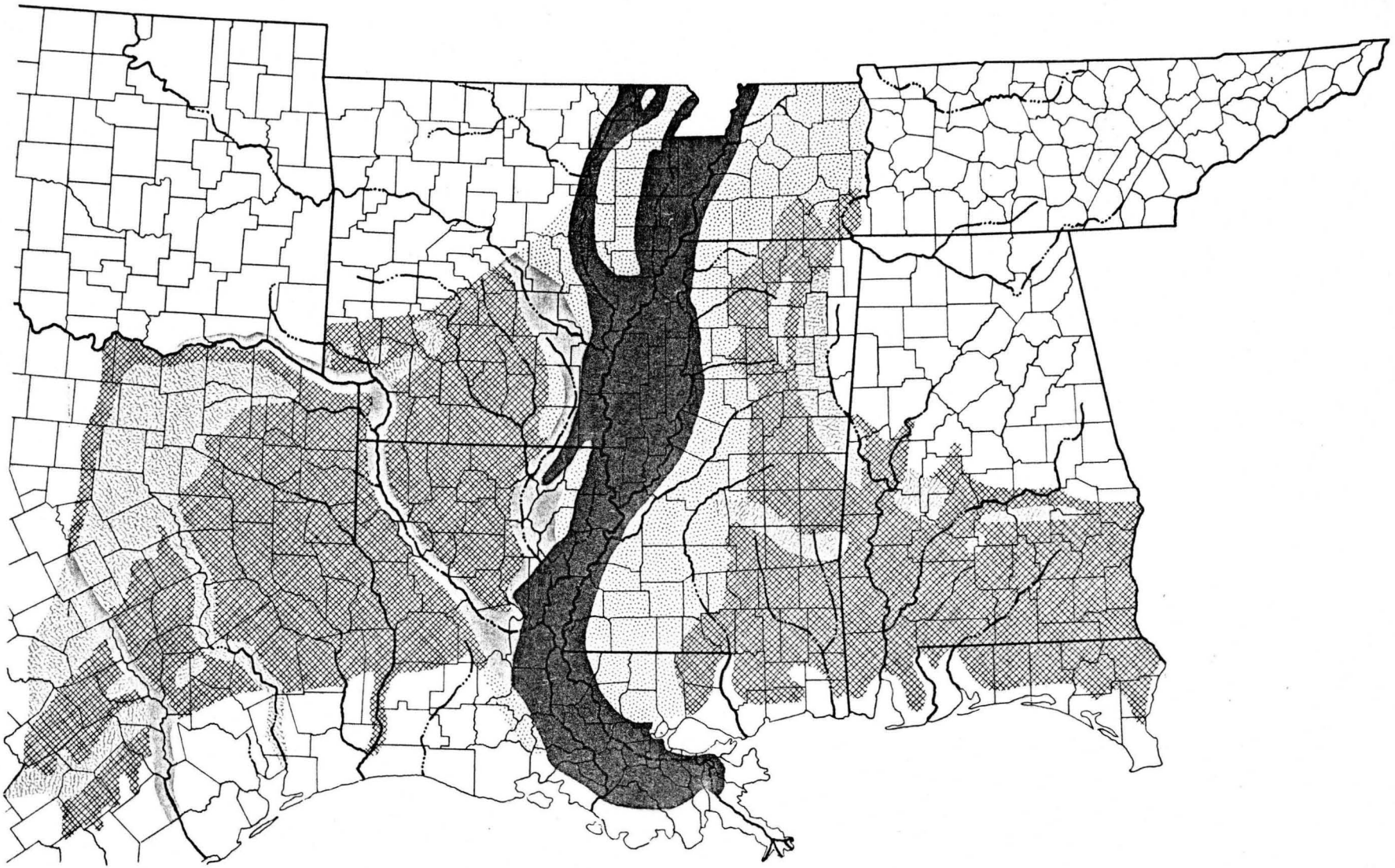
A table of suitability relationships for hardwoods is presented for each soil area. The tables indicate which species occur frequently and which occasionally, and which should be favored in management. Footnotes give information about species that are suited to special purposes, occur infrequently or only in special situations, or constitute forest weeds. Baldcypress and spruce pine are included in some tables because they are found on the same soils as hardwoods.

