Magnolia fraseri Walt. Fraser Magnolia

Magnoliaceae Magnolia family

Lino Della-Bianca

Fraser magnolia *(Magnolia fraseri),* also called mountain magnolia, earleaf cucumber-tree, umbrella-tree, or mountain-oread, is a fast-growing small tree scattered in the hardwood forests of the lower Appalachian slopes. It grows best on rich, moist, well-drained soils. The very large showy white flowers and large coarse foliage make this an attractive ornamental; otherwise it has little commercial value. The lumber is mixed with associated hardwoods for sawtimber and pulpwood, and the fruit is eaten by wildlife *(9,16).*

Habitat

Native Range

Restricted mostly to the Appalachians, Fraser magnolia (fig. 1) is found in moist habitats in the

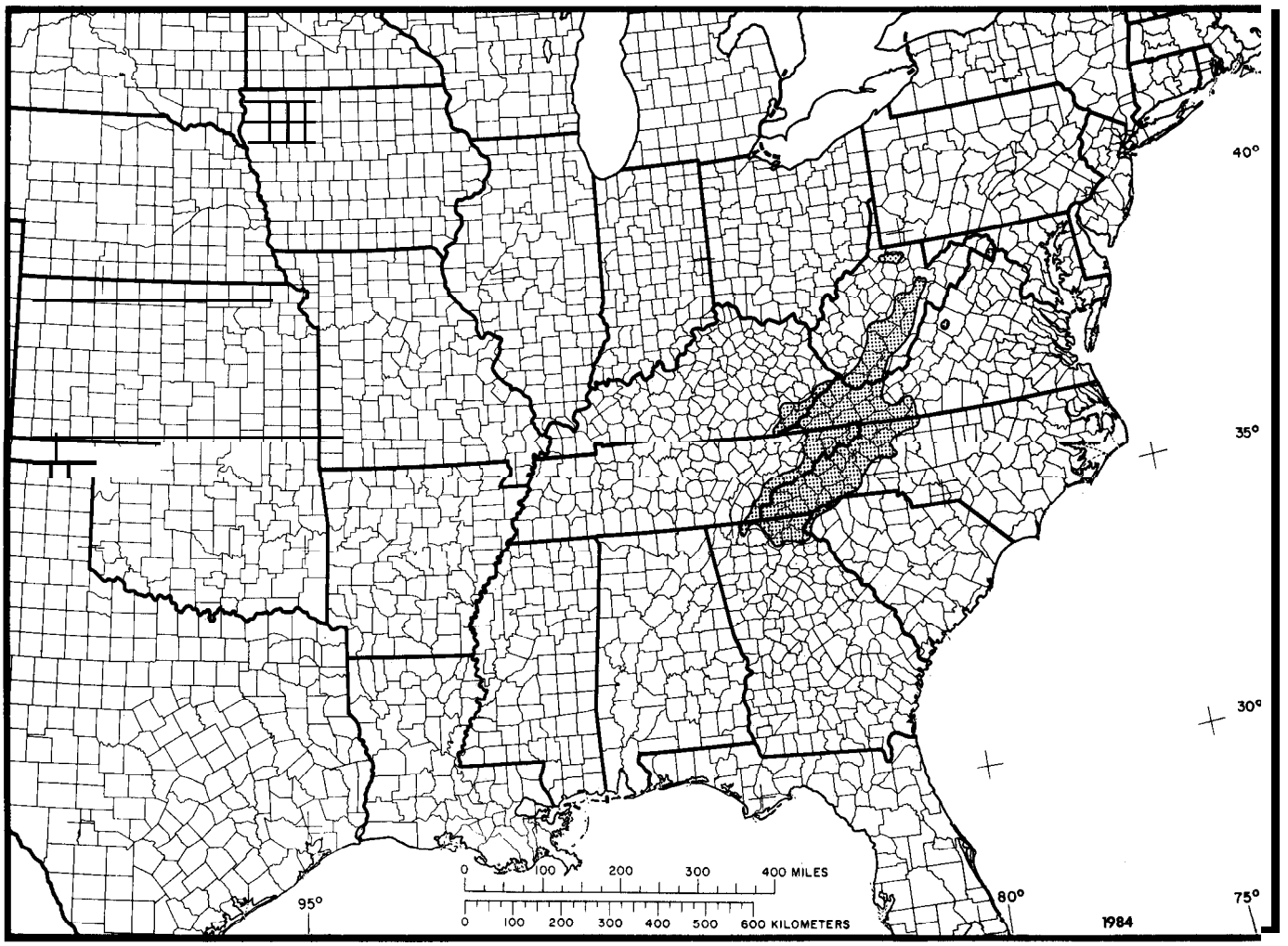

Figure *l-The native* range *of Fraser magnolia.*

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mountains of West Virginia, generally in the eastern half of the State, in western Virginia, in the southern Appalachians of east Tennessee and western North Carolina, and in the Blue Ridge Mountains of northwestern South Carolina and northeast Georgia *(12,13)*. It also grows in the Cumberland Mountains of southeastern Kentucky.

