

OAKS FOR THE ADELAIDE PLAINS: SUCCESSFUL SPECIES IN THE WAITE ARBORETUM

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Abstract

The University of Adelaide's Waite Arboretum is a valuable experimental collection. Species of oaks performing well there under natural rainfall of 625 mm are reported. Most successful are the species from the Mediterranean region, California and Mexico. Many of these oaks have potential for street or amenity planting.

Introduction

Oaks belong to *Quercus*, one of eight genera in the family Fagaceae that occurs primarily in temperate Northern Hemisphere. The family also includes sweet chestnuts *Castanea* (8 spp.), *Trigonobalanus* (3 spp.), beeches *Fagus* (10 spp.), *Chrysolepis* (2 spp.) and two tropical genera *Castanopsis* (134 spp.) and *Lithocarpus* (325 spp.) (Govaerts & Frodin, 1998). In Australia the family is represented by the Gondwanan genus *Nothofagus* (34 spp.) which considered to be in a separate family by Hill & Jordan (1993).

Of the 531 species of oaks, about 250 occur in the Americas, 125 in Asia and Malesia and the rest in Europe, N. Africa and Macaronesia (Govaerts & Frodin, 1998). Sierra Madre Occidental, Mexico and East and Southeastern Asia are rich in species. The infrageneric taxonomy of oaks is in a state of flux and various schemes exist. Oaks are widely cultivated, and widespread hybridisation and high variability make the delimitation of some species contentious.

The Waite Arboretum

The Waite Arboretum is nestled in the foothills of Adelaide, South Australia, 34°58'S 138°38'E at an altitude of 100 – 110m. The Arboretum occupies 30 hectares of the University of Adelaide's Waite Campus at Urrbrae and comprises about 2,200 trees and shrubs from all over the world representing about 880 species.

The soil is Urrbrae Fine Sandy Loam. The pH ranges from 5.7 at the surface, to neutral at 75 cm, to 8.6 at 90 - 175 cm depth. The climate is virtually frost free with a rainfall of 625 mm, mainly in winter, followed by a hot dry summer. Initially, all trees were irrigated throughout summer, but since 1960 trees are watered only for a few years until established.

From the outset the experimental value of the Arboretum was recognised and records have been kept of growth, flowering and fruiting. All the trees are labelled and mapped and the data stored electronically.

The Waite Arboretum oak collection

The Waite Arboretum oak collection dates from 1928 when the Arboretum was established. Ten species of oaks were planted in that first year. In the 1950s, due to the interest of Prof. James Prescott, second Director of the Waite Agricultural Research Institute and Prof. Lindsay Prior of Canberra in homoclimes, nine additional species of oaks from SW U.S.A. and Mexico were added to the collection: *Quercus agrifolia* Née, *Q. chrysolepis* Liebm., *Q.*

douglasii Hook. & Arn., *Q. emoryi* Torr., *Q. engelmannii* Greene, *Q. garryana* Douglas ex Hook., *Q. kelloggii* Newb., *Q. lobata* Née, *Q. obtusata* Bonpl. and *Q. wislizenii* A.DC.

Other species that have flourished are from southern Europe or N. Africa:

Q. canariensis Willd., *Q. cerris* L., *Q. coccifera* L., *Q. ilex* L., *Q. ithaburensis* Decne., *Q. petraea* (Matt.) Liebl., *Q. pubescens* Willd., *Q. robur* L. and *Q. suber* L. Asian species such as *Q. acutissima* Carruth., *Q. dentata* Thunb., *Q. leucotrichophora* A. Camus and *Q. phillyraeoides* A. Gray have not thrived.

Some northern U.S.A. species such as *Q. palustris* Münchh. struggle in the hot dry summers of the Adelaide Plains under natural rainfall, but do better in the Adelaide Hills. Other eastern N. American species such as *Q. macrocarpa* Michx., *Q. x leana* Nutt., and *Q. bicolor* Willd. have performed well. Autumn colour in the Arboretum is generally disappointing and rare in the oaks. In occasional years *Q. palustris* produces rich crimson foliage.

Over the last five years another 31 different species of oak have been added to the Waite Arboretum. Of interest were oaks from SW U.S.A. and Mexico, however many of these are shrubby and not suitable for street planting.

A current list of species represented in the Waite Arboretum is given in Appendix A.

