Quercus stellata Wangenh. Post Oak

Fagaceae Beech family

John J. Stransky

Post oak *(Quercus stellata),* sometimes called iron oak, is a medium-sized tree abundant throughout the Southeastern and South Central United States where it forms pure stands in the prairie transition area. This slow-growing oak typically occupies rocky or sandy ridges and dry woodlands with a variety of soils and is considered drought resistant. The wood is very durable in contact with soil and used widely for fenceposts, hence, the name. Due to varying leaf shapes and acorn sizes, several varieties of post oak have been recognized-sand post oak *(Q. stellata* var. *margaretta* (Ashe) Sarg.), and Delta post oak *(Q. stellata* var. *paludosa* Sarg.) are included here.

Habitat

Native Range

The range of post oak (figs. **1, 2)** extends from southeastern Massachusetts, Rhode Island, southern Connecticut and extreme southeastern New York (including Long Island); west to southeastern Pennsyl-

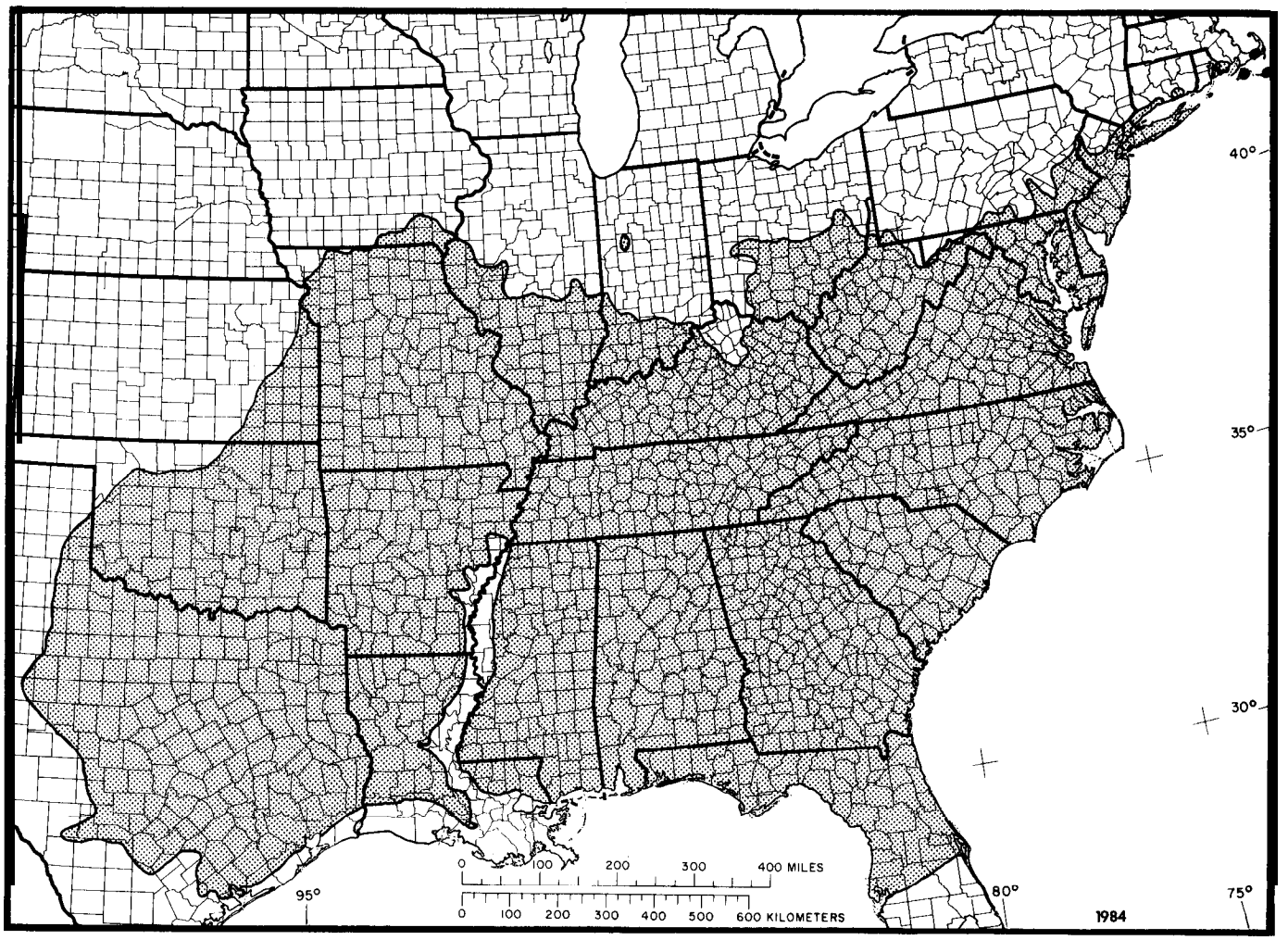

Figure 1—*The native range of post* oak.