Climate

Within the natural range of Fraser magnolia during the growing season, average rainfall varies considerably. In West Virginia, April to September rainfall averages 610 to 760 mm (24 to 30 in), but in north Georgia and western North Carolina, it averages 910 to 990 mm (36 to 39 in) ***(17).*** Total annual precipitation in West Virginia varies from 1020 to 1270 mm (40 to 50 in), while in the southern Appalachians, the variation is between 1020 and **2030** mm (40 to 80 in).

July temperatures average 21" to 24" C (70" to 75" F) and January temperatures range from -1" to 2" C (30" to 35" F) where Fraser magnolia occurs in West Virginia and Virginia, and from 2" to 4" C (35" to 40" F) in the southern end of the Appalachians, The frost-free period varies from 150 to 170 days in West Virginia and Virginia, and from 170 to 180 ***days*** in the southern Appalachians of eastern Tennessee and western North Carolina.

Soils and Topography

Fraser magnolia is generally found on mesic sites, but seedlings and saplings have been reported to occur on subxeric and even on xeric sites *(4,8,14,15,21)*. In the gorges of the southern Blue Ridge Front, it is more frequently found below midslope, being most common on the lowest third of north and south slopes, and on the bottom land. In the gorge region it has an unusual habit of growing in a multiple-stemmed group on bottoms and as a single-stemmed tree on slopes; elsewhere it occurs in either form. Sites on which it grows best are generally protected, moist, and fertile; soil temperatures on such sites are generally cool during the growing season in comparison with sites farther upslope.

On lower slopes and in the bottom of the Long Spur River Gorge in the southeastern escarpment of the Blue Ridge Mountains between Rosman and Highlands, NC, average chemical contents and other properties of the 0 to 13 cm (0 to 5 in) soil layer of the Tusquitee loam (an Umbric Dystrochrept of the order Inceptisols) supporting Fraser magnolia were as follows: sodium, 0.9 meq/100 g; potassium, 0.20 meq/100 g; calcium, 0.10 meq/100 g; and magnesium, 0.11 meq/100 g; nitrous nitrogen, 1.6 p/m; phosphorus, 2.0 p/m; and iron, 1.9 p/m; pH 4.8; and organic matter, 6.6 percent *(14,20)*. The nutrient status of this soil is low because plentiful soil moisture makes nutrients quickly available to all plants, and the nutrients are thus tied up until the plants are recycled.

In the Great Craggy Mountains above Dillingham, NC, at an elevation of 1200 m (3,940 ft) where the northwest slope averages 40 percent, the following average soil values prevail in a stand composed mostly of sugar maple *(Acer saccharum)*, American beech ***(Fagus grandifolia),*** yellow buckeye ***(Aesculus octandra),*** and Carolina basswood ***(Tilia caroliniana),*** and some Fraser magnolia: pH 4.8, organic matter 7 percent, bulk density 0.96 g/cm^3 (59.9 lb/ft^3). The top 15 cm (6 in) of mineral soil contained phosphate-phosphorus 1.7 kg/ha (1.5 lb/acre), potassium 118 kg/ha (105 lb/acre), calcium 936 kg/ha (835 lb/acre), and magnesium 108 kg/ha (96 lb/acre) *(6)*. The soils are mostly Edneyville stony loam which is a mesic Typic Hapludult of the order Ultisols *(20)*: parent materials are Precambrian acid crystalline rocks, including gneisses, schists, granite, diorite, and some mica-gneisses and mica-schists.

Farther northeast, near Grandfather Mountain (1956 m or 6,417 ft) in the Blue Ridge Front, Fraser magnolia grows on Ashe soil, a Typic Dystrochrept derived from Cranberry granite at an elevation of about 1200 m (3,940 ft). The terrain slopes steeply to the southeast, and the soils are deep, coarse, conspicuously gray-white sandy loams or loams which are very well drained. Rainfall is well distributed and plentiful throughout the year so soil moisture is ample and not restrictive to forest growth.

