Magnoliaceae—Magnolia family

Magnolia L.

magnolia

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The genus *Magnolia* comprises about 80 species of trees naturally distributed throughout eastern North America and southeastern Asia (Callaway 1994). It is the largest genus in the family Magnoliaceae. There are 10 species and varieties native to the United States (Callaway 1994) and 2 others native to Puerto Rico (Figlar 1982, 1984a) (table 1). Cucumber magnolia is the only species native to Canada. There are no indigenous magnolias in Europe (Johnson 1973). Sweetbay was the first native American magnolia to be cultivated in Europe in 1688 (Hora 1981).

Based on records of early fossil pollen and leaves, the magnolias are considered the most ancient of all flowering plants (FNAEC 1993). These plants are the base from which all other angiosperms have evolved (FNAEC 1993). Fossil records suggest that magnolias once occurred throughout western North America, western Asia, and Europe. Their range became restricted when the continents in the southern hemisphere separated and cold water moved northward, changing the humid tropical paleo-environment to a drier, colder climate (FNAEC 1993). In the past 20,000 years, the warm temperature taxa have not been disrupted and are in dynamic equilibrium (FNAEC 1993)

Magnolia spp. are widely planted as ornamentals (Dirr 1990). The leaves and flowers of magnolias are highly prized for decoration, and the fruits make excellent food for wildlife (Callaway 1994). Less than 2% of hardwood timber in the southeastern United States is from magnolias and is usually lumped together with that of tuliptree—*Liriodendron tulipifera* L. (Burns and Honkala 1990).

Floral biology. The large, perfect flowers of the magnolias are borne singly at the ends of the branches in the spring and summer. The flowers appear after the leaves between April and June, except for cucumber magnolia, which flowers before leaf bud-break. In section *Rhytidospermum,* the flowers have 6 to 9 tepals (sepals and petals), in section *Magnolia*, 8 to 12 tepals and in section *Tulipastrum*, 9 to 12 tepals (table 2) (Fernald 1970). The flowers have an usually pleasant fragrance, except those of umbrella magnolia, which have an unpleasant odor (Burns and Honkala 1990).

Magnolia flowers are highly specialized for cantharophily—pollination by beetles, which predate the other pollinators, that is, bees, wasps, butterflies, and moths (Peigler 1988). Beetle- pollinated flowers are characterized by their large size, white or pink color, lack of nectar, and abundance of pollen (Peigler, 1988). The flowers are proterogynous to prevent the flower from being pollinated with its own pollen. Magnolia flowers close at night. The beetles (members of the Mordellidae and Nitidulidae families) chew through the tepals with their strong mandibles to feed on the flower parts (Peigler 1988). While feeding, the beetles get covered with pollen. When the flower opens, the stigmas are no longer receptive, and the stamens have dehisced and detached from the gynandrophore (central axis of flower). The beetles, covered with pollen, leave the flower to feed on another flower, thus effecting cross-pollination (Thien 1974). The self-incompatible species—such as Fraser and pyramid magnolias, sweetbay, and cucumber

magnolia—cannot receive pollen from other flowers on the same tree (McDaniel 1963). Nonviable seeds may have been collected from trees that are self-incompatible. It is best to select other trees for future collections.

Seed biology. The fruits develop from the gynandrophore into a follicetum (Callaway 1994). The individual fruits are referred to as follicles and usually contain 1 to 2 seeds. The follicetum contains between 2 and 60 seeds/fruit (Burns and Honkala 1990). Seeds are released from the follicle when ripe and are suspended on a funiculus (Kozlowski 1972). The bright red color of the sarcotesta is adapted to an endozoochorous mode of dispersal (Kozlowski 1972). At maturity, the seeds are 6 to 18 mm long. The seeds of cucumber magnolia are 0.7 to 1.5 cm long, 0.3 to 0.6 cm thick, and 0.5 to 1 cm wide (Afanasiev 1937).