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Figure 2—*Post oak left after clearcutting the surrounding loblolly-pine hardwood forest in Nacogdoches County, TX.* (Courtesy J. C. Huntley)

vania and West Virginia, central Ohio, southern Indiana, central Illinois, southeastern Iowa and Missouri; south to eastern Kansas, western Oklahoma, northwestern and central Texas; and east to central Florida *(10)*.

It is a large and abundant tree in the southern Coastal Plain, the Piedmont, and the lower slopes of the Appalachians. It is common in the southwest and grows in pure stands in the prairie transition region of central Oklahoma and Texas known as the "Cross Timbers" (2).

Sand post oak *(Quercus stellata* var. *margaretta* (Ashe) Sarg.) ranges from southeastern Virginia, west to Missouri and eastern Oklahoma, south to central Texas, and east to central Florida. Delta post oak (*Q. stellata* var. *paludosa* Sarg.) is found in bottom lands of the Mississippi River in western Mississippi, southeast Arkansas, and Louisiana, and west to east Texas *(10)*.

Climate

The range of post oak reaches from the humid East to semiarid portions of Oklahoma and Texas. Within this region, average annual precipitation varies from more than 1520 mm (60 in) in west Florida and parts of Louisiana to less than 560 mm (22 in) in central Texas. Annual snowfall varies from 760 cm (30 in) in southeastern Iowa to a trace in Florida *(15)*.

Mean annual temperatures vary from 10" C (50° F) in southern New England and southeastern Iowa to 22" C (72" F) in central Florida. January temperatures average from -6" C (22" F) in southeastern Iowa to 17" C (62" F) in Florida; in July they range from 23" C (73" F) in southern New England to 29" C (85" F) in Texas. Temperature extremes of -11" C (12° F) in Kansas, Oklahoma, and Texas and -40" C (-40" F) in central Missouri have been recorded.

From northwest to southeast the average frost-free period increases from 165 to 300 days, 60 to 90 percent, respectively, of the annual precipitation occurring during this period.

Soils and Topography

Post oak grows on a variety of sites and soils. Its range coincides mostly with that of the Ultisols but also includes some Alfisols in the western portion of its distribution. Typically, it grows on dry sites. Rocky outcrops, ridges, and upper slopes with southerly or westerly exposures are common.

Soils are generally well drained, sandy, coarse textured, deficient in nutrients, and low in organic matter. The surface soil is generally thin but post oak, and especially the scrubby sand post oak, grows on deep sandy, gravelly soils.

Delta post oak grows in fine sandy loam soils on the highest first-bottom ridges in terraces. There is seldom standing water, but the site may be wet due to slow drainage.

Associated Forest Cover

In the Northern Forest Region, post oak is found in the forest cover type White Pine-Chestnut Oak (Society of American Foresters Type 51) *(4)*. On dry ridges and upper slopes its other associates are scarlet, white, and black oaks *(Quercus coccinea, Q. alba,* and *Q. velutina)*, hickories *(Carya* spp.), and pines *(Pinus* spp.).

In the Central Forest Region, post oak is most abundant in Post Oak-Blackjack Oak (Type 40). It extends over a wide area from eastern Kansas south to Texas and east to the Atlantic Coastal Plain. On heavier, clay soils a post oak variant of this type is found, and in the Texas "Cross Timbers" area and in Oklahoma, a post oak savanna. Along with other oaks, post oak is a common associate in several other cover types: Bear Oak (Type 43), Chestnut Oak (Type 44), White Oak-Black Oak-Northern Red Oak (Type 52), White Oak (Type 53), Black Oak (Type 110), Pitch Pine (Type 45), and Eastern Redcedar (Type 46).

