Quercus alba L. White Oak

Fagaceae Beech family

Robert Rogers

White oak *(Quercus alba)* is an outstanding tree among all trees and is widespread across eastern North America. The most important lumber tree of the white oak group, growth is good on all but the driest shallow soils. Its high-grade wood is useful for many things, an important one being staves for barrels, hence the name stave oak. The acorns are an important food for many kinds of wildlife.

Habitat

Native Range

White oak (figs. 1, 2) grows throughout most of the Eastern United States. It is found from southwestern Maine and extreme southern Quebec, west to southern Ontario, central Michigan, to southeastern Minnesota; south to western Iowa, eastern Kansas, Oklahoma, and Texas; east to northern Florida and Georgia. The tree is generally absent in the high Appalachians, in the Delta region of the lower Mississippi, and in the coastal areas of Texas and Louisiana.

The west slopes of the Appalachian Mountains and the Ohio and central Mississippi River Valleys have optimum conditions for white oak, but the largest trees have been found in Delaware and Maryland on the Eastern Shore.

Climate

White oak grows under a wide variety of climatic conditions. Mean annual temperature ranges from 7" C (45" F) along the northern edge of the growing area to nearly 21" C (70° F) in east Texas and north Florida. The extreme low temperature ranges from -46" C (-50" F) in Wisconsin and Minnesota to -18" C (0° F) in north Florida. Annual precipitation ranges from 2030 mm (80 in) in the southern Appalachians to 760 mm (30 in) in southern Minnesota. Snowfall averages 178 cm (70 in) in southern Maine and less than 3 cm (1 in) in northern Florida. The average noon July relative humidity is less than 50 percent in the western part of the range and more than 65 percent on the Atlantic Coast. The frost-free season is 5 months in the north and 9 months in the extreme southern part of the range. The mean maximum frost penetration in the soil is 102 cm (40 in) in the north and 3 cm (1 in) in the south.

The optimum range of white oak in the Ohio Valley and central part of the Mississippi Valley has the following average climatic conditions: annual temperature, 13" C (55" F); annual precipitation, 1020 mm (40 in); annual snowfall, from 38 to 51 cm (15 to 20 in); noon relative humidity in July, 55 percent; frost-free season, 6 months; and frost penetration, 25 cm (10 in) (28).

Soils and Topography

White oak grows on a wide range of soils and sites. It is found on podzols, gray-brown podzolic soils, brown podzolic soils, red and yellow podzolic soils, lithosols, planasols, and alluviums. The tree grows on both glaciated and nonglaciated soils derived from many parent materials. It is found on sandy plains, gravelly ridges, rich uplands, coves, and well-drained loamy soils. Growth is good on all but the driest, shallowest soils (28).

Mineral nutrition is not limiting to white oak growth except on very sandy soils where moisture is also a limiting factor. The amount of variability in white oak growth that can be accounted for by soil factors alone is low *(9,28,37)*. Nevertheless, several studies have identified the more important factors to be thickness of the A_1 and A_2 horizons and the percent clay in the surface soils *(18,25,28)*. White oak is most frequently found growing on soils in the orders Alfisols and Ultisols.

The major site factors influencing white oak growth are latitude, aspect, and topography *(9,18)*. White oak has the ability to grow on all upland aspects and slope positions within its range except extremely dry, shallow-soil ridges; poorly drained flats; and wet bottom land. It grows best on north- and east-facing lower slopes and coves and grows well on moderately dry slopes and ridges with shallow soils. White oak is more abundant although smaller in size on the drier west- and south-facing slopes than on the more mesophytic sites.

It is found at all altitudes in the central and southern parts of its range, but it is seldom found above 150 m (500 ft) in elevation in the northern part of its range. It is excluded from the high Appalachians in New York and New England; but it is a scrub tree at elevations of 1370 m (4,500 ft) in the southern Appalachians (28).