The relationships were derived mainly from data gathered on 515 plots throughout the States mapped in figure 1. The plots were established primarily for a study of the site factors that influence the growth of willow oak, cottonwood, cherrybark oak, water oak, and sweetgum *(1, 2, 3, 4, 5)*.[2] Hence they were located in mature, well-stocked, free-growing stands containing one or more of these five species. Data were taken, however, on all species present, and some supplementary information was secured for soils and species not adequately represented on the plots. Some soils listed in the tables do not occur in large bodies and are not widely distributed, while some are so important agronomically that very little of their acreage remains in forest. These circumstances, together with the sampling design imposed by the primary purpose of the study, resulted in an uneven distribution of plots among the soil areas. Of the total, 40 percent were in the Delta area, 20 percent in the Loess, 16 percent in the Coastal Plain, 13 percent in the Red, and 11 percent in the Blackland.

Since the tables were compiled from data and observations of natural stands, they may not apply where physical, chemical, and morphological conditions of the soil have been worsened, or where there are unusual soil variants such as sand ridges and exceptionally dry

[1] The author is stationed at the Southern Hardwoods Laboratory, which is maintained at Stoneville, Mississippi, by the Southern Forest Experiment Station in cooperation with the Mississippi Agricultural Experiment Station and the Southern Hardwood Forest Research Group.

[2] Italicized numbers in parentheses refer to Literature Cited, page 10.



Delta—included are some soils from Loess and Red areas.

Loess—included are some soils with Coastal Plain influence and some Delta soils.

Coastal Plain—mixed, in some places, with Blackland, Loess, and Red soils.

Blackland—some mixing or inclusions of Coastal Plain and Red soils.

Red—includes some Delta, Coastal Plain, and Blackland soils.

FIGURE 1.—
General location of the five soil areas in the Midsouth where southern hardwoods are grown.

phases. Species-site relationships in plantations may also differ from those indicated in the tables.

DELTA

The Delta area lies in the flood plains of the Mississippi River. The soils originated in alluvial material washed down from northern lands between the Appalachian and Rocky Mountains. They are fertile, and, under proper management, some of the best producers of high-quality hardwood timber (table 1).

Variations in the soils of recent natural levees usually can be traced to differences in

TABLE 1.—*Soil suitability for southern hardwoods in the Delta area*

Important commercial species [1]	Recent natural-levee soils		Old natural-levee soils			Slackwater soils		Depressional soils	
	Crevasse, Robinsonville	Commerce, Mhoon	Beulah, Bosket	Dubbs, Dundee	Forest-dale	Bowdre, Tunica	Sharkey, Alligator	Ark	Dowling, Souva
Ash, green	●	■	—	●	■	●	■	■	■
Baldcypress	—	●	—	—	●	—	■	●	■
Cottonwood, eastern	■	■	●	●	●	■	■	●	●
Elms, slippery & American	■	■	●	■	■	■	■	●	—
Hackberry and sugarberry	■	■	●	●	■	■	■	■	●
Hickory, water	—	—	—	●	■	●	■	●	■
Honeylocust	●	●	—	●	■	●	■	●	●
Maple, red	—	—	—	●	■	■	■	●	—
Maple, silver	●	■	—	—	—	—	—	—	—
Oak, cherrybark	●	●	■	■	■	●	●	●	—
Oak, Nuttall	—	●	—	●	■	●	■	●	●
Oak, overcup	—	●	—	●	■	●	■	●	■
Oak, Shumard	—	—	●	■	●	●	●	—	—
Oak, swamp chestnut	—	—	●	■	■	●	●	●	—
Oak, water	●	●	■	■	■	■	■	●	—
Oak, willow	—	—	■	■	■	■	■	●	●
Pecan	■	■	●	●	●	●	●	—	—
Persimmon, common	●	●	●	●	■	●	■	●	●
Sassafras	●	—	■	■	●	●	●	—	—
Sweetgum	●	■	■	■	■	■	■	●	●
Sycamore, American	■	■	■	■	●	●	●	●	—
Tupelo, black	—	—	■	■	●	●	●	—	—
Tupelo, water	—	—	—	—	—	—	—	●	●
Willow, black	●	■	—	—	●	—	●	■	■

