

## Fagaceae—Beech family

***Fagus* L.**

## beech

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**Growth habit, occurrence, and use.** The beeches—the genus *Fagus*—includes 10 species of medium-sized, deciduous trees native to the temperate regions of the Northern Hemisphere (Rehder 1940). Only 1 species, American beech, is native to North America, although another, the European beech, has been widely planted as an ornamental in the Northeast (table 1). Some authorities have argued that there are separate northern and southern species of American beech, but this view is not widely supported (Tubbs and Houston 1990). Beeches that grow in northeastern Mexico are now classified as a variety of American beech—*F. grandifolia* var. *mexicana* (Martinez) (Little 1965). There is some evidence of geographic races of European beech in that species' native range (Rudolf and Leak 1974). Beech wood is used for flooring, furniture, veneer, plywood, ties, charcoal, and many specialty products. The trees are highly valued for ornamental plantings, and the mast is widely utilized by numerous birds and animals (Tubbs and Houston 1990).

**Flowering and fruiting.** Beech flowers are monoecious. The minute male and female flowers appear in the spring when the leaves are about one-third grown (table 2). The staminate flowers occur in densely clustered, drooping heads 8 mm wide, whereas the pistillate flowers are generally paired on stout stalks about 2.5 cm long (Brown and Kirkman 1990). Flowers of European beech are quite vulnerable to late spring frosts (Matthews 1955). The fruit is a prickly bur approximately 2 cm long, which opens soon after maturity in the fall (figure 1).

Each fruit contains 2 or 3 yellowish-brown or chestnut-brown, unevenly triangular nuts, 1 to 1.5 cm long (figures 2 and 3). Times of flowering, fruiting, and seed dispersal for the 2 species are listed in table 2. Natural seed dispersal is chiefly by gravity and by animals such as rodents and blue jays (*Cyanocitta cristata*) (Johnson and Adkisson 1985; Tubbs and Houston 1990). Information on height at maturity, minimum seed-bearing age, and interval between good seedcrops is shown in table 3.

**Table 1**—*Fagus*, beech: nomenclature and occurrence

Scientific name	Common name	Occurrence
<i>F. grandifolia</i> Ehrh.	American beech, beech	Nova Scotia to S Ontario & N Michigan, S to N Florida & E Texas
<i>F. sylvatica</i> L.	European beech	Europe; planted in NE US

Source: Little (1979).

**Table 2**—*Fagus*, beech: phenology of flowering and fruiting

Species	Flowering	Fruit ripening	Seed dispersal
<i>F. grandifolia</i>	March–May	Sept–Nov	Sept–Nov (after frost)
<i>F. sylvatica</i> *	Apr–May	Sept–Oct	Oct–Nov (after frost)

Sources: Brown and Kirkman (1990), Rudolf and Leak (1974), Tubbs and Houston (1990).

\* Dates are similar for western Europe and the northeastern United States.

from white, to pink, magenta, and orange-red (Odenwald and Turner 1987). Indian azaleas are grown also as large-flowered greenhouse azaleas.

Kurume azaleas are derived primarily from Hiryu azalea—*R. obtusum* (Lindl.) Planch.—also indigenous to Japan. These low-mounding, fine-textured hybrids are slow growers with relatively small, single or “hose-in-hose” double flowers in a variety of colors (Odenwald and Turner 1987). Many selections are available and they are planted widely in the southern United States, even though they are very site-specific and temperamental shrubs.

**Flowering and fruiting.** The perfect, showy flowers appear from March to August (table 3). Flower colors vary widely, with white, pink, and purple predominating. Flowers are pollinated by bees (Gibson 1901) and to a lesser extent by birds (Cox 1990). Fruits are oblong, 5-valved, dehiscent

capsules that generally ripen during autumn (figure 1).

When mature, capsules turn from green to brown, at which time they split along the sides, releasing minute seeds (figures 2–4). Capsules of rosebay rhododendron contain about 400 viable seeds/capsule (Romancier 1970).