The primitive, angiospermous seeds of the magnolias are characterized by having a very small embryo with copious endosperm (Bouman 1977). The underdeveloped embryo is about 1 mm long and 0.4 mm in diameter and is located at the micropyle end of the seed (Afanasiev 1937; Evans 1933). The endosperm is 51% oil with no starch present. The embryo will not start to grow until it undergoes a cold, moist treatment followed by a warm treatment.

Magnolias have the most primitive seedcoat of the angiosperms. The seedcoat consists of 3 layers (Earle 1962)—the fleshy, outer, red sarcotesta; the parenchymatic middle layer (made up of 57% oil and reducing sugars); and the stony sclerotesta.

Seed crops from magnolia species vary according to environmental conditions. The viability of southern magnolia seedlots averages 50% (Burns and Honkala 1990). Cucumber magnolia reaches seed-bearing age at 30 years (Burns and Honkala, 1990). Seed size ranges from 10,000 to 16,000 seeds/kg (4,550 to 7,530 seeds/lb) (table 3).

Collection of fruits; extraction and storage of seeds. The fruits are usually picked from standing trees or from trees recently felled in logging. The seeds mature in August or September. It is recommended that the fruits be collected before the follicles open to eliminate competition with seed predators (Murphy 1996). The unopened fruit aggregates can be laid on screens to dry (Galle 1953).

The red sarcotesta can be removed by mechanical maceration or by rubbing the seeds over a screen. The oily residue left on seeds can be removed by rinsing them in soapy water, then in clean water (Callaway 1994). The seeds must be kept moist while in storage to retain their viability (Browse 1986; Hanchey and Kimbrough 1954). Saturated sphagnum moss can be added to a plastic bag to keep the seeds moist until sowing (Callaway 1994). Dead and damaged seeds can be removed by floating the seeds in water before storage or planting (Hanchey and Kimbrough 1954). Seeds that float—"floaters"—usually are not viable. Storage of seeds at 0 EC is recommended to reduce the level of infection by fungi (Afanasiev 1937).

Pregermination treatments. Del Tredici (1981) and Evans (1933) found that magnolia seeds exhibit double dormancy. Embryos will not develop until seeds are exposed to warm, moist temperatures after cold, moist temperatures. It takes a minimum of 2 months of cold, moist stratification at 0 to 10 EC to yield the greatest germination (Evans 1933). Stratification medium can be any absorbent material such as sphagnum moss, moss and sand, or vermiculite. During the after-ripening period, the oil and proteins are converted to reducing sugars and the water content of a seed increases from 49 to 61% (Evans 1933). Within 14 days of sowing, the embryo is 50% as long as the seed (Del Tredici 1981).

Other pretreatments such as freezing and sulfuric acid (H_2SO_4) soaks have proved injurious to magnolia seeds (Afanasiev 1937; Hanchey and Kimbrough 1954). Hot water soaks also were not beneficial to seed germination (Hanchey and Kimbrough 1954). Increasing oxygen to the seed had no effect on germination, but eliminating oxygen did inhibit germination (Afanasiev 1937).

Germination tests. Germination is epigeal and occurs rapidly following proper stratification and

placement in a standard germination medium (table 4) (Galle 1953). Official tests (AOSA 2001) recommend 45 days of prechilling followed by alternating temperatures of 20/30 EC for 42 days on top of moist blotters. Evans (1933) found that the seeds of southern magnolia germinate most rapidly at 29 EC and give the greatest total germination at 15 to 35 EC. Hanchey and Kimbrough (1954) found that 88% of the seeds of southern magnolia germinated after 2 months of storage in vermiculite at 15 EC. Seeds of sweetbay germinated 93% in 33 days after 58 days of prechilling (Del Tredici 1981). For seeds of cucumber magnolia, germination started earliest and progressed most rapidly at a constant temperature of 30 EC, but the highest germination was reached when the temperatures alternated between 15 EC in the dark for 6 hours and 18 hours of light at 26 EC (Afanasiev 1937). At 20 EC, seeds of cucumber magnolia germinated later and more slowly than at the higher temperatures; temperatures above 35 EC resulted in the death and decay of the seeds.