[1] In this and succeeding tables, common names are according to E. L. Little, Jr., **Check list of native and naturalized trees of the United States (including Alaska).** U. S. Dept. Agr., Agr. Handb. 41, 472 pp. 1953.

POST AND SPECIALTY SPECIES: Black locust, catalpa, and flowering dogwood on moderately to well-drained acid soils; Osage-orange on neutral to alkaline soils; mulberry on all soils.

LIMITED COMMERCIALLY OR IN OCCURRENCE: Boxelder on neutral to alkaline soils; bur oak, American holly, winged elm on acid soils; post oak, river birch, hickories (exc. water), and white oak on well-drained acid soils; swamp cottonwood and laurel oak on poorly drained acid soils; black walnut on well-drained soils; chinaberry, cedar elm, buckeye, and Kentucky coffeetree on all soils.

WEED SPECIES: American hornbeam and eastern hophornbeam on acid soils; planertree on wet soils; hawthorn, swamp-privet, redbud, and roughleaf dogwood on all soils.

■ Occurs frequently; favor in management.
● Occurs occasionally; favor.
■ Occurs frequently; manage, but do not favor.
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drainage and in texture. The alluvial sediments have been in place for such a short time that only the first stages of development have taken place. As materials left by the river contain lime, and as extensive leaching has not yet occurred, the soils are usually neutral to alkaline. They are generally light in color, because organic matter has not had time to build up. Crevasse and Robinsonville are moderately to well drained, while Commerce and Mhoon are somewhat poorly to poorly drained. The principal timber species found on these young soils are cottonwood, green ash, American elm, hackberry and sugarberry, pecan, sycamore, sweetgum, and black willow (table 1).

The old natural-levee soils are all acid. Beulah and Bosket are well drained, Dubbs and Dundee have moderate drainage, and Forestdale is poorly drained. In addition to the species common on the young soils, these old soils support oaks and hickories as well as sassafras.

The slack-water soils are nearly level or gently sloping, occupy broad areas, and usually are some distance from both the present and former channels of the Mississippi. Their clay content is high, and they are locally called buckshot and sometimes gumbo. They have developed under conditions of slow drainage. Differences among them result primarily from differences in the thickness of the layer of fine-textured sediments that overlies the sandier strata underneath. Alligator and Sharkey soils are poorly drained, while Bowdre and Tunica are moderately well drained. A wide variety of hardwoods occurs naturally on the slack-water soils.

Depressional soils occur in old, partly filled river channels throughout the Mississippi River flood plain. These channels provide means for the slow return of floodwaters to the bayous and main rivers. They are the lowest-lying soils of the region and are subject to flooding by local runoff even though they may be protected by levees. They were formed chiefly of alluvium washed from adjacent areas of other soils. All have weak profile development and are mottled or gray. Ark soils have better internal drainage than Dowling and Souva. The most important soil is Dowling, but species are limited to those tolerant of poor drainage and aeration.

LOESS

The band of soils lying immediately east and west of the Delta is loess, or wind-deposited.

The upland soils in this group vary in depth. Their texture is uniform, usually silt loam to silty clay loam. Only the noneroded condition is listed in table 2, as sites with less than 6 inches of topsoil are considered more suitable for pine than hardwoods. Calloway, Henry, and Bude have pans. Falkner, Tickfaw, and Hurricane also are poorly drained, being underlaid with stiff clays. Pine should be favored along with sweetgum, cherrybark oak, Shumard oak, and white oak on these soils, as they are very dry in summer.

