

## BUR OAK

### *Quercus macrocarpa*

#### Michx.

Plant Symbol = QUMA2

Contributed by: USDA NRCS Plant Materials Center, Manhattan, Kansas, Kansas State University, Manhattan, Kansas, and USDA NRCS National Plant Data Center & the Biota of North America Program



Figure 1. Bur oak planted as a yard tree.

John M. Row, USDA NRCS, Manhattan, KS

#### Alternate Names

Blue oak, mossycup oak, mossy-overcup oak, scrub oak

#### Uses

**Industry:** Bur oak wood is used for railroad ties, cabinetry, and tight cooperage --barrels, hardwood flooring, and fence posts. Main sources of trees for timber are Iowa and Illinois bottomlands. The wood is sometimes marketed as 'white oak' (Panshin and deZeeuw 1980).

**Wood characteristics:** The wood of bur oak is heavy to very heavy, hard to very hard (specific gravity 0.55-0.64 green and 0.66-0.79 oven-dry), without odor or taste, and straight grained; tight cooperage (good for barrels). Sapwood is whitish and heartwood light reddish (Panshin and deZeeuw 1980). It is susceptible to breakage at the crotch due to poor collar formation (Gilman and Watson 1994).

**Ornamental:** Probably too large for the average home landscape; however bur oak makes for an excellent park or large area tree (Dirr 1998).

#### Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

#### Description

**General:** A member of the Beech Family (Fagaceae), bur oak is a medium-sized to large tree, typically grows from 70 to 80 feet in height but can grow to 100 feet or more on better sites, with a massive trunk 2 to 3 feet in diameter and a broad, rounded crown of stout branches (Dirr 1998; Fowles 1965). The national Registry of Big Trees reports a specimen in Kentucky that is 99 feet tall and has a circumference of 295 inches and a crown spread of 127.5 inches (American Forests 2012). Shrubrier forms are found on bluffs and hillsides in the northwest part of the tree's range (Nixon 1993); branches and branchlets with corky-winged projections.

The leaves are variable on the plant, alternate, deciduous, 2 to 6 inches wide and 4 to 10 inches long; shape is ovate to oblong; mostly obovate, shaped like a fiddle, tapering to a wedge-shaped base, widest above the middle, with 2-3 rounded lobes on upper half of leaf and 5-7 deeper lobes on lower half of leaf, dark green above, gray-green below, turning yellow or brown in fall (Barkley 1986; Harlow *et al.* 1979; Stephens 1969).



Figures 2 and 3. Leaves deciduous, alternate, obovate, and shaped like a fiddle, tapering to a wedge-shaped base; branches and branchlets with corky-winged projections.

Ohio Division of Natural Resources, Division of Forestry

The stout twigs, yellowish brown, usually pubescent after the second year with conspicuous, corky branches after the first year on some trees. Bark light gray-brown, thick, rough, low ridges separated by shallow furrows into scaly plates, and vertical flattened ridges (Dirr 1998; Stephens 1969).

The inconspicuous flowers emerge shortly after the leaves appear, late April to mid-June. Male and female flowers are borne in separate catkins on the same tree on the current year's branchlets. Male catkins have greenish-brown flowers; female are with green scales and tinged with red. Even though bur oak is monoecious, pollen from one tree appears to germinate better on the stigmas of another favoring cross pollination (Fowells 1969; Johnson 1990).

Fruit is solitary and variable in size. The acorn matures in the first year and is  $\frac{3}{4}$  to  $1\frac{1}{2}$  inch long and  $\frac{1}{2}$  is enclosed with a deep cup which is conspicuously fringed on the margin (Dirr 1998). The common name (bur) is in reference to the cap-covered acorn. It has the largest acorns of all native oaks. Acorns mature in one growing season and drop from the tree August through November. Acorns germinate shortly after seedfall and require no cold stratification. Acorns on more northern trees may remain dormant and germinate the following spring (Johnson 1990).



**Figure 4. The acorn enclosed in a deep cup conspicuously fringed on the margin.**

John M. Row, USDA NRCS

**Variation within the species:** Two varieties are commonly recognized within the species.

Var. *depressa* (Nutt.) Engelm. (*Q. mandanensis* Rydb.) – mostly along the western margin of the Great Plains; small trees or shrubs with smaller and less fringed cups and corky twigs.

Var. *macrocarpa* – over most of the species range; trees with large thick cups.

Bur oak is a member of the white oak subgroup (subgenus *Lepidobalanus*) and hybridizes with various related species, including white oak (*Q. alba*), swamp white oak (*Q. bicolor*), overcup oak (*Q. lyrata*), swamp chestnut oak (*Q. michauxii*), chinkapin oak (*Q. muehlenbergii*), post oak (*Q. stellata*), live oak (*Q. virginiana*), and Gambel's oak (*Q. gambelii*) (Johnson 1990).

