

LIVE OAK

Quercus virginiana Mill.

Plant Symbol = QUVI

Common Names: southern live oak, southeastern live oak, Virginia live oak, chêne vert

Synonyms and other scientific names: *Quercus andromeda* Riddell; *Quercus virginiana* var. *eximea* Sarg.; *Quercus virginiana* var. *virescens* Sarg.; *Quercus virens* Ait., nom. illeg.

Description

General: Medium to large trees 50-80 ft (15-25 m) tall, with short trunks, long branches, and very broad crowns occasionally approaching 150 ft (45.7 m) wide, but with longer trunks and narrower crowns in some older woodlands, occasionally to 115 ft (35 m) tall. Very large, old trees can have trunks exceeding 10 ft (3 m) in diameter at breast height. Wood can lack obvious or distinct growth rings, especially towards the southern part of its range (Tomlinson, 1986). Short root suckers often forming near the trunk. Bark is gray, very dark brown, to black, and scaly to blocky. Young twigs tan to pale gray, covered in short hairs, becoming darker and nearly smooth in the second year. Buds small, red-brown, rounded. Leaves thickened, shiny on the upper surface, the lower surface pale with short hairs but green and without hair in shade-grown leaves. Leaves 1.4-3.5 in (35-90 mm) long, 0.8-1.5 in (20-38 mm) wide, usually rounded to oblong, without teeth, but some summer growth and growth on juvenile trees with toothed leaves (Nelson, 1994) that can be smaller. Leaves appear evergreen but actually are deciduous, with trees bare or nearly so for up to a few weeks during or just preceding flowering in the early spring. Male and female flowers inconspicuous, borne separately on the same tree (typical of all oaks), female flowers wind-pollinated, solitary or in clusters of 2-3 or rarely up to 5, male flowers in catkins of several flowers. Acorns stalked, solitary or up to five in a cluster, acorn caps 0.3-0.6 in (8-15 mm) long and wide, bowl- to goblet-shaped, with numerous, tiny, sharp-pointed scales, nuts barrel-shaped to egg-shaped, 0.6-1.0 in (15-25 mm) long, dark brown to black. Seedlings with a swollen primary root developing shortly after germination. For detailed descriptions see Correll & Johnston, 1970; Miller & Lamb, 1985; Nixon & Muller, 1997; Stein et al., 2003; and Tomlinson, 1986.



Cultivated tree, Greensboro, NC. Photographer: Douglas Goldman

Hybrids: *Quercus virginiana* is known, presumed, or suspected to hybridize with *Q. alba*, *Q. bicolor* (an artificial hybrid, *Q. ×nessiana* Palmer), *Q. lyrata* (*Q. ×comptoniae* Sarg.), *Q. macrocarpa* (*Q. ×burnetensis* Little), *Q. michauxii*, *Q. minima*, *Q. sinuata*, and *Q. stellata* (*Q. ×harbisonii* Sarg.). *Quercus virginiana* hybridizes with *Q. fusiformis* across of central Texas, leading to much confusion between these two species (Eaton et al, 2015; Jones, 1975; Nixon & Muller, 1997; B.J. Simpson, 1988). *Quercus virginiana* also occasionally may hybridize with *Q. geminata* (Cavender-Bares & Pahlisch, 2009).