Oaks with potential for street and amenity planting in Adelaide

Oaks have the advantages that they are long-lived (200 – 500+ years in their native habitats), hardy and handsome. Many Californian oaks occur naturally in a wide variety of soil types and climatic conditions. For example e.g. *Q. chrysolepis* is distributed where annual rainfall ranges from less than 150 mm to more than 2,780 mm (Tirmenstein, 1989). *Q. garryana* can withstand temperature extremes from

–34°C to 47°C (Howard, 1992). Generally oaks are not salt tolerant, but *Q. ilex* is successful near the coast.

Oaks provide dense summer shade, an attribute increasingly recognised as important in our climate. In a recent survey of Local Governments in South Australia, 76% of respondents considered shade as being ‘very’ or ‘extremely’ important as a factor affecting tree selection, ranking 3rd in importance after the factors ‘non-poisonous’ and ‘non-invasive root systems’ (Mackenzie, 2002).

Where solar access is required in winter, there are a number of deciduous species from which to choose. Some deciduous species e.g. *Q. petraea* Durmast oak retain their dead leaves until spring, which detracts from their appearance.

With water restrictions now in place in a number of Australian States, there is also a growing interest in using hardy species with low water requirements.

Disadvantages of oaks include that they are slow growing and acorns can be a slip hazard on pavements. This may be a reason to favour species such as *Q. kelloggii* that produces acorns only sporadically after 30 years of age, and large quantities only beginning at 80–100 years (Howard, 1992). Large leaved species like

Q. canariensis, though well adapted and providing excellent shade, may be a problem for waterways.

Evaluating species takes many years. Moreover, while a successful specimen is indicative of a suitable species under those site conditions, poor performance of a specimen may be due to poor planting stock or other factors.

All the following species have performed well in the Waite Arboretum. Many have stood the test of 40 summers without supplementary watering. A few younger specimens with potential have also been included. Some of the species are quite large and appropriate only for very wide grassy verges or parks and gardens.

Q. agrifolia coast live oak, California field oak

Evergreen; large, spreading, dense crown of dark green, medium sized leaves. The Arboretum specimen, 50 years old, has a height ~10m, spread ~11 m. It is described in the literature as drought-resistant (though less so than *Q. douglasii* or *Q. lobata*), height 6-25 m and may live over 250 years (Steinberg & Howard, 2002). It is native to W. California and Mexico.

Q. canariensis Algerian oak, Canary oak

Deciduous or semi-evergreen; very large and spreading; leaf size very variable, medium to 25 cm long; dead leaves may be retained till spring. The Arboretum specimens, 75 years old, have heights ~14 m, spreads ~14 m. It is native to

S. Portugal, Spain, Tunisia, Algeria and Morocco. A promising hybrid in the Waite Arboretum is *Q. canariensis* x *Q. robur* with a height ~6 m, spread 6 m after 12 years.

Q. cerris Turkey oak

Deciduous; spreading. The Arboretum specimen, 75 years old, has a height ~16 m, spread ~20 m. It is native to C. & S. Europe and Asia Minor and may attain a height of up to 43 m in some conditions (Royal Horticultural Society, 1999). This species may be too large for streets, but is suitable for parks.

Q. chrysolepis canyon oak, dwarf canyon live oak, maul oak

Evergreen; rounded crown; very attractive; medium size, oblong mostly entire leaves with yellow midrib and terminal twigs. The Arboretum specimen, 50 years old, has a height ~9 m, spread ~9 m. The species occurs naturally on a variety of soils and under rainfall ranging from <150 mm to >2,780 mm. It is reported to be long-lived (to 300 years) and deep rooted with roots extending up to 7.3 m below the soil surface (Tirmenstein, 1989). It is the most widely distributed Californian oak, extending from SW Oregon and into Mexico.

Q. coccifera Kermes oak, grain oak

Evergreen; very attractive, small, dense compact rounded crown; small dark green prickly leaves. The Arboretum specimens, 35 years old, have heights ~6 m, spreads ~6m. It is native to the Mediterranean.

Q. douglasii blue oak, Californian blue oak, iron oak, mountain white oak

Deciduous; upright branching; leaves blue-green, small to medium size. The Arboretum specimens, 50 years old, have heights ~12 m, spreads ~10 m.

This versatile species is described in the literature as flood-tolerant and drought-resistant, well adapted to hot dry summers and cool, wet winters with annual rainfall 510 mm – 1020 mm. In its native habitat it is 6 – 20 m high and the oldest known specimen is 400 years old (Howard, 1992). It is endemic to California.