There are 3 viability tests performed on magnolia seeds that correlate with germination. The endosperm of cucumber magnolia will produce green pigment in 2 to 3 days when placed on moist blotting paper at 24 to 30 EC (Afanasiev 1937). The proportion of seeds producing the green pigment is the proportion of viable seeds. Heit (1955) preferred the excised-embryo test for magnolia seeds and recommended soaking them in water up to 4 days to soften their seedcoats. The third viability test is staining with tetrazolium chloride (TZ). Seeds are soaked overnight, then each seed is cut latitudinally to expose the embryo and placed in TZ solution for 18 to 24 hours at 37 EC (NTSL 1997). Embryos that stain red are considered viable.

Nursery practice. Sowing seeds in a nursery bed is the preferred method of propagating magnolias when a large quantity of seedlings are required for reforestation. The seeds can be planted in October or November in nurserybeds and allowed to naturally stratify over the winter months. The seeds can be sown with or without their sarcotestas if the seeds have not been stored (Papetti 1996). When seed quantities are limited, hand-sowing is the preferred method. Magnolia seeds have been sown with a mechanical seeder at 3 drills/bed and 210 seeds/m (64/ft) (Murphy 1996). A fertilizer distributor has also been used to sow magnolia seeds (Buchanan 1996). It drops a seed every 5 cm (2 in), with 2 passes being made over the nurserybed. When planting in the spring, it is considered common practice to sow cleaned, prechilled seeds.

If rodents or birds are a problem, the seeds need to covered with a ground cloth to prevent predation (Bosch 1996). Coating seeds with Benlate or captan will deter seed fungi (Papetti 1996). For fall-sowing, the seeds should first be covered with 6 to 12 mm (¼ to ½ in) of mulch, then with the same amount of pine bark or pine straw (Buchanan 1996). For spring-sowing, the seeds need only be covered with the pine mulch.

In more-northern climates, magnolias are grown for 2 years to reach a height of 30 to 60 cm (12 to 18 in) (Murphy 1996). In southern nurseries, a 30-cm (12-in) seedling can be grown in 1 year. Heit (1939) found that shading the newly sprouted plants through the hot summer was beneficial to the survival and development of cucumber magnolia seedlings. Larvae of the black vine weevil—*Otorhynchus sulcatus* F.—larvae are a widespread pest of magnolias. Lamb and Kelly(1985) reported that larvae feed on the roots and kill the plants by eating the bark just below ground and recommend using diazinon as a protectant. Root pruning with a reciprocating blade makes lifting the large, fleshy root system easier (Buchanan 1996). Hand-lifting is the preferred method of lifting magnolias out of the nursery bed, because of the small quantities grown.

Fertilization is needed to stimulate the height growth of magnolias. In Florida nurseries, a blended fertilizer with no additional phosphorus is applied monthly (Buchanan 1996). In a Virginia nursery, a slow-release fertilizer applied just once lasts for 9 months until the lifting season (Papetti 1996).

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Table 1—*Magnolia,* magnolia: nomenclature and occurrence

Scientific name & synonym(s)	Common name	Occurrence
***M. acuminata* (L.)** *Tulipastrum acuminatum* (L.) Small	**cucumber magnolia,** cucumbertree, yellow cucumber magnolia	S Ontario & New York to Illinois, to E Oklahoma & Georgia
***M. ashei* Weatherby**	**Ashe magnolia**	Banks of Apalachicola River in Florida Panhandle & SE Alabama
***M. fraseri* Walt.** *M. auriculata* Lam.	**Fraser magnolia,** mountain magnolia	Mtns of Maryland, West Virginia, & Virginia, S to N Georgia, Alabama, & South Carolina
***M. grandiflora* L.** *M. foetida* (L.) Sarg.	**southern magnolia,** evergreen magnolia, bull bay	Coastal Plain from SE North Carolina to central Florida, & to E Texas
***M. macrophylla* Michx.**	**bigleaf magnolia,** greatleaf(ed) magnolia, large-leaf cucumbertree,	Ohio & Kentucky S to Georgia, W to Arkansas & Kentucky
***M. portoricensis* Bello**	**Puerto Rico magnolia**	W Puerto Rico
***M. pyramidata* Bartr.**	**pyramid magnolia** ear-leaf(ed) magnolia, ear-leaf umbrellatree	Banks of the Ochlochnee*, Apalachicola, & Escambia Rivers of the Florida Panhandle, SE Alabama, W to Texas
***M. splendens* Urban**	**shining magnolia**	E Puerto Rico
***M. tripetala* (L.) L.**	**umbrella magnolia,**	Streams or swamps from Pennsylvaniato Georgia, W to Arkansas & Mississippi
***M. virginiana* L.** *M. australis* Ashe *M. glauca* L.	**sweetbay,** swamp-laurel, sweetbay magnolia, southern sweetbay, evergreen sweetbay	Coastal swamps from Massachusetts to Florida, W to E Texas