Related species: *Quercus virginiana* is one of seven currently-recognized species of similar oaks contained within the North American and Caribbean *Quercus* L. subgenus *Quercus* L. section *Quercus* L. **subsection Virentes** (Loudon) A. Camus (section *Virentes* Loudon, [unranked] *Virentes* (Loudon) Trel.), consisting of trees or shrubs with small, rounded buds, leathery, nearly evergreen leaves that in mature plants usually are untoothed or sparsely toothed; acorns that develop in one growing season and have fused cotyledons; acorn caps with flattened, triangular scales that are darkened apically; and seedlings usually with swollen taproots. *Quercus* subsect. *Virentes* is estimated to have been derived around 11 million years before present (Cavender-Bares et al., 2015), and is most closely related to the much more diverse and widespread white oaks in the remainder of *Quercus* sect. *Quercus* (Cavender-Bares et al., 2015; Hipp et al., 2014). Other species within *Quercus* subsect. *Virentes* are: *Q. brandegeei* Goldman, a small to medium-sized tree with very elongate acorns, of lower elevations in mountainous areas in southernmost Baja California, Mexico (Roberts, 1989; Wiggins, 1980); *Q. fusiformis* Small (*Quercus virginiana* var. *fusiformis* (Small) Sarg.), the Texas live oak, perhaps the most cold-hardy member of *Quercus* subsect. *Virentes* (Cavender-Bares et al., 2015; Diggs et al., 1999), a solitary-trunked to thicket-forming, small to large-sized tree or rarely a shrub, bearing somewhat elongated acorns, in various soil types and rock outcrops (especially limestone and granite), of southwestern Oklahoma, central and southern Texas, and northeastern Mexico; *Q. geminata* Small (*Q. virginiana* var. *geminata* (Small) Sarg., *Q. virginiana* var. *maritima* (Chapm.) Sarg.), the sand live oak, a thicket-forming shrub to medium-sized tree with leaves with revolute margins often resembling upside-down boats, of deep, dry, sandy soil in the outer coastal plain from Mississippi to North Carolina; *Q. minima* (Sarg.) Small (*Q. virginiana* var. *minima* Sarg.), the dwarf live oak, a

low, rhizomatous shrub forming dense colonies, and usually with toothed leaves, in somewhat moist, sandy soil, with a similar distribution to *Q. geminata*; *Q. oleoides* Schltdl. & Cham., a small to large-sized tree of seasonally dry subtropical and tropical forests from northeastern Mexico south to Costa Rica (Boucher, 1983; Jiménez et al., 2016; Kappelle, 2016); and *Q. sagraeana* Nutt. (orthographic variant *Q. sagraana*; *Q. cubana* A. Rich., *Q. oleoides* var. *sagraeana* (Nutt.) C.H. Mull., *Q. virginiana* var. *sagraeana* (Nutt.) Trel.), the sole Caribbean member of the genus (Trelease, 1924), a medium to large-sized tree of sandy to rocky soils in flat to hilly areas of western Cuba (Borhidi, 1996), which could be derived from *Q. virginiana* (Gugger & Cavender-Bares, 2013), or more likely *Q. oleoides* followed by introgression with Florida live oaks (Eaton et al., 2015). Live oaks in sandy soils of southernmost Texas may be hybrids of *Q. fusiformis* with *Q. oleoides*, and the name *Q. oleoides* var. *quaterna* C.H. Mull. has been used for at least some of these trees (Nixon & Muller, 1997). For further information on *Quercus* subsect. *Virentes* see Camus (1939), Muller (1961) and Trelease (1924) for a detailed morphological summary, and Cavender-Bares et al. (2015) for phylogeny and biogeography.

The largest known living specimen of *Quercus virginiana* is in St. Tammany Parish, Louisiana (American Forests, 2016), with a height of only 68 ft, (20.7 m) but a crown spread of 139 ft (42.4 m) and a trunk circumference of nearly 39 ft (11.9 m). Because this tree has several trunks it may not be a single tree. Close competitors are a three-trunked tree in Waycross, Georgia, and a single-trunked tree in Seminole County, Georgia (Georgia Forestry Commission, 2015). The Waycross tree is 77 ft, (23.5 m) tall, an average crown spread of 155 ft (47.2 m) and a trunk circumference of 35 ft (10.7 m). The Seminole county tree is 89 ft, (27.1 m) tall, an average crown spread of 147 ft (44.8 m) and a trunk circumference of about 32 ft (9.8 m).

Distribution: Live oak is native to the coastal plain of the southeastern United States, from southeastern Virginia southward to south Florida and west to eastern Texas (Nixon & Muller, 1997). It is common to abundant throughout much of its natural range, but less so at its northeastern extremity in Virginia where it is relatively rare except along the coast near Virginia Beach (Weakley et al., 2012). It is also locally naturalized in Utah (USDA NRCS, 2016). For current distribution, please consult the [profile page for this species](#) on the PLANTS Web site.