**Collection of fruits, seed extraction, and cleaning.**

In general, capsules should be observed closely from mid-September onward and collected as they start to turn from green to brown (Bowers 1960). Fruits are dehiscent and if capsules are not collected before they open, most of the seeds will be lost. However, capsules can be picked green and then opened in gentle heat as long as their seeds are fully developed. Capsules may be air-dried at about 21 °C for 2 to 4 weeks (Blazich and others 1991; Malek and others 1989) or oven-dried for 12 to 24 hours at 35 °C (Dirr and Heuser 1987). Many capsules will split open during drying,

**Table 3**—*Rhododendron*, rhododendron and azalea: growth habit and flowering

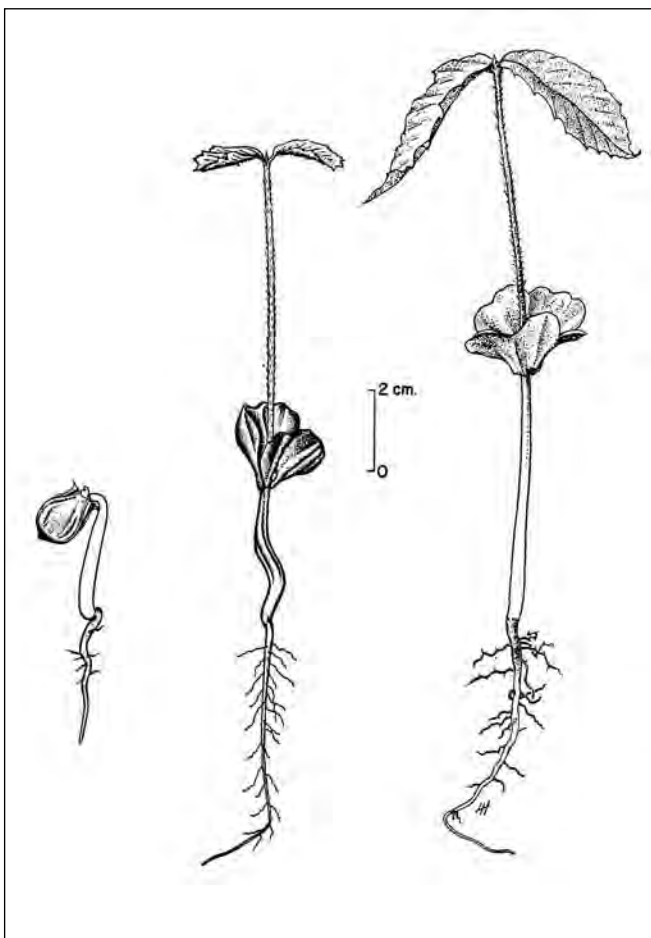
Species	Growth habit & maximum height	Flowering	Flower color
<b>EVERGREEN RHODODENDRONS</b>			
<i>R. carolinianum</i>	Compact shrub; to 1.8 m	May	Pink, mauve, white
<i>R. catawbiense</i>	Spreading, rounded in the open; generally wider than tall to 3 m, sometimes small tree to 6 m	May–June	Magenta, pink, white, red
<i>R. chapmanii</i>	Shrub to 1.8 m	May	Rose
<i>R. macrophyllum</i>	Open tree-like shrub; often erect to 3–9 m	May–June	Purplish rose, white
<i>R. maximum</i>	Shrub in cultivation; to 4.6 m (sometimes to 12 m in the wild)	June–July	White, pink, purplish red
<i>R. minus</i>	2.8 m	June	Rose, white
<b>DECIDUOUS RHODODENDRONS</b>			
<i>R. alabamense</i>	Low stoloniferous shrub; to 0.6–2.4 m	Apr–May	White
<i>R. albiflorum</i>	Erect shrub; from 0.9–2.1 m	June–July	Creamy white, yellow
<i>R. arborescens</i>	From low spreading bushes in open to tall and leggy in shade; up to 6 m	June–July	White
<i>R. atlanticum</i>	Stoloniferous shrub, forms branching sprays when well established; 0.3–1.5 m	May	White, pink
<i>R. austrinum</i>	Stiff and upright; from 3.0–3.6 m	Apr	Yellow-orange
<i>R. calendulaceum</i>	Stiff and upright; to 3.6 m	May–June	Yellow, orange, scarlet, pink
<i>R. camtschaticum</i>	Very small shrub; to 0.2 m	May	Reddish purple
<i>R. canadense</i>	Much branched shrub; to 0.9 m	Apr	Rose-purple, white
<i>R. canescens</i>	Sparingly branched shrub; to 4.6 m	Apr–May	Pink, white
<i>R. cumberlandense</i>	Low and twiggy, often stoloniferous shrub; to 2.4 m but rarely over 1.8 m	June–July	Yellow, orange, scarlet
<i>R. flammeum</i>	Mounding form; to 2.5 m	May	Scarlet, orange, yellow
<i>R. lapponicum</i>	Dwarf, procumbent shrub; to 0.3 m	Apr	Purple
<i>R. oblongifolium</i>	Upright, somewhat stoloniferous shrub; to 1.8 m	June	White, pink
<i>R. occidentale</i>	Rounded, occasionally upright or low shrub; to 1.0–4.6 m	Apr–Aug	White, pink, pale yellow
<i>R. periclymenoides</i>	Usually tall, vigorous and much-branched shrub; to 2.7 m & up to 4.5 m in wild	May	Pale pink, rose, reddish, white
<i>R. prinophyllum</i>	Upright, well branched shrub; to 2.5 m	May	Pink, white, rosy red
<i>R. prunifolium</i>	Tall, rounded-topped; up to 3.6 or 5.5 m in wild	July–Aug	Yellow, orange, scarlet
<i>R. vaseyi</i>	Upright shrub to 3.6 m	Apr–May	White, pink, crimson
<i>R. viscosum</i>	Form various: large & upright to dwarf, small tree; from 3–6 m, rounded or straggly shrub, stoloniferous form to 4.6 m	July–Oct	White, pink