Q. emoryi Emory oak, blackjack oak, bellota

Evergreen, gradually dropping leaves in spring as the new leaves form; open, lightly branched; small thick light green leaves. The Arboretum specimens, 18 years old, have heights ~8 m, spreads ~6 m. In its native habitat it is a shrub or medium-size tree to 20 m. This is the most abundant species of oak in southern New Mexico to Arizona (Pavek, 1994). It occurs on a variety of soils and is drought tolerant. Its range also extends to W. Texas and Mexico.

Q. engelmannii Engelmann oak, mesa oak

Semi-evergreen; wide spreading, rounded crown; small dark green leaves. The Arboretum specimens, 50 years old, have heights ~10 m, spreads ~12 m. It is native to S. California and Mexico.

Q. garryana Oregon white oak, Garry oak, shin oak, post oak

Deciduous. The Arboretum specimens, 45 years old, have heights ~9m spreads ~8m. The species is drought-resistant, tolerant of a wide range of acid soils and diverse climates, long-lived (to 500 years), can withstand temperature extremes from -34 to 47 °C, and attains a height of 7 – 27 m (Howard, 1992). It is native to W. U.S.A. and S. W. Canada.

Q. ilex evergreen oak, holly oak, Holm oak

Evergreen; very dense, rounded crown; small to medium dark green variable toothed leaves. The Arboretum specimens, 75 years old, have heights ~13 m, spreads ~16m. This species may attain 27 m in height in favourable sites and thrives near the coast (Royal Horticultural Society, 1999). It is native to SW Europe.

Q. ithaburensis Tabor oak, Vallonea oak

Almost evergreen, leaves shed as new leaves emerge; comes into leaf in early August with prolific flowers; graceful pendulous branches; medium-size bright green leaves. The Arboretum specimens, 30 years old, have heights ~8 m, spreads ~7 m. It is native of SE Italy to eastern Mediterranean.

Q. kelloggii California black oak, Kellogg oak

Deciduous, large leaves. The Arboretum specimens, 50 years old, have heights ~10 m, spreads ~11 m; less drought tolerant than other Californian oaks in the Arboretum, showing signs of water stress in recent dry years. The species is typically 9 – 25 m in its native habitat, but may exceed 35 m and live up to 500 years (Howard, 1992). It is native to California and Oregon.

Q. x leana (*Q. imbricaria* x *Q. velutina*)

Almost evergreen; upright branches, open canopy; medium-size light green leaves, few turning yellow/orange in late August. The Arboretum specimen, 55 years old, has a height of ~14 m, spread ~11 m. It is a natural hybrid occurring to C. & EC. U.S.A.

Q. lobata valley oak, California white oak

Deciduous or semi-evergreen; medium sized lobed leaves; comes into leaf very early in August. The Arboretum specimens, 50 years old, have heights ~12 m, spreads ~12 m. In its native habitat, it is the largest North American oak, typically 10 – 25 m but may attain 30 m and live up to 500+ years. It is reported as drought resistant, with several vertical roots that tap groundwater and extensive horizontal root branches: vertical root depth has been recorded as deep as 26 m in some individuals (Howard, 1992). It is endemic to California in areas with rainfall ranging from 140 mm to 2030 mm.

Q. obtusata

Semi-deciduous; medium size leaves. The Arboretum specimen, 12 years old, has height ~7 m, spread ~3 m and is showing promise. It is native to Mexico.

Q. pubescens Downy oak

Deciduous to semi-evergreen; medium sized, lobed leaves. The Arboretum specimen, 30 years old, has a height ~12 m, spread ~7 m. The dead leaves are retained till spring, which detracts from its otherwise attractive appearance. It is native to E., C. & S. Europe, N. Turkey.

Q. robur English oak

Deciduous; wide spreading; medium-size, lobed leaves; dead leaves retained till spring. The Arboretum specimen, 75 years old, has a height ~11 m, spread ~16 m. There are many cultivars including 'Fastigiata' which is also doing well in the Arboretum, at 12 years old, it has a height ~7 m, spread ~1.5 m and has potential for very narrow situations. It has a wide natural distribution from Europe to Iran.

Q. suber cork oak

Evergreen; rounded crown; leaves small, dark green. The Arboretum specimens, about 50 years old, have heights ~12 m, spreads ~14 m. This is a very ornamental, drought tolerant species with thick patterned bark from which commercial cork is obtained. It is suitable for many temperate areas in southeastern Australia and it is surprising that it is not more widely planted in the wine growing districts of South Australia where dense shade in public areas would be an asset. It is native to W. and C. Mediterranean.

Q. wislizenii interior live oak, dwarf / scrub interior live oak, Sierra live oak

Semi-evergreen to almost evergreen; leaves glossy dark green, persisting for two years, small with entire or finely toothed margins; early leafing. The Arboretum specimens, 50 years old, have heights ~11 m, spreads ~11 m.