Habitat: Warm-temperate to subtropical or marginally tropical woodlands, savannas, and grasslands, on slightly damp to somewhat dry clay, loam, or sand, occasionally on limestone. Perhaps best represented in evergreen woodlands on maritime barrier islands, but also in various forest types in peninsular Florida, including those of floodplains, moist hammocks, and upland tropical hammocks on limestone (Clewett, 1985; Duever et al., 1986, ch. 5; Harms, 1990; Nixon & Muller, 1997; Snyder et al., 1990). Throughout much of its range its branches are hosts to many epiphytic plants, especially bromeliads (such as ball moss, *Tillandsia recurvata* (L.) L. and Spanish moss, *T. usneoides* (L.) L.), ferns (typically resurrection fern, *Pleopeltis polypodioides* (L.) Andrews & Windham), and orchids.

Adaptation

Live oak is tolerant of a wide range of soil moisture, pH, and compaction (Dirr, 1998), and survives both significant drought and short periods of flooding (Allen & Kennedy, 1989; Arnold et al., 2012 [in part for *Q. fusiformis*]; Carey, 1992). Live oak is notably salt-tolerant (Van Arsdell, 1980), and coastal populations of live oak exhibit more leaf succulence due to frequent exposure to salt spray (Sinclair & Lyon, 2005). Live oak also is tolerant of freezing weather, although more northern populations seem to be most tolerant of sub-freezing temperatures as well as salt (Kurtz et al., 2013), and naturally occurring trees from further north within its range display an innate tendency toward partial deciduousness in the winter (Cavender-Bares, 2007). This species also exhibits a combination of both intolerance and tolerance of fire, with the above-ground parts of a tree damaged or killed by even low-intensity ground fires, with smaller trees most susceptible to damage, but the root crown surviving and producing many suckers after a fire (Carey, 1992; Harms, 1990). This species is native to a region likely to experience hurricanes, which this species withstands well (Harms, 1990), perhaps due to its very hard wood. Live oaks in south Florida fully recovered within a decade after severe damage caused by Hurricane Andrew in 1992 (Douglas Goldman, personal observation).

Uses

Timber/wood: *Quercus virginiana* wood is brown to nearly white (darker in heartwood than sapwood), close-grained, and is extremely hard, strong, and heavy (Austin, 2004; Panshin & de Zeeuw, 1970). Dry wood has a density of around 56-63 lb/ft³ (900 - 1009 kg/m³, 0.9-1.0 g/cm³; Alden, 1995; Cavender-Bares et al., 2004; National Hardwood Lumber Association, 2014), and perhaps higher (Steve Cross, personal communication, August, 2015), and a high specific gravity, around 0.8 for fresh wood and up to 1.00 for oven-dried wood (Alden, 1995; Jenkins et al., 2004; Meier, 2015; Panshin & de Zeeuw, 1970), making its wood one of the densest of North American tree species.

Live oak wood has a long reputation for hardness and durability. Nuttall (1865, pp. 29-30) found the substantial weight of the wood to be similar to that of lignum vitae (*Guaiacum officinale* L.), a tree species noted for its remarkable wood density. Stuart (1833, p. 94) commented that “the wood of this tree is almost incorruptible”, and Catesby (1731, p. 17) stated that the

wood was “harder and tougher than any other oak”. Consequently, it is appropriate to use for “articles requiring exceptional strength and toughness” (Panshin & de Zeeuw, 1970). The wood can have a satiny surface and receive a high polish (Camus, 1939, p. 450). It is used for durable items like furniture and flooring (Meier, 2015), and also has been used for pulp and firewood (Duncan & Duncan, 1988).