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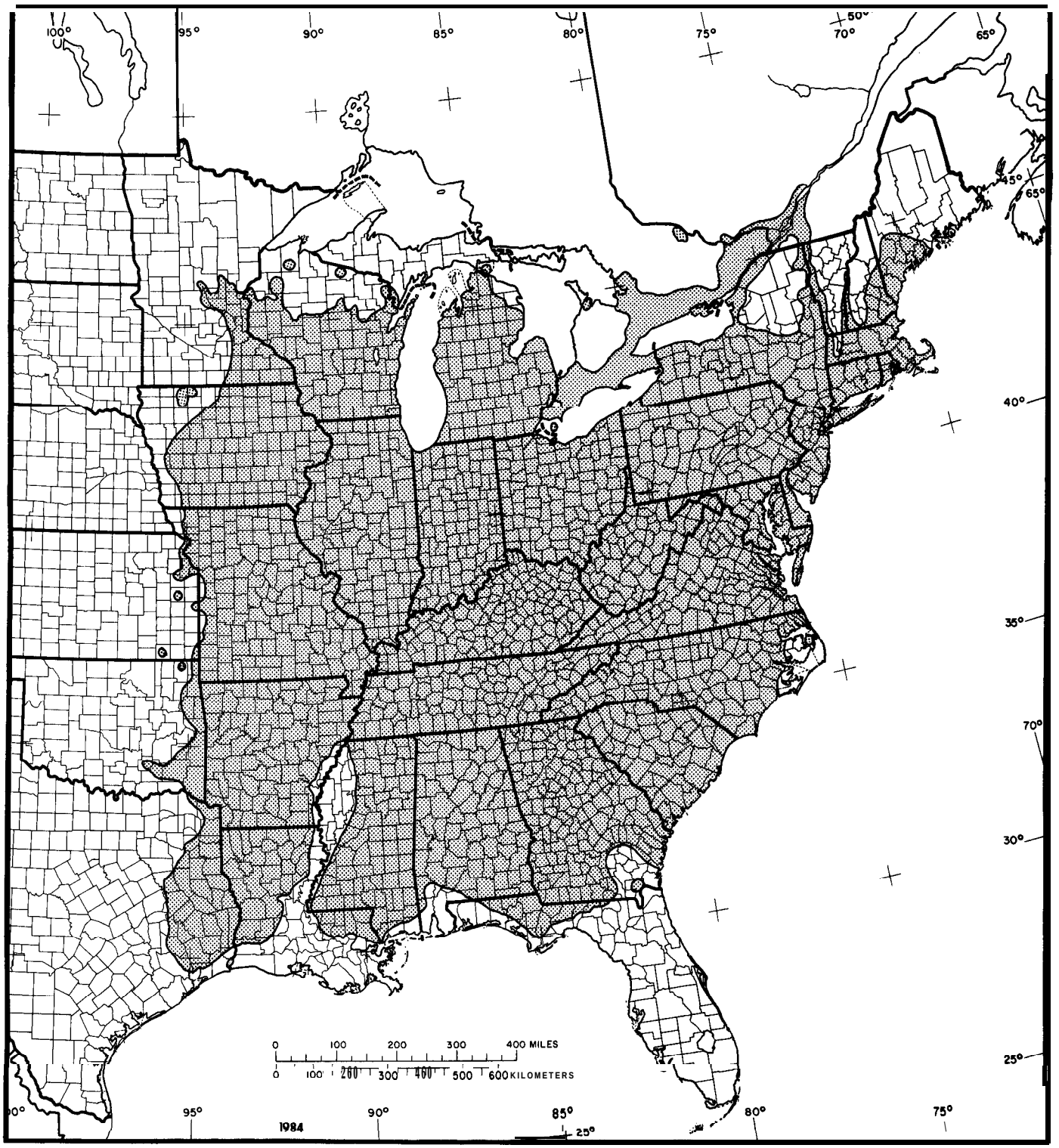

Figure 1--The *native range of white oak.*

Figure 2—*White oak.*

Associated Forest Cover

White oak grows in association with many other trees, the more important of which are other upland oaks *(Quercus* spp.), hickories *(Carya* spp.), yellow-poplar *(Liriodendron tulipifera),* American basswood *(Tilia americana),* white ash *(Fraxinus americana),* sweetgum *(Liquidambar styraciflua),* blackgum *(Nyssa sylvatica),* American beech *(Fagus grandifolia),* sugar maple *(Acer saccharum),* shortleaf pine *(Pinus echinata),* loblolly pine *(P. taeda),* eastern white pine *(P. strobus),* and eastern hemlock *(Tsuga canadensis).* The most frequent associates are other oaks and the hickories.