On the Jefferson National Forest in western Virginia, Fraser magnolia is found mostly on soils developed from sandstone or shale. In the Appalachian Plateau of West Virginia, it grows on rich, moist, colluvial soils derived from upper-Devonian and Pennsylvanian rock formations *(3,7)*. Fraser magnolia generally grows at elevations ranging from 500 to 1700 m (1,640 to 5,580 ft) but is most common from about 600 to 1300 m (1,970 to 4,270 ft).

Associated Forest Cover

Fraser magnolia is a moderately frequent tree species in a number of forest types; however, its relative density is generally less than 10 percent, regardless of its size or location *(3,7,8)*. For example, it constitutes only 0.3 percent of all trees on the Jefferson National Forest in western Virginia.

At elevations greater than 1200 m (3,940 ft) associated species include mountain maple *(Acer*

spicatum), striped maple ***(A. pensylvanicum),*** and sugar maple, American beech, American basswood *(Tilia* ***americana),*** Carolina basswood, yellow buckeye, yellow birch ***(Betula alleghaniensis),*** and eastern hophornbeam *(Ostrya* ***virginiana)*** *(2,3,4,6,8).* Elsewhere, commonly associated species are: sweet birch *(Betula lenta),* hickories ***(Carya*** spp.), American chestnut ***(Castanea dentata)*** (as sprouts), flowering dogwood *(Cornus* ***florida),*** white ash ***(Fraxinus americana),*** Carolina silverbell *(Halesia carolina),* American holly ***(Rex opaca),*** butternut *(Juglans* ***cinerea),*** black walnut ***(J. nigra),*** yellow-poplar ***(Liriodendron tulipifera),*** cucumbertree ***(Magnolia*** *acuminata),* blackgum ***(Nyssa*** *sylvatica),* sourwood ***(Oxydendrum arboreum),*** black cherry ***(Prunus serotina),*** white, scarlet, chestnut, and northern red oaks ***(Quercus alba, Q. coccinea, Q. prinus,*** and ***Q. rubra,*** respectively), black locust ***(Robinia*** *pseudo-*) ***acacia),*** white basswood ***(Tilia heterophylla),*** and eastern hemlock ***(Tsuga canadensis)*** *(14,15).* Eastern white pine *(Pinus* ***strobus),*** pitch pine ***(I? rigida),*** Table Mountain pine *(P.* ***pungens),*** and shortleaf pine ***(I? echinata)*** are occasional associates.

Life History

Reproduction and Early Growth

Any forest activity that increases the amount of incident light striking the forest floor and exposes mineral soil is conducive to the establishment of Fraser magnolia regeneration on mesic sites that have seed-bearing trees of the species.

Flowering and Fruiting-Fraser magnolia has perfect flowers. The blossoms open from May to June depending on latitude, elevation, and weather conditions. The solitary flowers are about 20 to 30 cm (8 to 12 in) wide; they consist of six to nine obovate-spatulate petals conspicuously constricted below the middle *(9,16).* The fruit is an oblong, conelike aggregate of fleshy one- or two-seeded follicles, that ripen in late summer to early fall. At maturity, the red, drupelike seeds are about 1.5 cm (0.6 in) long.

Seed Production and Dissemination-A good seed crop occurs only every 4 to 5 years. Cleaned seeds range from 5,470 to 12,460/kg (2,480 to 5,650/lb), averaging 10,030/kg (4,550/lb) *(14,18).*

Seedling Development-Germination is epigeal. Stratified seeds placed in a sandy medium and kept at day and night temperatures of 30" C (86" F) and 20" C (68" F), respectively, from 40 to 100 days, have a germinative capacity of 8 to 21 percent-low in comparison to other magnolias ***(18).*** In spite of low germinative capacity, Fraser magnolia is one of the tree species that colonizes canopy gaps caused by the fall of single, large eastern hemlocks in the Great Smoky Mountains (2). It is also common as volunteer regeneration along logging roads in the southern Appalachians and is found frequently as seedlings and saplings in small openings on mesic sites near seed-bearing trees (fig. 2).

Figure 2—Magnolia fraseri ***seedlings growing under a closed mesic cove-hardwood canopy at an elevation of 945 m (3,100 ft) in the southern Appalachians. The whorl of large, eared leaves is characteristic of the species.***

Foliage begins expanding the last week in April. Radial growth initiates in middle to late May and continues until the second week of August; at times it may last until the first week of September ***(14).*** Seedling reproduction is regarded as slow growing over most of its range when it is under closed or even partial canopies; however, Fraser magnolia seedlings even in clearcuts quickly fall behind other fast-growing intolerant species such as yellow-poplar, black cherry, and sweet birch.