Live oak is best known for its use in ship construction (Loudon, 1854; Wood, 1981), especially in the 18th and 19th centuries. The combination of the hardness of the wood, resistance to decomposition (Meier, 2015), and the various branch and trunk shapes (Wood, 1981), made *Q. virginiana* an ideal choice for use with various robust structural elements of wooden ships prior to the use of steel. The USS Constitution earned the name “Old Ironsides” when cannon balls launched by the HMS Guerriere in August, 1812, were observed bouncing off the Constitution’s hull, which was partly constructed of live oak (Wood, 1981). Events like this only reinforced the value of live oak timber, and helped result in the establishment, in 1828, of the first Federally-owned and managed tree farm in the United States, the Naval Live Oaks, now part of Gulf Islands National seashore near Pensacola, Florida (Snell, 1983; Wood, 1981). On occasion live oak is still used for ship construction. Beginning in 2011, the Maritime Museum of San Diego began constructing a replica of the Spanish galleon San Salvador, which in 1542 was the first European vessel to visit the west coast of what would become the United States (Maxwell, 2012). Live oak is still used on occasion for the construction of some smaller modern vessels, such as shrimp boats (Wood, 1981).

Ornamental/landscaping: Live oak commonly is used in horticulture within its native geographic range, and occasionally in areas beyond it that have similar climatic conditions. First cultivated in 1739 (Olson, 1974), it is used in municipal plantings, and around commercial establishments and homes. It is hardy in areas as cold as USDA Plant Hardiness Zone 7 (Dirr, 1998), even though it is native to Zones 8-10, but it is susceptible to damage from freezes that last for several days (B.J. Simpson, 1988). Its broad shape makes it an elegant horticultural subject, and it can grow rapidly with adequate moisture (Osorio, 2001), especially when young. It is tolerant of diverse soil types and some variation in soil moisture, and transplants relatively easily, especially when young (Dirr, 1998; Rehder, 1940). Attempts have been made to find cold-hardy live oaks that will survive as far north as Boston, Massachusetts (Dosmann & Aiello, 2013). Despite being cold-hardy beyond its native range, its evergreen habit can make it more susceptible to branch breakage from ice or snow accumulation (Douglas Goldman, personal observation).

Habitat restoration: Live oak also has been used for reforestation in areas where it is climatologically suitable. It has been used for revegetating well-drained portions of bottomland hardwood areas in the lower Mississippi valley (Allen & Kennedy, 1989), as well as coal mine sites in eastern Texas (Davies & Call, 1989).

Wildlife: The acorns of this species, and the related *Q. fusiformis*, are valuable forage for waterfowl, turkey, wild pigs, raccoons, and deer (Allen & Kennedy, 1989; Elston & Hewitt, 2010 [treated as *Q. virginiana*]), with this species readily established by animal dispersal (Osorio, 2001).

Ethnobotany

Historically, the swollen, tuber-like roots of live oak seedlings were fried and eaten (Nixon & Muller, 1997). The Houma tribe of southeastern Louisiana used a decoction of the bark of live oak for treating dysentery (Moerman, 1986). Catesby (1731, p. 17) noted that the acorns were very sweet, and that the native people usually would store them and use them to thicken their venison soup, and extract from them a pleasant oil similar to that of almonds. Bartram (1791, p. 85) similarly noted the natives’ use of a sweet acorn oil in cooking, and also observed their roasting the fruit in hot embers, consumed like chestnuts. The earliest human inhabitants of what is now northwestern Costa Rica consumed the acorns of the tropical live oak, *Quercus oleoides* (Janzen & Hallwachs, 2016)

Several old live oak trees have special historical significance. See Miller & Lamb (1985) for a list of such specimens.

Status

Threatened or Endangered: This species is not listed as threatened or endangered by the Federal government, or by any state where it naturally occurs.

The vague statement “today live oaks are protected for public enjoyment” (Moore, 2002; Nesom, 2003) has led to confusion about the protected status of *Quercus virginiana*. This statement should not be interpreted to mean that this species is excluded from commercial forestry use wherever it occurs. This species is protected only in public parkland, just like any other plant species, or protected in some communities by tree ordinances (e.g. J.D. Simpson, 2015), but outside these areas it is not protected and commercial forestry use can be explored.

Wetland Indicator: In all regions where it naturally occurs, this species is considered FACU, or a facultative upland species, usually not occurring in wetlands (U.S. Army Corps of Engineers, 2016). However, it is considered an upland plant (UPL) in the Western Mountains, Valleys, and Coast region (specifically Utah), where it is an introduced species.

Weedy or Invasive:

Live oak is not an officially designated weed in any state where it occurs.