White oak is a major component of three forest cover types *(10)*: White Oak-Black Oak-Northern Red Oak (Society of American Foresters Type 52), White Oak (Type 53), and Yellow-Poplar-White Oak–Northern Red Oak (Type 59). It is a minor component of the following 28 other forest types:

Northern Forest Region
14 Northern Pin Oak
19 Grey Birch-Red Maple
21 Eastern White Pine
22 White Pine-Hemlock
23 Eastern Hemlock
26 Sugar Maple-Basswood
27 Sugar Maple
51 White Pine-Chestnut Oak
60 Beech-Sugar Maple

Central Forest Region
40 Post Oak-Blackjack Oak
42 Bur Oak
43 Bear Oak
44 Chestnut Oak
45 Pitch Pine
46 Eastern Redcedar
55 Northern Red Oak
57 Yellow-Poplar
58 Yellow-Poplar-Eastern Hemlock
61 River Birch-Sycamore
110 Black Oak

Southern Forest Region
75 Shortleaf Pine
76 Shortleaf Pine-Oak
78 Virginia Pine–Oak
79 Virginia Pine
80 Loblolly Pine–Shortleaf Pine
81 Loblolly Pine
82 Loblolly Pine-Hardwood
91 Swamp Chestnut Oak-Cherrybark Oak

Life History

Reproduction and Early Growth

Flowering and Fruiting—White oak flowers in the spring at about the same time leaves appear. The time may vary from late March to late May depending upon latitude. It is monoecious; flowers of both sexes are present on the same tree. The yellowish staminate flowers appear first and are borne in 5- to 8-cm (2- to 3-in) catkins. The reddish pistillate flowers appear 5 to 10 days later either singly or in pairs on short stalks. Female flowers that are not fertilized abscise during the development period. High abscission rates are common and may be related to weather conditions during the period of pollination, ovule development, and fertilization (44). Ripe anthers open and close with changes in relative humidity. Normally, pollen dissemination is completed within 3 days but periods of wet weather delay pollen shedding. Dry winds and freezing weather are also detrimental to flower development and pollen shedding (28). Acorn crops are good in years when the weather is warm for 10 days during flowering and then cool for 13 to 20 days afterward. The acorn crop has been poor in years when cool periods preceded warm periods at the time of flowering (36).

Acorn maturity is reached approximately 120 days after pollination. Acorn drop follows 25 days later and is complete within a month. Physiological

maturity, as indicated by normal germination, is reached when acorns change color from green to light brown (4). Acorns germinate almost immediately after falling to the ground in September or October.

Seed Production and Dissemination-White oak can produce seeds prolifically, but good acorn crops are irregular and occur only every 4 to 10 years. Sometimes several years may pass without a crop. Acorn yields range from 0 to 500,000 acorns per hectare (202,000/acre) *(7,22,28)*. This great variation in acorn production exists not only among isolated stands of oaks but also among individual trees within stands and from year to year.

Trees normally bear seeds between the ages of 50 and 200 years, sometimes older; however, open-grown trees may produce seeds as early as 20 years. Individual white oak trees tend to have either very good or very poor seed crops and are noticeably consistent in seed production from year to year *(20,28,36,40)*. A recent study *(13)* showed that white oak flower production varies not only annually but also among trees within a given year and that much of the variation in acorn production can be related to flower abundance at the time of pollination. More than 23,000 acorns were produced during a good seed year by an individual white oak tree growing in Virginia; it was 69 years old, 63.5 cm (25 in) in d.b.h., and 21 m (69 ft) tall, and had a crown area of 145 m^2 (1,560 ft^2). Average production in good years for individual forest-grown trees, however, is probably no more than 10,000 acorns.

Several studies have shown that only a small portion of the total mature acorn crop (sometimes only 18 percent) is sound and fully developed; the remainder is damaged or destroyed by animals and insects *(15,28,40)*. However, some damaged acorns germinate if the embryo is not damaged. Light acorn crops are often completely destroyed by animals and insects, so seedlings are produced only during heavy crop years.

Seeds are disseminated by rodents (chiefly squirrels and mice), gravity, and wind. The area seeded by individual trees is small and therefore widespread reproduction depends on adequate distribution of seedbearing trees.