Terrace soils in the Loess area show considerable profile development. Olivier, Calhoun, Carroll, Hatchie, and Almo are poorly drained and have strong pans that seriously limit root development and height growth of hardwoods.

A number of river flood plains in the Loess area border the Delta on the east. From north to south, the principal ones are the Obion, Forked Deer, Hatchie, Wolf, Coldwater, Tallahatchie, Yocona, Yalobusha, Yazoo, Big Black, Pearl, Homochitto, and Amite. Soils in this group may be found also in the flood plains of rivers and streams in and near Crowley's Ridge and Macon Ridge in Arkansas, and adjacent to and near small loess ridges in Louisiana west of the Mississippi River.

In general, the same wide variety of species is found in the terraces of this soil area as on the bottoms. The middle and lower slopes of the uplands and the acid bottoms are particularly productive of many important commercial species.

TABLE 2.—*Soil suitability for southern hardwoods in Loess area*

Important commercial species	Uplands						Terraces		Acid bottoms	
	Memphis-Loring, Natchez		Lexington, Atwood, Brandon		Grenada, Providence, Franklin-ton, Dulac, Lax, Tippah	Calloway, Henry, Falkner, Bude, Tickfaw, Hurricane	Lintonia, Richland, Dexter, Freeland	Olivier, Calhoun, Carroll, Hatchie, Almo	Vicksburg, Collins	Falaya, Waverly
	Ridge and upper slope	Middle and lower slope [1]	Ridge, upper, and middle slope	Lower slope						
Ash, green & white	●	■	—	●	●	■	●	■	■	■
Baldcypress	—	—	—	—	—	—	—	—	●	■
Basswood, American	●	■	—	●	●	●	●	●	●	—
Beech, American	●	■	—	■	●	●	■	●	■	■
Cherry, black	●	■	●	●	●	●	●	●	●	●
Cottonwood, eastern	—	●	—	●	—	—	●	●	■	■
Elms, slippery & American	●	■	●	■	■	●	■	■	■	■
Hackberry and sugarberry	—	●	—	●	●	●	●	●	●	●
Hickories (exc. water)	■	■	■	■	■	●	■	●	■	●
Honeylocust	—	●	—	●	—	●	—	●	●	■
Magnolia, southern	●	■	●	●	●	●	●	●	●	●
Maple, red	●	■	●	■	■	■	■	■	■	■
Oak, cherrybark	■	■	●	■	■	■	■	●	■	■
Oak, Nuttall	—	—	—	—	—	—	●	●	●	■
Oak, overcup	—	—	—	—	—	—	—	●	●	■
Oak, Shumard	■	■	■	■	■	●	■	●	■	●
Oak. southern red	■	■	■	■	■	●	●	●	●	●
Oak, swamp chestnut	●	●	—	●	●	●	●	●	●	■
Oak, water	■	■	■	■	●	■	●	■	■	■
Oak, white	■	■	■	■	■	■	●	●	●	●
Oak, willow	●	●	●	●	●	●	●	●	●	■
Persimmon, common	■	●	■	●	■	●	■	●	●	■
Pines	●	●	■	●	●	●	●	●	●	●
Sassafras	■	●	●	●	●	●	●	●	●	●
Sweetgum	■	■	■	■	■	■	■	■	■	■
Sycamore, American	●	●		●	●	●	●	●	■	■
Tupelo, black	■	■	■	■	■	■	●	●	●	■
Yellow-poplar	■	■	■	■	■	●	■	●	■	●

[1] Includes all slopes greater than 17 percent.

POST AND SPECIALTY SPECIES: Black locust, flowering dogwood, and catalpa on well-drained acid soils; eastern redcedar and mull

SPECIES LIMITED COMMERCIALLY OR IN OCCURRENCE: Cucumbertree and black walnut on well-drained soils; chinkapin oa oak, black oak, sugar maple, northern red oak, and royal paulownia on well-drained upland soils; laurel oak and pin oak on bottoms; water tupelo, swamp cottonwood, and swamp tupelo on wet, acid bottoms; boxelder on all bottoms; river birch on w American holly on all acid soils; post oak on uplands and terraces; water hickory and black willow on all poorly drained s cedar elm, winged elm, and buckeye on all soils; spruce pine on acid lower slopes, terraces, and bottoms.