Sources: Callaway (1994), Figlar (1984a, b), Fordham (1960), LHBH (1978), Sargent (1965), Wasson (2001)..
* Sometimes spelled Ochlokonee.

Table 2—*Magnolia,* magnolia: characteristics

Species	Ploidy	Flower color	Leaves, underside color, & hair	Tepals
M. acuminata	2N=76	Yellow-green, yellow	Deciduous, green, & tomentose	9–12
M. ashei	2N=38	White	Deciduous, silver, & pubescent	9
M. fraseri	2N=38	Creamy white	Deciduous, pale green, & glabrous	6–9
M. grandiflora	2N=114	Creamy white	Evergreen, rusty brown, & tomentose	9–15
M. macrophylla	2N=38	White	Deciduous, silver, & pubescent	9
M. portoricensis	2N=114	Creamy white	Evergreen, rusty brown, & glabrous	9–12
M. pyramidata	2N=38	Creamy white	Deciduous, pale green, & glabrous	6–9
M. splendens	2N=114	Creamy white	Evergreen, rusty brown, & pubescent	9–12
M. tripetala	2N=38	White	Deciduous, gray-green, & pubescent	6–9
M. virginiana	2N=38	Creamy white	Deciduous or evergreen, silver, & glabrous	8–12

Sources: Callaway (1994), Johnson (1973), LHBH (1978), McDaniel (1968).

Table 3—*Magnolia*, magnolia: seed data

	Cleaned seeds/weight				
	Range		Average		
Species	/kg	/lb	/kg	/lb	Samples
M. acuminata	6,400–14,500	2,900–6,600	12,020	5,450	15
M. fraseri	5,470–12,460	2,480–5,650	10,030	4,550	12
M. grandiflora	12,800–15,000	5,800–6,800	14,220	6,450	8
M. macrophylla	—	—	9,550	4,330	1
M. portoricensis	—	—	7,410	3,360	1
M. tripetala	—	—	16,540	7,500	1
M. virginiana	—	—	16,600	7,530	5

Sources: Bonner (2002), Dirr and Heuser (1987), Francis and Rodriguez (1993), Heit (1968), Olson and others (1974).

Table 4—*Magnolia,* magnolia: germination test conditions and results for stratified seeds

		Germination test conditions				
		Temp (EC)		Duration	Germinative capacity	
Species	Medium	Day	Night	(days)	Avg (%)	Samples
M. acuminata	Sand–perlite	26–30	15–20	35–60	8–86	4
M. fraseri	Sand–perlite	30	20	40–100	8–21	6
M. grandiflora	Sand–vermiculite	30	20	30–50	43–90	9
M. macrophylla	—	22	22	35	71	35
M. portoricensis	Potting mix	24	30	44	64	—
M. virginiana	Sand–peat	18	18	33	93	1
M. virginiana	Kimpac	30	20	47–61	32–50	4

Sources: Afanasiev (1937), Del Tredici (1981), Francis and Rodriguez (1993), Hanchey and Kimbrough (1954), Jones, Leroy (1969), Olson and others (1974), Seitner (1981), Toumey (1942).