Seedling Development-Germination is hypogeal. Sound white oak acorns have a germination capacity between 50 and 99 percent (30). Seeds germinate in the fall soon after dropping, requiring no pretreatment for germination. For germination to occur, the moisture content of acorns must not fall below 30 to 50 percent. Germination is favored at soil temperatures between 10" and 16" C (50° and 60" F). Germination is severely limited after 15 days of exposure to flooded conditions *(1)*. When acorns germinate, their roots begin to grow but the shoot remains dormant. This trait serves to protect it from damage by freezing *(11)*.

After germination, root growth continues until interrupted by cold weather. Broken radicles are replaced on freshly sprouted seeds. Root and shoot growth resumes in the spring, and after the first growing season, seedlings 7.6 to 10.2 cm (3 to 4 in) high normally develop a large taproot 6 to 13 mm (0.25 to 0.50 in) in diameter and more than 30.5 cm (12 in) long.

Oak seedling establishment is best on loose soil because the radicle cannot penetrate excessively compact surfaces. A humus layer is especially important because it keeps the soil surface loose and porous and because it mechanically supports the acorn as the radicle penetrates the soil (28).

If climate and soil are favorable for germination, white oak reproduces adequately from seed when: (1) large seed trees are within about 61 m (200 ft); (2) litter cover is light to moderate (but not thick); and (3) light reaching seedling level is at least 35 percent of full sunlight. Reproduction is least abundant on moist sites that have a thick carpet of ferns and lesser vegetation *(6)*. Seedlings persist more readily in open stands typical of dry exposures but can be maintained on moist sites if adequate sunlight reaches the forest floor.

Although important, soil moisture is probably not a critical factor in determining early seedling survival except under unusually dry conditions. At least one study has shown that when available soil moisture was 19 percent of oven dry soil weight, white oak seedling survival was 98 percent; at 3 percent available moisture, survival was 87 percent (28).

A Missouri study has shown that despite an adequate crop of sound acorns, the number of new white oak seedlings produced in any given year is low compared to other oaks, particularly black oak *(Quercus velutina)*. However, these individuals may persist in the understory for many years (90 years) by repeatedly dying back and resprouting. This phenomenon permits the gradual buildup of advance reproduction that is often taller and more numerous than the advance reproduction of associated oaks.

Under ideal growing conditions it is common for individual seedlings to grow 0.6 m (2 ft) or more a year. However, white oak seedlings established at the time of overstory removal normally grow too slowly to be of value in stand reproduction. Mean height of seedlings 10 years after overstory removal on sites with a site index of 13 to 19 m (43 to 63 ft) at base age 50 years in Missouri was slightly more than 0.6

m (2 ft) while seedling sprouts and stump sprouts averaged 4.9 and 6.4 m (16 and 21 ft), respectively *(27)*.

Vegetative Reproduction-Small white oak trees sprout prolifically and vigorously when cut or damaged by fire. The ability to sprout depends on the d.b.h. of the parent trees as follows (23):

D.b.h. class		Stumps likely to sprout
cm	*in*	*percent*
5 to 14	2 to 5	80
14 to 29	6 to 11	50
29 to 42	12 to 16	15
42-	16-	0

Shoot elongation of stump sprouts increases with increasing stump diameter up to 15 cm (6 in) after which it declines. Annual height growth of stump sprouts when overstory competition is removed averages 0.7 m (2.2 ft) (24).

Another source of vegetative reproduction is seedling sprouts. Seedling sprouts are stems with root systems that are several to many years older. These develop as a result of repeated dieback or mechanical damage.

In general, low stump sprouts from pole-size trees and seedling sprouts are about as good as trees grown from seed. However, sprouts originating high on the stump are likely to have heartwood decay (28).

The seedlings and seedling sprouts already present in a mature stand (advance reproduction), together with stump sprouts, regenerate the stand with oaks following overstory removal. Although many stands may have adequate numbers of stems, the size of the reproduction when the overstory is removed is the key to adequate growth and subsequent stocking (31). A minimum of 1,095 stems per hectare (443/acre) that are 1.37 m (4.5 ft) tall or taller is required to ensure a future stocking of at least 546 dominant and codominant oaks per hectare (221/acre) when average stand diameter is 7.6 cm (3 in) (33). Nevertheless, stands deficient in advance reproduction may be adequately stocked if a sufficient number of stumps sprout.