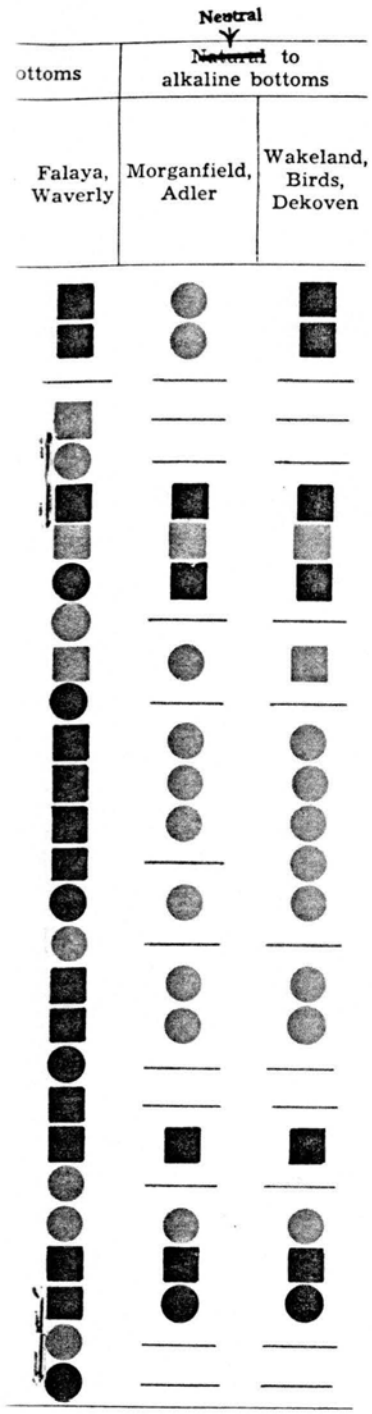
WEED SPECIES: Eastern hophornbeam, and American hornbeam on acid terraces and bottoms; blackjack oak and smooth sumac on w terraces; swamp-privet and common buttonbush on wet, poorly drained bottoms; hawthorn on all soils.

■ Occurs frequently; favor in management.

● Occurs occasionally; favor.

■ Occurs frequently; manage, but do not fav

● Occurs occasionally; manage, but do not fa



r and mulberry on all soils.

inkapin oak, scarlet oak, chestnut
in oak on wet, acid terraces and
irch on well-drained acid bottoms;
drained soils; pecan, chinaberry,

mac on well-drained uplands and

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COASTAL PLAIN

Many soils supporting hardwoods in the Midsouth are on terraces and bottoms within the Coastal Plain. In general, they are sandy, acid, and lacking in natural fertility, but some have adequate moisture and drainage for many of the important species.

Table 3 lists the principal Coastal Plain soils and the hardwoods that occur naturally on them. Soils developed on upland positions are omitted, because most are too poor and dry for commercial hardwoods, except perhaps on lower slopes. Pines (excluding spruce pine) are included because they are better adapted to poorly drained panlike soils than are hardwoods. Of the terrace soils the best drained are Cahaba, Kalmia, and Amite, and the poorest drained are Stough, Wahee, Myatt, and Leaf. The best drained bottom-land soils are Ochlockonee, Iuka, and Bruno, and the poorest drained are Bibb, Chastain, and Johnston. Stough, Wahee, Myatt, and Leaf have subsoils that act like pans with respect to water relations.

Rivers whose alluvium is derived primarily from Coastal Plain soils include the Chattahoochee bordering a part of Florida and Alabama; Escambia in Florida; Black Warrior, Cahaba, Alabama, Tombigbee, and Mobile in Alabama; Leaf, Chickasawhay, Pascagoula, and Pearl in Mississippi; Calcasieu and Sabine in Louisiana; Saline and Ouachita in Arkansas; Neches and Angelina in Texas; and numerous smaller streams throughout the area.