Vegetative Reproduction-Although Fraser magnolia seedlings have difficulty in surviving to even an intermediate canopy position, stump sprouts survive more easily. It is highly possible that many, if not most, of the larger Fraser magnolia trees in the Appalachian forest region are of stump sprout origin; possibly many are seedling sprouts (7). In this growth habit, the species closely resembles yellow-poplar and northern red oak. Seemingly, clearcutting with resultant sprout growth is the best way of reproducing Fraser magnolia.

Sapling and Pole Stages to Maturity

Growth and Yield-On most mesic sites, where Fraser magnolia does best, its sprouts grow vigorously from sapling to pole stage. In a Blue Ridge gorge, it was the last tree to begin growth in spring 1965 and 1966, but it grew very rapidly until growth cessation in late August *(14).* Peak growth occurred at or below midslope. Average circumferential 3-year growth measured by band dendrometer at d.b.h. was 1.08 cm (0.424 in). On the flat, moist bottom land between slopes, Fraser magnolia trees were even-aged, about 50 years old, and formed part of a closed canopy.

In an intensive cleaning study established in spring 1960 in an U-year-old mixed hardwood sapling stand near the Pink Beds on Pisgah National Forest, NC *(5),* 14-year diameter growth of the four largest trees on one O.Ol-ha (0.025-acre) plot was measured. Site quality was 28.7 m (94 ft) for yellow-poplar; there were 2,076 trees per hectare (840/acre) and 3.44 m^2/ha (15 ft^2/acre) of basal area after cleaning. Results were as follows:

Species	Diameter,: age (yr) 11	14	21	25
	cm	*cm*	*cm*	*cm*	*cm*
Fraser magnolia	9.1	13.7	17.0	19.6	22.1
Yellow-poplar	5.8	10.9	14.7	20.6	26.7
Northern red oak	6.9	10.4	12.4	16.3	17.8
Sweet birch	4.1	7.1	10.2	14.0	15.5
	in	*in*	*in*	*in*	*in*
Fraser magnolia	3.6	5.4	6.7	7.7	8.7
Yellow-poplar	2.3	4.3	5.8	8.1	10.5
Northern red oak	2.7	4.1	4.9	6.4	7.0
Sweet birch	1.6	2.8	4.0	5.5	6.1

The 14-year increase in diameter for Fraser magnolia was 13.0 cm (5.1 in); for yellow-poplar, 20.8 cm (8.2 in); for northern red oak, 10.9 cm (4.3 in); and for sweet birch, 11.4 cm (4.5 in) *(19).* Although at age 11 Fraser magnolia was larger than yellow-poplar by 3.3 cm (1.3 in), by age 21 yellow-poplar had exceeded it in size and was 4.6 cm (1.8 in) larger at age 25. At that time the plot contained 22.96 m^2/ha (100 ft^2/acre) of basal area and the stand was reduced to 1,483 trees/ha (600 trees/acre). This example serves to illustrate that Fraser magnolia sprout growth can be rapid in the early years of an even-aged stand. By maturity, however, Fraser magnolia is an intermediate tree in relation to the stand canopy. In this regard, growth of Fraser magnolia resembles that of Carolina basswood and cucumbertree; all three generally grow slower than yellow-poplar.

Fraser magnolia needs sunlight for growth and survival. This is shown by its generally contorted bole and branches, which result from growing leaders constantly twisting to exploit light from small openings. Occasionally a forest-grown Fraser magnolia can become as large as 61 cm (24 in) d.b.h. and 24 m (80 ft) tall (7). The largest tree on record, growing in Philadelphia, PA, has a d.b.h. of 81 cm (32 in), a total height of 20 m (65 ft), and a crown spread of 15 m (50 ft).

No Fraser magnolia grows in the mountain counties of Virginia northeast of Roanoke Gap. The greatest volume is found in western Virginia, followed by North Carolina. Lesser volumes are found in West Virginia, Kentucky, and Tennessee, but specific data are not available *(11).*

Stand and stocking data for Fraser magnolia in the Southeastern States are shown in table 1. Pulpwood-size trees through the 25.4 cm (10 in) diameter class account for 81 percent of the cubic-foot volume and 91 percent of the trees. The largest trees fall only into the 40.6 cm (16 in) diameter class and constitute less than 1 percent of all trees but 19 percent of total board-foot volume. Yields per acre are unavailable because of the sporadic occurrence and low density of Fraser magnolia.

Rooting Habit-Fraser magnolia seedlings have a deeply penetrating taproot. By the time seedlings become saplings, lateral roots are well developed *(7).* Because of generally loose, friable soils, the root configuration of the trees remains unchanged through maturity except that roots grow larger.