Sapling and Pole Stages to Maturity

Growth and Yield-White oak is a large, long-lived tree often 24 to 30 m (80 to 100 ft) in height and 91 to 122 cm (36 to 48 in) in d.b.h. Individual trees 46 m (150 ft) high, 244 cm (96 in) in d.b.h., and 600 years old have been recorded. In the open it is characterized by a short stocky bole with a wide-spreading rugged crown. In the forest, white oaks develop a tall straight trunk with a compact crown *(28)*.

White oak generally has the reputation of being a slow-growing tree. According to growth averages from Forest Resources Evaluation data in the Central States, lo-year d.b.h. growth of white oak was 3.0 cm (1.20 in) for seedlings and saplings, 3.5 cm (1.37 in) for poles, and 4.7 cm (1.84 in) for sawtimber. These growth rates were slower than scarlet oak *(Quercus coccinea)*, northern red oak *(Q. rubra)*, or black oak but faster than chestnut oak *(Q. prinus)*. Among the non-oak species only hickory and beech had slower growth rates than white oak, while yellow-poplar, black walnut *(Juglans nigra)*, white ash, and sugar maple all had faster growth rates than white oak *(16)*.

Although white oak was once a component of mixed, uneven-aged stands, most white oaks today are in pure to mixed second growth stands of sprout origin. Individual trees may contain 5.7 m^3 (1,000 fbm) or more of wood but this is uncommon. Pure and mixed unthinned stands at age 80 normally contain from 28 to 168 m^3/ha (2,000 to 12,000 fbm/acre) of wood, occasionally more. Mean annual volume growth over a 60-year period in these stands ranges from 0.95 m^3/ha on fair to poor sites to 2.2 m^3/ha on good sites (68 fbm/acre to 156 fbm/acre) ***(17)***. Total volumes of fully stocked, even-aged stands of mixed oak have been reported to be 89.3 m^3/ha (6,380 ft^3/acre) at age 100 on site index 24.4 m (80 ft) sites; and merchantable volumes of 294 m^3/ha (21,000 fbm/acre) have been found in stands on comparable sites in Wisconsin at age 100. However, such high volumes are rare and occur in localized areas (28).

Because oaks in general, and white oak specifically, are long-lived trees, rotation length can be long (120+ years). But rotation lengths can be shortened by as much as 50 percent and yields increased dramatically if stands are thinned early and regularly, particularly on good sites. If thinnings are begun at age 10 and stands rethinned to 60 percent stocking at lo-year intervals, volume yield at age 60 on good sites (264 m^3/ha or 18,840 fbm/acre) is approximately double that in similar unthinned stands. Mean annual growth in such thinned stands is 3.9 m^3/ha (279 fbm/acre) ***(17)***.

Throughout its range, site index for white oak is generally less than for yellow-poplar and other important oaks on the same site *(26,28)*. White oak site index is approximatley 1.2 m (4 ft) less than black oak and 2.1 m (7 ft) less than scarlet oak. On all sites the index for white oak is higher than that for shortleaf pine. And on the poorest sites, the index for white oak is higher than that for yellow-poplar.

Rooting Habit-White oak is deep rooted-a trait that persists from youth to maturity. White oak seedlings produce a conspicuous, well-developed taproot but this gradually disappears with age and is replaced by a fibrous root system with well-developed, tapered laterals. Although the deepest point of root penetration observed during a study conducted at the Harvard Black Rock Forest in Massachusetts approached 1.2 m (4 ft), most of the main branches away from the central stem were within 53.3 cm (21 in) of the ground surface. Fine roots are typically concentrated in dense mats in the upper soil horizons usually close to trunks but occasionally lying beneath the base of neighboring trees *(5,14,39)*.

Root grafts between neighboring trees are common, especially under crowded conditions.

The ratio between the area of the root system and the area of the crown ranges from 3.4 to 1 to 5.8 to 1.

Following stand thinning, roots of released trees are capable of elongating at the rate of 0.24 m (0.8 ft) per year.

Root regeneration of young forest-grown seedlings may be hampered following top damage. A study of root regeneration of 1-O white oak seedlings growing under greenhouse conditions has shown that new growth of seedlings whose shoot tops were pruned was 20 to 80 percent less than that of unpruned seedlings ***(12).***

Reaction to Competition-White oak is generally classed as intermediate in tolerance to shade. It is most tolerant in youth and becomes less tolerant as the tree becomes larger. White oak seedlings, saplings, and even pole-size trees are nevertheless able to persist under a forest canopy for more than 90 years.