### **Ethnobotany**

Native Americans used the inner bark to make decoctions with astringent properties to treat various maladies such as cramps, diarrhea, wounds and sores, hemorrhoids, heart and lung trouble, suppress menses caused by a cold, poison oak, and insect bites. A compound containing wood and inner bark was used to expel pinworms. The large acorns were often roasted in ashes or boiled to remove the bitter taste and prepared in various ways for human consumption. Young growths were used by a number of tribes to make popgun pistons (Moerman 1998).

**Wildlife:** The acorns are eaten by many birds and mammals, including squirrels, rabbits, ground squirrels, mice, deer, black bear, wild turkey, wood ducks, flickers, woodpeckers, and blue jays. They are dispersed by rodents and blue jays, which frequently cache the acorns for later use. Bur oak is browsed by deer, elk, moose, and cattle. Red-tailed hawks, screech owls, fox squirrels, and flying squirrels nest in large trees of bur oak (Fowells 1965; Johnson 1990; Gucker 2011).

**Conservation:** Bur oak is tolerant of city smoke and other air pollutants and of soils that are compacted, sandy, and/or of high pH – it is commonly planted as a shade tree in many urban areas of the United States. The trees become large and are suited for lawns and other open areas, including golf courses, parks, large islands, and fields. They also are useful in rehabilitation of degraded strip-mine sites and have been widely planted in windbreak and shelterbelt systems because of their drought tolerance. A deep tap root system penetrates to lowered water tables during the dry periods. They are used in riparian forest plantings (Johnson 1990).

According the National Register of Big Trees, removal of a bur oak tree 60 feet tall and 105 feet wide with a circumference of 322 inches would cost \$3456.39 to replace the storm water control service it provides. This same tree removes 19.56 lbs. of nitrogen, sulfur, ozone and particulate matter every year (American Forests 2007).

**Distribution:** Bur oak grows naturally throughout much of the north-central United States and the eastern Great Plains. It occurs from extreme southeastern Saskatchewan, southern Manitoba, southwestern and southeastern parts of Ontario, to New York's Finger Lakes Region and southwestern Quebec, to central Maine and New Brunswick, scattered regions in New England, most of Ohio, southern half of Michigan westward to the Dakotas and extreme northeastern Wyoming, central Nebraska and Kansas, south to Tennessee, Arkansas, and the central prairies of Texas – with rare outliers in Louisiana, Mississippi, and Alabama (Fowells 1965). For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.



**Habitat:** Bur oak grows in a range of habitats and moisture regimes – from prairies to valley floors and upland woods. It is a pioneer or early seral species at prairie margins, and savannas.



**Figure 5.** The light gray-brown bark is thick and rough.

John M. Row, USDA NRCS, Manhattan, KS

### **Adaptation**

The trees are slow-growing but long-lived and may reach ages of 300 to 400 years old with some trees to 450. It is classified as intermediate in tolerance to shade (Fowells 1965).

Bur oak has declined on savannas and prairies due to grazing and fire suppression. It is not resistant to flooding (Johnson 1990), although mature bur oak in the Missouri and Mississippi flood plains withstood up to 8 weeks inundation during the Great Flood of 1993. Young trees planted in the Missouri River Flood Plain in 2000-2001, were approximately 9 feet tall when inundated by up to 8 feet of water during the 2008 Flood (Cordsiemon 2012).

It grows quickly on moist, rich bottomlands, but is relatively intolerant of flooding during the growing season; bur oak can only survive flooding or saturated soils 30 consecutive days (Tang and Kozlowski 1982). At the north and west ends of its range, where bur oak occurs on rocky bluffs with thin soil and where repeated fire also may be common, it commonly grows as small trees or thickets of low shrubs. Young plants grow well in full sun to partial sun. It is one of the most drought resistant of the North American oaks (Johnson 1990). It is often associated with calcareous soils. It has high aerosol salt tolerance and good soil salt tolerance (Gilman and Watson 1994).

Bur oak is hardy in USDA Winter Hardiness Zones 4 to 8.

### **Establishment**

Most natural seed germination occurs during the fall (directly after maturation) and unless germination is rapid, few seeds survive predation by insects, small birds, and mammals. Litter-covered acorns appear to be more vulnerable to rodents, insects, and fungus.