Reaction to Competition-Fraser magnolia responds best to some form of even-age management. It is classed as being intermediate in tolerance to shade. Clearcutting is one way to regenerate it. At best, however, Fraser magnolia is likely to constitute less than 10 percent of any stand *(3,8).* Since most of the regeneration is of sprout origin *(7,141,* it is highly dependent on the availability and distribution of Fraser magnolia trees in the original stand. Any additional trees that develop are likely to be seedling sprouts from damaged prelogging seedlings. Since

Table l-Inventory of ***Magnolia fraseri*** combined for Virginia, North Carolina, South Carolina, and Georgia *(11)*

D.b.h. class	Number of trees	Merchantable stem volume In thousands		Saw log volume In thousands	
	thousands	m^3	ft^3	m^3	fbm[1]
15 cm or 6 in	2,004	129.2	4,566	—	—
20 cm or 8 in	1,771	319.2	11,279	—	—
25 cm or 10 in	763	235.7	8,328	—	—
30 cm or 12 in	206	88.9	3,143	33.0	5,782
36 cm or 14 in	102	53.5	1,889	37.9	6,649
41 cm or 16 in	21	16.4	579	17.0	2,983
Total	4,867	842.9	29,784	87.9	15,414

[1]International 0.25-inch log rule.

many seedlings are found in mature stands, a one- or two-cut shelter-wood would help seedlings grow to sapling size before the final harvest cut, and in this way they would have a competitive advantage over faster growing, more intolerant species. Because Fraser magnolia grows in clumps, early release by precommercial thinning to one stem accelerates its diameter growth and improves its form. Although Fraser magnolia can compete well on most sites with associated tree species for the first 40 or 50 years, at best it is short-lived and is prone to drop out of stands when it is 60 to 70 years old. When intermediate thinnings are part of stand management, as opposed to custodial management, Fraser magnolia is very often one of the first trees to be cut because of its generally poor form and susceptibility to damage. There is little incentive to manage it in the hope of producing high-quality timber.

Damaging Agents-Because of its thin bark, Fraser magnolia is very susceptible to fire and to logging damage *(7)*; both can lead to various wood rots.

Nectria magnoliae causes cankers on small or suppressed Fraser magnolia trees *(10)*. Whenever such trees become dominant or crown free, the cankers often heal. Fungi capable of causing rot of the central cylinder or in wounds are ***Ganoderma applanatum, Fomes geotropus, Daedalea ambigua, Polyporus calkinsii, P. curtisii,*** and ***Laetiporus sulphureus.*** White heartrot in living trees is caused by ***Fomes sclerodermeus***. Sprout leaves may be heavily attacked by common powdery mildew, ***Phyllactinia guttata. Phyllosticta magnoliae*** causes a large black leaf spot. ***Phoma pedunculi*** and ***Cytospora tumulosa*** occur on branches. Fraser magnolia probably cannot withstand prolonged inundation, as evidenced by the cool, moist, but well-drained sites where it generally grows.

Several insect species can damage, if not kill, Fraser magnolia. ***Euzophera ostricolorella*** attacks the base of mature trees and ***E. magnolialis*** kills seedlings *(1)*. The ambrosia beetle, ***Platypus compositus,*** makes tunnels and larval cradles in the wood. ***Xyloterinus politus*** breeds in injured, dying, and recently cut trees, severely degrading lumber of infested wood because of adult tunneling. Larvae of the June beetle, ***Phyllophaga forsteri,*** feed on roots, and adults feed on foliage. Magnolia scale, ***Neolecanium cornuparvum*** feeds on current-year twig growth, seriously weakening and sometimes killing host trees.

Special Uses

In the lumber trade, Fraser magnolia is included with yellow-poplar sawtimber and pulpwood (7). It has little value as firewood and generally has little value as sawtimber because of sweep and crook. Wildlife use larger defective trees of Fraser magnolia as den trees. Sprouts are browsed. In a mountainous area of western North Carolina, where Fraser magnolia sprouts occurred with a frequency of 20 percent and a density of 717 stems per hectare (290/acre), the species was 37-percent utilized by white-tailed deer *(5)*.

Frequent use is made of Fraser magnolia as an ornamental *(16)*.

Genetics

Certain distribution patterns are affected by polyploidy. Among magnolias, the relatively sharply peaked and restricted diploids, Fraser magnolia and umbrella magnolia, may be compared with the tetraploid cucumbertree *(21)*. Supposedly, a diploid species with extensive ecotypic variation should have a wider range than a polyploid derived from it; how-

ever, cucumbertree has the widest range of all three species.

No races or hybrids of Fraser magnolia have been reported, but a variety, *Magnolia fraseri* var. *pyramidata* (Bartr.) Pampanini, is occasionally mentioned *(13).*

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