BLACKLAND

The Blackland soils occur chiefly in Alabama, Mississippi, and eastern Texas, with smaller areas in Louisiana and Arkansas. They are found within the much larger Coastal Plain land area, but differ in their prairie-like nature and characteristic color.

In general, Blackland soils are derived from marly clays and soft limestone. Some have weathered slightly acid, but most are neutral to alkaline. Texture is principally fine or clay-size. The alluvial soils are sufficiently fertile to support excellent growth of some hardwood species, provided that moisture and drainage are adequate. The upland soils are not considered suitable for hardwood timber.

The principal soils that support good stands are listed in table 4. The terrace soils, Kipling and Geiger, are poorly to somewhat poorly drained clays, medium acid to neutral. Of the bottom-land soils, Marietta and Verona are young alluvium, somewhat poorly to poorly drained, coarse to medium in texture, and neutral to calcareous. Of the fine-textured acid soils, Kaufman

TABLE 3.—*Soil suitability for hardwoods in the Coastal Plain area*

Important commercial species	Terraces			Bottoms from Coastal Plain materials					
	Cahaba, Kalmia, Amite	Flint, Prentiss, Tilden, Izagora	Stough, Wahee, Myatt, Leaf	Ochlockonee, Iuka, Bruno	Mantachie, Urbo	Bibb	Chastain		Johnston
							Coarse surface	Fine surface	
Ash, green & white	—	●	●	●	■	■	●	●	●
Baldcypress	—	—	—	—	●	■	●	●	●
Beech, American	—	—	—	●	■	●	●	●	—
Birch, river	—	—	—	■	●	—	—	—	—
Cherry, black	●	●	●	■	●	—	—	—	—
Cottonwood, eastern	—	—	●	●	●	●	●	●	—
Elms, slippery & American	●	●	●	■	■	■	●	—	—
Hackberry and sugarberry	—	●	●	●	●	●	●	●	—
Hickories (exc. water)	■	■	●	■	■	●	●	●	—
Magnolia, southern	●	●	—	■	■	●	●	—	—
Maple, red	●	●	■	■	■	■	■	●	■
Oak, cherrybark	●	■	■	■	■	■	■	■	—
Oak, laurel	—	—	●	●	●	■	■	■	—
Oak, Nuttall	—	—	—	—	●	■	●	■	—
Oak, overcup	—	—	—	—	●	■	●	■	—
Oak, Shumard	●	●	●	●	●	●	●	●	—
Oak, southern red	■	■	●	●	●	●	—	—	—
Oak, swamp chestnut	—	●	●	●	■	■	●	●	—
Oak, water	■	■	■	■	■	■	■	■	—
Oak, white	■	■	■	■	■	●	●	●	—
Oak, willow	●	●	■	●	■	●	●	■	—
Persimmon, common	●	●	●	●	●	●	●	●	—
Pines (exc. spruce)	■	■	■	●	●	●	●	●	—
Pine, spruce	—	—	—	●	●	●	●	●	—
Sweetgum	■	■	■	■	■	■	■	■	●
Sycamore, American	—	—	—	■	■	●	●	●	—
Tupelo, black	■	■	■	■	■	■	■	■	—
Tupelo, water	—	—	—	—	—	●	●	●	■
Walnut, black	●	●	●	●	●	●	●	—	—
Yellow-poplar	■	■	■	■	■	■	●	—	●

POST AND SPECIALTY SPECIES: Black locust and flowering dogwood on moist, well-drained soils; mulberry on all soils.

SPECIES LIMITED COMMERCIALLY OR IN OCCURRENCE: Basswood, pecan, post oak, and silver maple on well-drained soils; shingle oak, sweetbay, and swamp tupelo on poorly drained soils; boxelder, winged elm, honeylocust, black willow, sassafras, American holly, buckeye, chinaberry, and common sweetleaf on all soils.