One-year old, bare root seedlings, 12 to 18 inches tall are used in plantings. Survival is generally good. Initial growth is centered on root development. Two to three years after planting, top growth should average 8 to 12 inches annually with good weed control. Planting in windbreak rows should be spaced 10 to 18 feet apart and 20 to 24 feet between adjacent rows (Kansas Forest Service 2010).

Although strong and rapid development of the taproot contribute to difficulty in transplanting, bur oak saplings can be obtained in ball-and-burlap and they may be transplanted as young plants from containers. Transplants are best made in spring.

The taproot of young bur oaks rapidly penetrates into the soil, sometimes growing more than 4 ½ feet deep in the first growing season. This early root development, along with high water-use efficiency, may explain why bur oak can pioneer on droughty sites and can successfully establish itself in competition with prairie shrubs and grasses (Fowells 1965).

### **Management**

Bur oak bark is thick and fire-resistant and larger trees often survive fire. Grass fires often kill only seedlings and young trees, but even seedlings may survive unless fires occur at short intervals or with enough intensity of heat. Top-killed smaller trees (or those mechanically damaged) sprout vigorously from the stump or root crown after fire. In areas of frequent fire and strong herbivore browsing, the underground portions may be much older and more extensive than the continually resprouting aerial portions. Where fire suppression is prevalent, bur oak communities may be replaced by more shade-tolerant maple-basswood forests (Gucker 2012).

### **Pests and Potential Problems**

Few insects or diseases cause serious damage to bur oak. Reported insect problems include oak webworm (*Archips fervidana*), oak skeletonizer (*Bucculatrix ainliella*), solitary oak leafminer (*Cameraria hamadryadella*) and gregarious oak leafminer (*C. cincinnatiella*), variable oakleaf caterpillar (*Heterocampa manteo*), and June beetles (Johnson 1990). Oak lacebug (*Corythucha arcuata*) may heavily defoliate bur oaks in shelterbelt plantings, especially during dry weather.

Acorn-inhabiting curculionid weevils of the genera *Conotrachelus* and *Curculio* cause the most damage to

acorns. Two species of *Conotrachelus*, *C. naso* and *C. posticatus* infest bur oak acorns (Gibson 1971).

Oak wilt (*Ceratocystis fagacearum*) is a less serious problem in bur oak than in species of red oak, but the disease sometimes spreads through root grafts of adjacent trees, and entire groves have been killed by the gradual expansion of the disease from one center of infection. Bur oak is susceptible to attack by the cotton root rot (*Phymatotrichum omnivorum*) and Strumella canker (*Strumella coryneoidea*). Other pathogenic fungi have been recognized (Johnson 1990).

### Environmental Concerns

None known

### Seeds and Plant Production

Trees as young as 5 years of age began producing acorns in a spaced plant nursery where 20% of the trees from 20 different sources. Acorn production ranged from heavy to light in the provenance test at Manhattan, Kansas (USDA NRCS, Unpublished Data). For forest trees the minimum seed-bearing age is 35, with optimum seed production occurring between 75–150 years, and trees are known to produce seed up to 400 years. Abundant acorns are produced every 2–3 years, with light crops in the intervals (Fowells 1965).



**Figure 6. Five year old 'Lippert' bur oak produced some 40 acorns.** John M. Row, USDA NRCS, Manhattan, KS

Bur oak may be transplanted or it is easily propagated from seed. Seed should be stored over winter in a cool, moist place at 1–4°C. Germination frequency may be enhanced by stratifying 30–60 days at 1–5°C but stratification is not required for germination, except for var. *oliviformis*, which typically germinates during the spring. Most natural seed germination occurs during the fall (directly after maturation) but seed may be planted in either the spring or fall. Seeds should be planted ½ to 1 ¼ inches deep, in groups of 2–3, spaced at roughly 6 foot intervals (Kansas Forest Service 2010).

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

'Boomer' bur oak was released in 1994 by the James E. "Bud" Smith PMC. Collected from Custer Co., Oklahoma, Boomer was selected for its growth rate and

habit under windbreak conditions. It performs well in dry areas.

'Lippert' bur oak, released in 1993 by the Manhattan, Kansas PMC, is a seed propagated cultivar. It is recommended for conservation use in multi-row windbreaks, reforestation for watershed protection, and wildlife habitat plantings. Lippert's deeply furrowed bark and bright green foliage make it an attractive tree for farmsteads.

Ekalaka Germplasm bur oak is a Selected Class pre-varietal selection of bur oak released by the Bridger, Montana PMC in 2009. It was selected for more rapid growth in height, higher percentage seedling survival, and better vigor. It is recommended for various conservation applications such as windbreaks, shelterbelts, riparian forest buffers, Xeriscapes®, woody draw restoration projects, and wildlife plantings.