In the Southern Forest Region, sand post oak is a chief hardwood component of Sand Pine (Type 69). Sand post oak and post oak grow on drier sites of Longleaf Pine (Type 70) and in Southern Scrub Oak (Type 72). Post oak is a common associate in Longleaf Pine-Slash Pine (Type 83), Shortleaf Pine (Type 75), Virginia Pine (Type 79), Loblolly Pine (Type 81), and Loblolly Pine-Shortleaf Pine (Type 80), and on better drained sites of Slash Pine (Type 84). In the oak-pine types post oak is a common associate in Shortleaf Pine-Oak (Type 76), Virginia Pine-Oak (Type 78), and the Loblolly Pine–Hardwood (Type 82); sand oak is an important component of Longleaf Pine-Scrub Oak (Type 71).

Delta post oak is found in Swamp Chestnut Oak–Cherrybark Oak (Type 91). In Mesquite (Type 68) of east central Texas, post oak appears in mixture with mesquite ***(Prosopis*** spp.).

The most common hardwoods associated with typical post oak are blackjack oak ***(Quercus*** *marilandica)*, black oak, and the hickories. Less common associates include southern red oak (Q. *falcata)*, white oak, scarlet oak, chestnut oak ***(Q.*** *prinus)*, shingle oak ***(Q. imbricaria),*** live oak ***(Q. uirginiana),*** chinkapin oak ***(Q. muehlenbergii),*** bluejack oak (Q. *incana)*, Shumard oak ***(Q. shumardii),*** blackgum ***(Nyssa*** *sylvatica)*, sourwood ***(Oxydendrum arboreum),*** red maple *(Acer rubrum)*, winged elm ***(Ulmus alata),*** hackberry ***(Celtis occidentalis),*** chinkapin ***(Castanea*** spp.), and dogwood *(Cornus* spp.). Coniferous associates are eastern redcedar ***(Juniperus virginiana),*** shortleaf pine *(Pinus* ***echinata),*** Virginia pine *(P. virginiana)*, pitch pine *(P. rigida)*, loblolly pine *(P.* ***taeda),*** and occasionally longleaf and slash pines *(P.* ***palustris*** and *P.* ***elliottii).*** At higher elevations eastern white pine *(P. strobus)* and hemlock *(Tsuga* spp.) are sometimes associates.

Delta post oak is commonly associated with cherrybark oak ***(Quercus falcata*** var. ***pagodifolia),*** water oak ***(Q. nigra),*** willow oak *(Q. phellos)*, swamp chestnut oak (Q. *michauxii)*, white oak, sweetgum ***(Liquidambar*** *styraciflua)*, blackgum, American elm *(Ulmus* ***americana),*** winged elm, white ash ***(Fraxinus americana),*** hickories, and loblolly pine.

In the South, where post oak is a major component in many stands, the following small trees are common associates: shining sumac ***(Rhus*** *copallina)*, smooth sumac ***(R. glabra),*** gum bumelia ***(Bumelia lanuginosa),*** hawthorns ***(Crutaegus*** spp.), yaupon ***(Rex vomitoria),*** possumhaw ***(I.*** *decidua)*, redbud ***(Cercis canadensis),*** and rusty blackhaw ***(Viburnum*** *rufidulum).*

Life History

Reproduction and Early Growth

Flowering and Fruiting-Post oak is monoecious; staminate and pistillate flowers are on the same tree in separate catkins (aments). Flowers appear at the same time as the leaves. Flowering usually begins in March in the South and extends through May further north, Staminate flowers are borne in pendant catkins 5 to 10 cm (2 to 4 in) long. The calyx is yellow, pubescent, and five-lobed; the lobes are acute and laciniately segmented, with four to six stamens and pubescent anthers. Pistillate catkins are short-stalked or sessile and inconspicuous; the scales of the involucre are broadly ovate and hairy with red, short, enlarged stigmas ***(18).***

The acorns mature in one growing season and drop soon after ripening, from September through November. Late freezes after the start of flowering and leafing may cause seed crop failures. The acorns are sessile or short-stalked, borne solitary, in pairs, or clustered; acorns are oval or ovoid-oblong, broad at the base, 13 to 19 mm (0.5 to 0.75 in) long, striate, set in a cup one-third to one-half its length. The cup is bowl-shaped, pale, and often pubescent within. Externally it is hoary-tomentose. The scales of the cup are reddish brown, rounded or acute at the apex, and closely appressed ***(18).***

Seed Production and Dissemination-In common with many other oaks, post oak begins to bear acorns when it is about 25 years old. Good acorn crops are produced at 2- to 3-year intervals; although at several locations in Missouri over a 6-year period, post oak consistently averaged only 200 seeds per tree per year while white, blackjack, black, and scarlet oaks of the same size on the same site bore from 500 to 2,400 acorns per tree. Isolated trees in open fields in east Texas consistently produced well. Elsewhere in Texas, trees less than 15 cm (6 in) in d.b.h. had no acorns ***(12).***