WEED SPECIES: Blackjack oak and smooth sumac on well-drained soils; planertree, roughleaf dogwood, poison-sumac, and buttonbush on poorly drained soils; eastern hophornbeam, American hornbeam, devils-walking-stick, hawthorn, and flatwoods plum on all soils.

■ Occurs frequently; favor in management.
● Occurs occasionally; favor.
■ Occurs frequently; manage, but do not favor.
● Occurs occasionally; manage, but do not favor.

is moderately well drained, Houlka is somewhat poorly drained, and Una is poorly drained. Of the fine-textured alkaline group, Catalpa, which is brown, and West Point (sometimes called Trinity), which is black, have the best internal drainage. Tuscumbia has the poorest.

The larger river flood plains in the Blackland area with some of these soils are Tombigbee, Alabama, Noxubee, and Trinity.

TABLE 4.—*Soil suitability for hardwoods in the Blackland area*

Important commercial species	Terrace soils:[1] Kipling, Geiger	Bottom soils: Recent coarse and medium-textured: Marietta, Verona	Bottom soils: Fine-textured acid: Kaufman	Bottom soils: Fine-textured acid: Houlka	Bottom soils: Fine-textured acid: Una	Bottom soils: Fine-textured calcareous: Catalpa, West Point	Bottom soils: Fine-textured calcareous: Leeper, Tuscumbia
Ash, green & white	■	■	●	■	■	■	■
Cottonwood, eastern	●	■	●	●	●	■	■
Elms, slippery & American	●	■	●	■	●	■	■
Hackberry and sugarberry	●	■	●	■	■	■	■
Hickories (exc. water)	●	●	■	■	●	—	—
Maple, red	●	■	●	■	■	—	●
Maple, silver	●	●	—	—	—	●	●
Oak, cherrybark	●	●	■	■	■	—	—
Oak, Durand	●	●	■	■	—	●	●
Oak, Nuttall	—	—	●	■	■	●	●
Oak, overcup	—	—	●	●	■	—	●
Oak, post	■	—	—	—	—	—	—
Oak, Shumard	●	●	■	■	●	—	—
Oak, swamp chestnut	●	●	●	■	●	●	—
Oak, water	■	■	●	■	■	●	●
Oak, white	●	—	●	●	●	—	—
Oak, willow	●	■	●	■	■	●	—
Persimmon, common	●	●	●	■	●	—	—
Sweetgum	●	●	■	■	■	●	●
Sycamore, American	●	●	●	●	●	●	●
Tupelo, black	●	●	●	●	●	●	●
Yellow-poplar	—	●	●	●	●	—	—

[1] Noneroded phases only.

POST AND SPECIALTY SPECIES: Black locust and catalpa on all well-drained, moist soils; eastern redcedar on all dry soils; Osage-orange on all neutral to alkaline soils; mulberry on all soils.

SPECIES LIMITED COMMERCIALLY OR IN OCCURRENCE: Boxelder, winged elm, honeylocust, and pecan on all soils; American beech, southern magnolia, spruce pine, American holly, shingle oak, sassafras, and chinaberry on all acid soils; black walnut and black cherry on all well-drained, moist soils; laurel oak and sweetbay on acid, poorly drained soils; black willow and baldcypress on all moist, poorly drained soils.

WEED SPECIES: Hawthorn and privet on all soils; American hornbeam, eastern hophornbeam, roughleaf dogwood, and flatwoods plum on all acid soils; smooth sumac on all moist, well-drained soils; redbud and Hercules-club on terraces and acid soils.

■ Occurs frequently; favor in management.
● Occurs occasionally; favor.
■ Occurs frequently; manage, but do not favor.
● Occurs occasionally; manage, but do not favor.

RED

Reddish-brown soils occupy the flood plains of the Arkansas and Red Rivers and include acid to alkaline sands, silts, and clays. They are formed of alluvium, mainly from the western plains. The more alkaline soils occur in the Red River flood plain and the more acid soils in the Arkansas River flood plain.