Bur oak seed is readily available through commercial seed sources in the central and western US. Seedlings can be purchased from both state and commercial nurseries. Foundation seed of Plant Materials program selections is available by contacting the releasing PMC or respective Plant Materials Specialist.

### References

- American Forests, National Register of Big Trees: bur oak, *Quercus macrocarpa* [online:cited January 2007].
- American Forests, National Register of Big Trees: *Quercus macrocarpa* (<http://americaforests.org/resources/bigtrees/quercus-macrocarpa-5/>). [online:cited April 2012].
- Barkley, T. ed. 1986. *Flora of the Great Plains*. 1986. Univ. Press of Kansas. Lawrence. 1392p.
- Cordisimon, R. 2012. Personal Communication. USDA NRCS Elsberry Plant Materials Center.
- Dirr, M. A. 1998. *Manual of Woody Plants: Their identification, Ornamental Characteristics, Culture, Propagation and Uses*. 821-822. Stipes Publishing L. L. C. Champaign IL.
- Fowells, H. A. 1965. *Silvics of Forest Trees of the United States*. Agriculture Handbook No. 271. USDA Forest Service, Washington, DC.
- Gibson, L. P. 1971. Insects of bur oak acorns. *Annals of the Entomological Society of America*.
- Gilman, E. F. and D. G. Watson. 1994. *Quercus macrocarpa*. Fact Sheet ST-551. U.S. Forest Service. Southern Group.
- Gucker, Corey L. 2011. *Quercus macrocarpa*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <http://www.fs.fed.us/database/feis/> [online:cited November 2012].

- Harlow, W. H., E. S. Harrar, and F. M. White. 1979. *Textbook of Dendrology*. Sixth Edition. McGraw-Hill Book Co. 510p.
- Johnson, P. S. 1990. *Quercus macrocarpa* Michx. Bur Oak. Pp. 686-692, IN: R. M. Burns and B. H. Honkala. *Silvics of North America. Volume 2. Hardwoods*. USDA, Forest Service Agric. Handbook 654, Washington, D.C.
- Kansas Forest Service. Bur oak. (<http://www.Kansasforests.org/pubs/conservation/index.shtml>). [online: cited July 2010].
- Moerman, D.E. 1998. Native American Ethnobotany. Timber Press. Portland. London. 927pp.
- Nixon, K.C. and others 1993. *Quercus*. Pp. 445-506, IN: *Flora of North America, North of Mexico. Vol. 3*. Oxford Univ. Press, New York, New York.
- Ohio Division of Natural Resources, Division of Forestry Bur oak (*Quercus macrocarpa*). [http://www.ohiodnr.com/forestry/trees/oak\\_bur/tabid/5390/Default.aspx](http://www.ohiodnr.com/forestry/trees/oak_bur/tabid/5390/Default.aspx) [online: cited July 2010].
- Panshin, A. J. and C. deZeeu. 1980. *Textbook of wood technology*, 4<sup>th</sup> Edition. McGraw-Hill Series in Forest Resources. McGraw-hill Book Co., New York. 722p.
- Stephens, H.A. 1969. *Trees, shrubs, and woody vines in Kansas*. Univ. of Kansas Press. Lawrence. 250p.
- Tang, Z. C. and T. T. Kozłowski 1982. Some physiological and morphological responses of *Quercus macrocarpa* seedlings to flooding. *Can. J. For. Res.* Vol. 12: 196-202.
- USDA NRCS. Unpublished Data. Bur oak (*Quercus macrocarpa* Michx.) seed source study. Manhattan Plant Materials Center, Manhattan, KS.

**Prepared By:**

John M. Row, Plant Materials Specialist  
NRCS Plant Materials Center  
Manhattan, KS 66502

Wayne A. Geyer, Professor  
Forestry Division, Kansas State University  
Manhattan, KS 66506

Guy Nesom, Formerly BONAP, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, NC 27599

**Citation**

Row, J. M., W. A. Geyer, and G. Nesom. 2012. Plant Guide for bur oak (*Quercus macrocarpa* Michx.). USDA-Natural Resources Conservation Service, Manhattan, KS 66502.

Published November 2012

Edited:

For more information about this and other plants, please contact your local NRCS field office or Conservation District at <http://www.nrcs.usda.gov/> and visit the PLANTS Web site at <http://plants.usda.gov/> or the Plant Materials Program Web site <http://plant-materials.nrcs.usda.gov>.

PLANTS is not responsible for the content or availability of other Web sites.

Keywords: bur oak, *Quercus*, *Quercus macrocarpa*, fire-resistant, large tree, long-lived tree, drought tolerant