The number of post oak acorns per kilogram averages 838 (380/lb) but may range from 441 to 1,340 (200 to 608/lb) *(17).*

In a sampling of post oak acorn yields from 736 trees for 18 years (1950-67) in western Louisiana and eastern Texas, the average number of fresh acorns per kilogram was 476 (216/lb) with 39 percent moisture content (5). Mast yield increased linearly with increasing bole size. Expected acorn yield was 1.6 kg (3.6 lb) from trees 30.5 cm (12 in) in d.b.h., and 3.6 kg (8.0 lb) from trees 50.8 cm (20 in) in d.b.h. The percentage of acorn-producing trees also increased with increasing d.b.h. from 42 percent on 15.2 cm (6 in) trees to 76 percent on 55.9 cm (22 in) trees. Expected acorn yield rose from 0.9 kg (2 lb) on trees with a 3.0 m (10 ft) crown diameter to 5.5 kg (12.1 lb) on trees with a 6.1 m (20 ft) crown diameter. Average acorn yield per tree over the 18-year observation period varied from a low 0.03 kg (0.07 lb) in 1962 to a high 4.4 kg (9.7 lb) in 1965.

Seedling Development-Post oak acorns germinate in the autumn soon after dropping. They do not exhibit dormancy. Germination is hypogeal. The best seedbed is a moist soil covered with 2.5 cm (1 in) or more of leaf litter.

Vegetative Reproduction-Post oaks up to 25 cm (10 in) in d.b.h. sprout prolifically after being cut or burned. Along the southwestern margins of its range, post oak spreads rapidly into former grasslands after periodic prairie fires were stopped, and much of this extension appears to be of sprout origin. In one study in which potted seedlings were deprived of moisture until the aboveground parts died, two to three times as many post oaks sprouted after normal moisture was restored than did white, blackjack, northern red, or scarlet oaks *(12).*

In a comparison of the sprouting habits of five oaks, post oak had more one-stem clumps and fewer sprouts per clump on the average than did black oak, chestnut oak, white oak, or scarlet oak. This characteristic would be important in culture by coppice except that post oak grows more slowly than the others.

Sapling and Pole Stages to Maturity

Growth and Yield-In the Southeast, mature post oaks are from 15.2 to 18.3 m (50 to 60 ft) tall and from 30 to 61 cm (12 to 24 in) in d.b.h. Maximum height rarely exceeds 30 m (100 ft), and diameters exceeding 122 cm (48 in) are uncommon. In the extreme western part of its range, mature trees are seldom larger than 9 to 12 m (30 to 40 ft) tall and 38 to 46 cm (15 to 18 in) in d.b.h. Height and diameter growth for post oak are usually slower than for any of the associated trees except blackjack oak. Ten-year diameter growth generally averages less than 5 cm (2 in), and in central Oklahoma it may be only 13 mm (0.5 in).

Diameter growth of individual post oaks averaging 17 cm (6.7 in) in d.b.h. was stimulated when most of the stand was removed to favor forage production in Robertson County, TX *(12).* Post oak stands were thinned from an average of 14.9 m^2/ha (65 ft^2/acre) basal area to 8.9, 6.0, and 3.0 m^2/ha (39, 26, and 13 ft^2/acre). In the two ensuing growing seasons, average annual diameter growth for the heaviest thinning was twice that of the uncut check plots (3.6 mm compared to 1.8 mm, excluding bark, or 0.14 in compared to 0.07 in).

Average post oak stands in east Texas contain a volume of about 47.2 m^3/ha (7.5 cords or 675 ft^3/acre). In an Oklahoma woodland, typical of the dry upland post oak type, post oaks 30 cm (12 in) in d.b.h. and larger made up 64 percent of the sawtimber volume (Doyle rule) in a stand averaging nearly 28.0 m^3/ha (2,000 fbm/acre). The average post oak contained 0.4 m^3 (70 fbm).

Rooting Habit-Post oak seedlings have especially thick taproots, usually exceeding the shoot diameter; but overall root development is less than that of northern red *(Quercus rubra),* scarlet, white, and blackjack oak *(12).* Although post oak seedlings do become established on sites having a tight clay subsoil, their growth is slow and most roots develop above the underlying clay *(3).* Post oak seedlings were found to be the most drought resistant of four Missouri oaks, primarily because of the greater drought tolerance of their leaf and root cells *(13).* In Alabama, post oak was the least tolerant of flooding of all species tested (6).