Their wide range in properties produces an equivalent range in quality and growth of many important commercial hardwoods. Suitability relationships are shown in table 5.

Of the terrace soils, McKamie, Hortman, and Muskogee are moderately to well drained acid soils, Morse and Asa are similar in drainage but neutral to alkaline, and Gore, Acadia, and Wrightsville are poorly to somewhat poorly drained and acid.

Of the acid bottom-land soils, Pulaski, Gallion, Lonoke, and Mer Rouge are better drained than Hebert, Portland, and Perry. Of the

TABLE 5.—*Soil suitability for hardwoods in the Red area*

Important commercial species	Terraces			Bottoms			
	McKamie, Hortman, Muskogee	Morse, Asa	Gore, Acadia, Wrightsville	Pulaski, Gallion, Lonoke, Mer Rouge	Yahola, Norwood	Hebert, Portland, Perry	Miller, Buxin, Roebuck, Pledger
Ash, green & white	■	●	■	■	■	■	■
Cottonwood, eastern	—	—	—	●	■	●	●
Elms, slippery & American	■	■	●	■	■	■	■
Hackberry and sugarberry	■	■	●	■	■	■	■
Hickories (exc. water)	■	—	■	■	—	●	●
Honeylocust	—	■	—	●	●	●	■
Oak, cherrybark	■	●	●	■	—	■	—
Oak, Nuttall	●	●	●	●	●	■	●
Oak, overcup	—	—	●	●	●	■	●
Oak, swamp chestnut	■	—	●	■	—	■	●
Oak, water	■	●	●	■	●	■	●
Oak, white	■	—	●	●	—	●	—
Oak, willow	■	●	●	●	—	■	●
Pecan	●	■	—	■	■	●	■
Pines	■	—	■	—	—	—	—
Sweetgum	■	■	■	■	■	■	●
Sycamore, American	●	●	—	■	■	●	●
Tupelo, black	●	—	■	●	—	—	—

POST AND SPECIALTY SPECIES: baldcypress on all poorly drained soils; eastern redcedar on all moderately to well-drained soils; Osage-orange on neutral to alkaline soils; mulberry and persimmon on all soils.

SPECIES LIMITED COMMERCIALLY OR IN OCCURRENCE: post oak on well-drained acid soils; swamp tupelo on poorly drained acid soils; blackjack oak, American holly, winged elm, sassafras, and Shumard oak on acid soils; boxelder on neutral to alkaline soils; American smoketree on poorly drained neutral to alkaline soils; black willow, pumpkin ash, water hickory, and pin oak on all poorly drained soils; cedar elm, chinaberry, and red maple on all soils.

WEED SPECIES: American hornbeam and eastern hophornbeam on acid soils; hawthorn, swamp-privet, redbud, and roughleaf dogwood on all soils; devils-walkingstick on terraces.

■ Occurs frequently; favor in management.
● Occurs occasionally; favor.
■ Occurs frequently; manage, but do not favor.
● Occurs occasionally; manage, but do not favor.

others, which are neutral to alkaline to calcareous, Yahola and Norwood are better drained than Miller, Buxin, Roebuck, and Pledger.

LITERATURE CITED

(1) Beaufait, W. R.
1956. Influence of soil and topography on willow oak sites. U. S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 148, 12 pp., illus.

(2) Broadfoot, W. M.
1960. Field guide for evaluating cottonwood sites. U. S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 178, 6 pp., illus.

(3) ————
1961. Guide for evaluating cherrybark oak sites. U. S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 190, 9 pp., illus.

(4) ————
1963. Guide for evaluating water oak sites. U. S. Forest Serv. Res. Paper SO-1, 8 pp., illus. South. Forest Expt. Sta., New Orleans, La.

(5) ———— and Krinard, R. M.
1959. Guide for evaluating sweetgum sites. U. S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 176, 8 pp., illus.