It is reported to have a deep root system with roots extending up to 21 m deep and it grows on a variety of soils. (Tirmenstein, 1990). It is native to California and Mexico.

Conclusion

Many oaks from California, Mexico and the Mediterranean region have shown promise growing in the Waite Arboretum under 625 mm rainfall without supplementary watering. A number of these merit consideration as street trees or for amenity planting as they are handsome, hardy species that provide good shade.

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Appendix A. Quercus species in the Waite Arboretum 2003 – see following page

Scientific name

Quercus acutissima Carruth.
 Quercus agrifolia Née
 Quercus agrifolia Née
 Quercus alba L.
 Quercus alnifolia Poech
 Quercus arkansana Sarg.
 Quercus bicolor Willd.
 Quercus canariensis Willd.
 Quercus cerris L.
 Quercus chapmanii Sarg.
 Quercus chrysolepis Liebm.
 Quercus coccifera L.
 Quercus coccifera L.
 Quercus dalechampii Ten.
 Quercus dentata Thunb.
 Quercus douglasii Hook. & Arn.
 Quercus emoryi Torr.
 Quercus engelmannii Greene
 Quercus faginea Lam.
 Quercus falcata Michx.
 Quercus frainetto Ten.
 Quercus gambelii Nutt.
 Quercus garryana Douglas ex Hook.
 Quercus georgiana M. A. Curtis
 Quercus glandulifera Blume
 Quercus glaucoides M. Martens & Galeotti
 Quercus grisea Liebm.
 Quercus ilex L.
 Quercus infectoria G. Olivier subsp. veneris (A. Kern.) Meikle
 Quercus infectoria Olivier
 Quercus ithaburensis Decne.
 Quercus john-tuckeri Nixon & C.H. Mull.
 Quercus kelloggii Newb.
 Quercus laurina Bonpl.
 Quercus leucotrichophora A. Camus
 Quercus libani G. Olivier
 Quercus lobata Née
 Quercus lobata Née x Q. robur L.
 Quercus 'Macon' (Q. macranthera x Q. frainetto)
 Quercus macranthera Fisch. & C. A. Mey. ex Hohen.
 Quercus macranthera subsp. sypirensis (C. Koch) Minitsky
 Quercus macrocarpa Michx.
 Quercus michauxii Nutt.
 Quercus myrtifolia Willd.
 Quercus obtusata Bonpl.
 Quercus palustris Muenchh.
 Quercus petraea (Matt.) Liebl.
 Quercus petraea (Matt.) Liebl. subsp. iberica (Steven ex M. Bieb.) Krassiln.
 Quercus petraea (Matt.) Liebl. subsp. pinnatiloba (K. Koch) Menitsky
 Quercus phellos L.
 Quercus phillyreoides A. Gray
 Quercus polymorpha Schtdl. & Cham.
 Quercus pubescens Willd.
 Quercus robur L. 'Fastigiata'
 Quercus robur L. subsp. pedunculiflora (K. Koch) Menitsky
 Quercus robur L. subsp. robur
 Quercus rugosa Née
 Quercus suber L.
 Quercus variabilis Blume
 Quercus virginiana Mill.
 Quercus wislizenii A. DC.
 Quercus wislizenii A. DC. var. frutescens Engelm.
 Quercus x comptonae Sargent (Q. lyrata x Q. virginiana)
 Quercus x hispanica Lam. (Q. cerris x Q. suber)
 Quercus x leana Nutt. (Q. imbricaria x Q. velutina)

Common name

bristle oak
 California field oak
 coast live oak
 white oak
 golden oak

 swamp white oak
 Algerian oak, Canary oak
 Turkey oak

 canyon oak
 Kermes oak
 Kermes oak

 Daimyo oak
 blue oak
 Emory oak
 Engelmann oak, mesa oak

 Spanish red oak
 Italian oak
 Gambel oak
 Oregon white oak

 gray oak
 evergreen oak, holly oak, Holm oak

 Tabor oak, Vallonea oak

 California black oak, Kellogg oak

 Himalayan oak

 valley oak

 Caucasian oak, Persian oak

 burr oak
 swamp chestnut oak
 myrtle oak, seaside scrub oak

 Spanish oak
 Durmast oak

 willow oak
 Ubage oak

 downy oak
 English oak, truffle oak

 English oak
 netleaf oak
 cork oak

 live oak
 interior live oak
 interior live oak