Saplings and pole-size trees respond well to release. A 41 percent increase in diameter has resulted in young stands 1 year following release, and this trend has continued through the fourth year following release. Moreover, diameter growth of released trees for a 20-year period can be expected to be double that of nonreleased trees. Release significantly increases height growth only for those trees in the intermediate or suppressed crown classes. Young white oak sprout clumps thinned to one stem show a slightly greater diameter growth response over released single-stemmed trees *(8,28,29)*. Such increases are possible when stands are heavily thinned, but the response becomes less dramatic as residual stand stocking increases. Other things being equal, however, the trees to release should be the large potential crop trees that show evidence of rapid recent growth.

Thinning combined with fertilization can boost 2-year diameter growth by 95 percent over unthinned and unfertilized pole-size white oak according to tests conducted in the Boston Mountains of Arkansas (19). The addition of nitrogen and calcium to soils in the Allegheny Plateau region of central Pennsylvania increased stand volume more than 40 percent *(42)*.

White oak usually becomes dominant in the stand because of its ability to persist for long periods of time in the understory, its ability to respond well after release, and its great longevity. When associated with other oaks and hickory in the central and southern hardwood forests, white oak is considered a climax tree. On good sites in the north, it is usually succeeded by sugar maple. In the Ozark-Ouachita Highlands, white oak is climax on moderately dry to moist sites. In sheltered, moist coves and well-drained second bottoms throughout its range it may be succeeded by beech and other more tolerant species *(10)*.

Most research and field experience suggest that even-aged silviculture is.most suitable for white oak growing in pure or mixed hardwood stands. Although selection silviculture has been considered, it has been difficult to develop a sustainable stand structure without continual cultural treatments to restrain the more tolerant species, particularly on the better sites *(34)*.

If oak advance reproduction is adequate, clearcutting is the recommended silvicultural system (32). If oak advance reproduction is scarce or absent, new seedlings need to be established. Some reduction of overstory density should help to stimulate seed production, but because of the periodicity of seed crops, it will probably take a long time to establish an adequate number of new seedlings. Seedlings can be planted under an overstory and allowed to develop. The overstory should be maintained at about 60 percent stocking and if competition from an existing understory will impair the growth of the planted seedlings, its density should be reduced. Planting oaks after clearcutting has generally been unsatisfactory because the planted seedlings do not grow fast enough to compete with new sprouts. Reducing both overstory and understory competition is likely to accelerate the growth of small oak advance reproduction. However, even with this increased growth, advance oak reproduction grows slowly and the development period may be from 10 to 20 years or longer.

Natural pruning of white oak is usually good in moderately to heavily stocked stands. Large dominant trees have cleaner boles than smaller trees in lower crown classes. Some branches along the trunk tend to persist when exposed to sunlight.

Epicormic sprouting may be heavy on trees that have been grown in fully stocked stands for 20 years or more and then given sudden and heavy release (28). However, residual stand density and the vigor of trees may be more important to the persistence of epicormics than to their initiation following thinning *(41)*. Significantly more epicormic branches have been observed on multiple-stemmed trees than on single-stemmed trees.

Live branches not more than 4 cm (1.5 in) in d.b.h. may be saw-pruned without danger of introducing rot. However, epicormic sprouts will often develop around the edges of the wound on saplings and small pole-size trees. Diameter growth of thinned and pruned trees may be 10 percent less than thinned but unpruned trees (35).

Damaging Agents-Several insects attack white oak trees *(15,28,43)*. They are usually not important but may become epidemic and kill weakened trees. Economically, the most important are the wood borers. These may damage the wood of standing trees and cause log and lumber defects.

White oak is attacked by several leaf eaters including the gypsy moth ***(Lymantria dispar),*** orangestriped oakworm *(Anisota* ***senatoria),*** variable oakleaf caterpillar ***(Heterocampa manteo),*** several oak leaf tiers *(Psilocorsis* spp.), and walkingstick ***(Diapheromera*** *femorata)*. Frequently trees are killed from an interaction of damaging agents such as a defoliator followed by invasion of a shoestring fungus and the twolined chestnut borer *(Agrilus bilineatus)*.