Please consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use. Please consult the PLANTS Web site (<http://plants.usda.gov/>) and your state's Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Planting Guidelines

Live oaks grow rapidly when planted, provided they are given adequate water and are not root-bound in pots prior to planting (Osorio, 2001). They are best transplanted when small (Dirr, 1998), and transplanting success is greatest when planted in raised beds in sandy soil, with root collars at the surrounding soil level but not above or below it (Bryan et al., 2011). Because this species forms large root systems and wide crowns with age, these factors should be considered when planting live oaks in areas where they could obstruct vehicular traffic or damage sidewalks (Osorio, 2001).

Management

Live oak that are well-established under favorable conditions or in ideal habitats are very resistant to competition from other plant species (Harms, 1990). When used in habitat revegetation projects this species establishes better when inoculated with mycorrhizae (Davies & Call, 1990). In areas managed for game or browsing animals, the related species, *Q. fusiformis*, can out-compete many valuable forage plant species, even though it is a valuable browse and mast species itself (Fulbright & Garza, 1991 [treated as *Q. virginiana*]). Controlling *Q. fusiformis* thickets with fire only increases the density of these thickets (Springer et al., 1987 [as *Q. virginiana*]). However, with *Q. fusiformis*, abundant browsing can inhibit the establishment of mature trees (Russell & Fowler, 1999).

Pests and Potential Problems

Numerous fungal diseases affect live oak. *Quercus virginiana* is susceptible to oak wilt (Diggs et al. 1999; Peacock & Smith, 2013; Sinclair & Lyon, 2005), caused by *Ceratocystis fagacearum* (Bretz) J. Hunt (anamorph *Chalara quercina* B.W. Henry; *Thielaviopsis quercina* (B.W. Henry) A.E. Paulin et al.). The disease is spread by burrowing beetles or root grafts between trees. Symptoms can occur in part or all of the tree, consisting of leaf necrosis, with larger leaf veins becoming yellow to bronze, and gradual branch die-back over one to a few years. Oak wilt can be contained by removing infected trees, injection of systemic fungicides, or breaking root grafts by trenching (Peacock & Smith, 2013; Sinclair & Lyon, 2005). Some diseased Texas live oaks, *Q. fusiformis*, with symptoms once attributed to persimmon wilt, a disease caused by the fungus *Nalanthamala diospyri* (Crand.) Schroers & M.J. Wingf. (*Acremonium diospyri* (Crand.) W. Gams; *Cephalosporium diospyri* Crand.), actually suffered from oak wilt (Lewis & Oliveria, 1979 [treated as *Q. virginiana*]). A canker disease caused by *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl. (*Botryodiplodia theobromae* Pat.; *Diplodia theobromae* (Pat.) W. Nowell; *Botryosphaeria rhodina* (Berk. & M.A. Curtis) Arx.; *Physalospora rhodina* Berk. & M.A. Curtis), a secondary pathogen, can kill live oaks that already are badly damaged by oak wilt (Lewis & Oliveria, 1979). Bot canker, caused by *Diplodia corticola* A.J.L. Phillips et al. (teleomorph *Botryosphaeria corticola* A.J.L. Phillips et al.) and *D. quercivora* Linald. & A.J.L. Phillips (teleomorph not yet identified), causes significant branch dieback in live oak (Dreaden et al., 2014; Mullerin & Smith, 2015). Chrysoporthe canker, a disease typically afflicting *Eucalyptus*, caused by *Chrysoporthe cubensis* (Bruner) Gryzenh. & M.J. Wingf. (*Cryphonectria cubensis* (Bruner) Hodges; *Endothia eugeniae* (Nutman & F.M. Roberts) J. Reid & C. Booth), has been found on *Q. virginiana* in Florida (Sinclair & Lyon, 2005). Chestnut blight, caused by *Cryphonectria parasitica* (Murrill) M.E. Barr (*Endothia parasitica* (Murrill) P.J. Anderson & H.W. Anderson), affects not only chestnut species (*Castanea* Mill.), and causes local damage to slow dieback in live oaks which can be fatal (Phelps, 1974). Live oaks also experience diebacks caused by *Biscogniauxia atropunctata* (Schwein.) Pouzar (*Hypoxylon atropunctatum* (Schwein.) Cooke) (Van Arsdell, 1972) and *Amphilogia gyrosa* (Berk. & Broome) Gryzenh. et al. (*Cryphonectria gyrosa* (Berk. & Broome) Sacc. & D. Sacc.; *Endothia gyrosa* (Berk. & Broome) Höhn.) (Sinclair & Lyon, 2005), both which can affect several oak species. *Taphrina caerulescens* (Desm. & Mont.) Tul. causes leaf blister, resulting in leaf deformities or some defoliation (Harms, 1990). Two species of fungi are known to occur only on the dead, outer bark of *Q. virginiana*, specifically *Peniophorella baculorubrens* (Gilb. & M. Blackw.) K.H. Larss. (*Hyphoderma baculorubrense* Gilb. & M. Blackw.) and *Perenniporia phloiophila* Gilb. & M. Blackw., resulting in little harm to the tree other than the loss of areas of the oldest, outermost bark, causing what is otherwise known as "smooth patch" (Gilbertson & Blackwell, 1984).