Reaction to Competition-Post oak is intolerant of competition and is classed as intolerant of shade. Because of its slow height growth it often is overtopped by other trees, including most other oaks. On poor sites, however, post oak tends to persist and become dominant because it is more drought resistant than many of its associates *(12).*

Damaging Agents-Post oak is susceptible to most insects, diseases, and pollutants that present a threat to other oaks. Regeneration efforts are hampered by acorns being destroyed by weevils. Insect defoliators, leafrollers, tent caterpillars, Gypsy moth, sawfly, leaf miners, and skeletonizers may cause growth losses, and when repeated, may cause mortality *(14).* The foliage also is susceptible to at-

tacks by aphids, lace bugs, various scales, gall wasps, and mites. The trunk, twigs, and roots may be damaged by carpenter-worms, borers, beetles, twig pruners, white grubs, and cicadas (locusts). Some of these cause defects that render the wood unfit for many commercial purposes *(1).*

Chestnut blight fungus *(Cryphonectria parasitica)* causes many defects as well as mortality to post oak throughout its range (8). The tree also is subject to oak wilt *(Ceratocystis fagacearum)*, a vascular disease prevalent mostly north of the 35th parallel, but not to the same degree as on red oaks. Soil-inhabiting fungi may cause heavy seedling mortality by damping off. Powdery mildews stunt and deform nursery seedlings.

Many fungi produce spots, blotches, blisters, and blights on the foliage. They rarely cause real damage but are unsightly.

Decay fungi cause cankers, rots, and discoloration of the upper and lower stem, as well as of the roots. The Texas root rot *(Phymatotrichum omnivorum)* attacks mainly oaks planted on old farm fields or in subdivisions *(14).*

Several species of mistletoe are often found on branches and trunks of post oak. Infected branches may be stunted and eventually die. Trees usually are not killed.

Nonpoint source pollutants near large cities cause twigs of many oaks to die back, or kill the trees. The specific diagnosis is usually difficult. Sulfur dioxide, fluoride, ammonia, and some herbicides have been identified as probable agents.

Special Uses

Post oak is a valuable contributor to wildlife food and cover. Acorns provide high energy food during fall and winter and are considered important in the diet of wild turkey, white-tailed deer, squirrels, and many other rodents. When acorns are available animals fatten quickly, go through the winter in good condition, and are most likely to produce healthy young (7). Leaves are used for nest building by birds, squirrels, and raccoons *(11).* Cavities provide nests and dens for various birds and mammals.

Considered a beautiful shade tree for parks, post oak is often used in urban forestry. It is also planted for soil stabilization on dry, sloping, stony sites where few other trees will grow. It develops an attractive crown with strong horizontal branches. Large trees are difficult to transplant and do not tolerate compaction or removal of soil in developments *(19).*

The wood of post oak, commercially called white oak, is classified as moderately to very resistant to decay *(16).* It is used for railroad ties, lathing, siding, planks, construction timbers, mine timbers, trim molding, stair risers and treads, flooring (its highest volume finished products), fenceposts, pulp, veneer, particle boards, and fuel. The bark provides tannin, decorative and protective mulch in landscaping, and fuel.

The tannin in oak leaves, buds, and acorns is toxic to cattle, sheep, and goats. Oak poisoning is a problem in the Southwest where annual livestock losses costing more than $10 million have been estimated. Poisoning occurs more frequently in drought years when other forage is in short supply. The most dangerous season is during the sprouting of new foliage, a period of about 4 weeks in March and April *(9).*

Genetics

The great variation in post oak and its tendency to hybridize creates a number of varieties and hybrids. The following hybrids with ***Quercus stellata*** have been recognized *(10)*: ***Q. alba*** *(**Q. x fernowii*** Trel.); ***Q. bicolor*** *(**Q. x substellata*** Trel.); ***Q. durandii*** *(**Q. x mucnubiuna*** Sudw.); ***Q. huvurdii*** (unnamed); Q. *lyrata* *(**Q. x sterrettii*** Trel.); ***Q. mucrocurpa*** *(**Q. x guadulupensis*** Sarg.); ***Q. minima*** *(**Q. x neo-thurpii*** A. Camus); ***Q. mohriunu*** (unnamed); ***Q. prinoides*** *(**Q. x stelloides*** Palmer); ***Q. prinus*** *(**Q. x bernardiensis*** W. Wolf); ***Q. virginiana*** *(**Q. x hurbisonii*** Sarg.).

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