White oak also hosts various scale insects, gall-forming insects, and twig pruners, but most of these are of minor importance. White oak acorns are commonly attacked by insects, in some cases affecting half the total acorn crop. Weevils of the genera *Curculio* and *Conotrachelus* cause most acorn damage. Light acorn crops usually are more heavily infested than heavy ones. Two moths damage acorns, the filbertworm *(Melissopus* ***latiferreanus)*** and ***Valentinia*** *glandulella*. The Cynipid wasps cause galls to develop in the acorn or on the cup.

The oak timberworm ***(Arrhenodes minutus)*** frequently damages white oak, making it unfit for tight cooperage. Attacks by this insect usually occur at wounds made by logging, lightning, and wind. Golden oak scale ***(Asterolecanium variolosum)*** can seriously damage and even kill the tree. It is especially damaging when accompanied by drought,

Decay of heartwood resulting from fire scars causes the most serious white oak losses. The amount of decay depends on the size of the wound, the species of fungi, and the length of time since wounding. In general, rot spreads in the stem if the basal scar is more than 0.3 m (1 ft) in d.b.h. The larger the wound, the faster the rot (28).

Oak wilt, a vascular disease caused by the fungus ***Ceratocystis fagacearum,*** is potentially the most destructive disease of both the red and white oaks. It is widely distributed throughout the Central States. White oak is less susceptible to oak wilt than the red oak species, and may lose only a limb at a time, or may sustain infection by the pathogen without ever showing symptoms *(21)*.

Several other diseases of white oak seldom kill or cause much loss. Perennial cankers induced by bark diseases ***Strumella coryneoides*** and ***Nectria galligena*** are responsible for most of the losses in white oak particularly where ice and snow accumulation is common. Damage results from a weakening of the bole at the cankers with subsequent wind breakage. The trunk can become wholly or partially unmerchantable.

A root rot caused by the fungus ***Armillaria*** *mellea* attacks weakened trees. Root rot caused by *Armillaria* ***tabescens*** is similar and attacks oaks in the South. White root rot caused by ***Inonotus dryadeus*** is common on weak and suppressed trees.

The fungus ***Gnomonia veneta*** causes irregular brown areas on leaves and shoots. It may cause loss of some leaves and rarely, complete defoliation.

Oak leaf blister, caused by ***Taphrina*** *caerulescens*, is prevalent on eastern oaks, producing blisterlike swellings on the foliage.

White oak is moderately resistant to ice breakage, sensitive to flooding, and resistant to salt spray and brief salt-water submergence *(21,28)*. It is sensitive to fire injury but less so than scarlet oak. Coal smoke and the resulting fly ash deposit on the soil surface substantially reduce white oak productivity *(2,38)*.

Special Uses

Acorns are a valuable though inconsistent source of wildlife food. More than 180 different kinds of birds and mammals use oak acorns as food; among them are squirrels, blue jays, crows, red-headed woodpeckers, deer, turkey, quail, mice, chipmunks, ducks, and raccoons. White oak twigs and foliage are browsed by deer especially in clearcuts less than 6 years old (3).

White oak is sometimes planted as an ornamental tree because of its broad round crown, dense foliage, and purplish-red to violet-purple fall coloration. It is less favored than red oak because it is difficult to transplant and has a slow growth rate.

Genetics

In addition to the type variety, two varieties of ***Quercus alba*** have been named: ***Q. alba*** var. ***repanda*** Michx. and ***Q. alba*** var. ***latiloba*** Sarg.

Seven hybrids are recognized: ***Quercus x jackiana*** Schneid. *(Q. alba x bicolor);* ***Q. x bebbiana*** Schneid. *(Q. alba x macrocarpa);* ***Q. x beadlei*** Trel. *(Q. alba x michauxii);* ***Q. x faxonii*** Trel. *(Q. alba x prinoides);* ***Q. x saulii*** Schneid. *(Q. alba x prinus);* ***Q. x fernowii*** Trel. *(Q. alba x stellata);* ***Q. x bimundorum*** Palmer *(Q. alba x robur).*

White oak also hybridizes with the following: Durand oak ***(Quercus durandii),*** overcup oak *(Q. lyrata),* and chinkapin oak *(Q. muehlenbergii).*

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