The bacterium *Xylella fastidiosa* Wells et al. causes leaf scorch in live oak, resulting in branch die-back (McGovern & Hopkins, 1994).

Vascular epiphytic plants, especially *Tillandsia recurvata* and *T. usneoides*, are not parasites, but when present in very large quantities on live oaks they can increase wind loading and shading of foliar surfaces (Coder, 2010). A leafless, vining

parasitic plant, *Cassytha filiformis* L., a member of the avocado or laurel family (Lauraceae), uses the sand live oak (*Q. geminata*) as one of many hosts in Florida (Sinclair & Lyon, 2005).

Live oak has a handful of significant insect pests. Twigs often are damaged by gall formation, and although insecticides can control gall-forming wasps reinfestation from untreated trees makes gall inhibition more difficult (Platt Bird et al., 2013). The roots of live oaks can be attacked by the larvae of a large beetle, the live oak root borer, *Archodontes melanopus* (Linnaeus, 1767), resulting in deformed growth of effected trees (Harms, 1990).

“Oak Decline” refers to a generalized decline in growth, vigor, and health of oak trees, potentially fatal, caused by a wide variety of factors, including drought, physical damage caused by construction equipment or storms, soil compaction, insects, and secondary pathogens. Symptoms are slowed growth, undersized or deformed leaves, chlorosis, cankers on trunks and branches, and dieback of twigs and branches. See Sinclair & Lyon (2005) for a detailed summary of Oak Decline.

Competition with other species can have a negative impact on live oak establishment. For example, the presence of the invasive Brazilian peppertree (*Schinus terebinthifolius* Raddi) significantly inhibits the establishment of live oak seedlings (Nickerson & Flory, 2015).

Environmental Concerns

The related oak, *Q. fusiformis*, can invade grasslands, reducing available forage for wildlife (Fulbright & Garza, 1991 [treated as *Q. virginiana*]).

Control

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Seeds and Plant Production

Quercus virginiana averages 352 cleaned seeds per pound (Olson, 1974). Propagation by seed is preferred (Dirr, 1998), and healthy acorns germinate rapidly and in high percentages (Olson, 1974). Acorns don't require vernalization, but desiccated or frozen acorns become inviable, and those stored unfrozen in moist peat tend to germinate but bear soil-borne fungal pathogens (Dirr & Heuser, 1987), so planting acorns shortly after collection is preferred. Propagation by cuttings, especially from younger trees, has had some success (Dirr & Heuser, 1987), but cuttings made from root suckers have rooted at very high rates and in turn have produced few root suckers themselves (Niu & Wang, 2007).

Cultivars, Improved, and Selected Materials (and area of origin)

Several live oak cultivars are available. One of the most popular is High Rise ('QVTIA'), a selection with rapid vertical growth which is well-suited for narrow planting spaces. For a summary of live oak cultivars see Coder (2010) and Dirr (1998).

Cultivars should be selected based on the local climate, resistance to local pests, and intended use. Consult with your local land grant university, local extension or local USDA NRCS office for recommendations on adapted cultivars for use in your area.

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