**Sources:** Davidian (1992), Leach (1961), LHBH (1976).

the same 3 to 5 °C (Suszka 1975). Some laboratories also test stratified beech seeds with the common alternating regime of 30 °C (day) and 20 °C (night) with acceptable results (table 5). Because of the lengthy tests, viability estimation by tetrazolium staining is recommended as an alternate method (ISTA 1993). Both tetrazolium and indigo carmine staining (Suszka 1991) are commonly used in Europe. North American testing rules (AOSA 1993) do not include either of these beech species, but the same methods should work for both. Germination is epigeal (figure 4).

**Nursery practice.** Beech seeds can be sown in the fall as soon after collection as possible, or stratified seeds can be sown in the spring. In the stratification/storage procedure described earlier for European beech, seeds can be removed from storage and planted at any time in the spring without additional treatment. This procedure eliminates the uncertainty over when to start stratification in time for spring-sowing and is favored by nurserymen in Europe (Gosling 1991). Sowing density should be 700 viable seeds/m<sup>2</sup> (65/ft<sup>2</sup>) for European beech, which, on the average, should produce about 325 seedlings/m<sup>2</sup> (30/ft<sup>2</sup>) (Aldhous 1972). Seeds should be covered with 12 mm (1/2 in) of soil. Fall-sown beds should be mulched until midsummer and given special protection against rodents (Rudolf and Leak 1974). Some seedbeds may require half-shade until past mid-summer. Vegetative propagation by cuttings is very difficult, but some successes have been reported for stem cuttings taken in late summer. Grafting is more common for ornamental selections (Dirr and Heuser 1987).

**Figure 4**—*Fagus grandifolia*, American beech: seedling development at 2, 5, and 7 days after germination.



**Table 5**—*Fagus*, beech: germination test conditions and results

Species	Cold stratification (days)	Test conditions			Germination rate		Germination (%)
		Medium	Temp (°C)		Amount (%)	Period (days)	
			Day	Night			
<i>F. grandifolia</i>	90	Sand	30	20	84–47	85	—
<i>F. sylvatica</i>	42	Sand, paper	30	20	—	—	81
<i>F. sylvatica</i>							
Fresh seeds	140	Sand + peat	1	1	56–120	100	—
Stored seeds	150	Sand + peat	5	5	60–110	100	—

Source: Rudolf and Leak (1974).

**Table 3**—*Aronia*, chokeberry: cold stratification periods, germination test conditions and results

Species	Cold stratification period (days)	Germination test conditions			Germinative capacity	
		Temp (°C)			Amount (%)	Samples
		Day	Night	Days		
<i>A. arbutifolia</i>	90	20	20	30	94	4
<i>A. melanocarpa</i>	90–120	30	20	30	22	4
<i>A. x prunifolia</i>	60	20	20	30	96	2

Sources: Crocker and Barton (1931), Gill and Pogge (1974).

There are no official test prescriptions for chokeberries, but tests of stratified seeds can be done on paper or in soil, sand, or peat for 28 days, at diurnally alternating temperatures of 30 (day) and 20 °C (night) or at a constant 20 °C. Germination starts after about 8 days and may be virtually complete in 20 to 30 days (Crocker and Barton 1931). Germination of seeds stratified as recommended here was mostly in the 90 to 100% range (table 3). Germination of unstratified seed was quite low, 0 to 15%, in tests that extended into a second year (Adams 1927). Germination is epigeal.

**Nursery practice.** In some nurseries, the dried fruits are soaked in water for a few days and mashed and then the whole mass is stratified until spring. Limiting the stratification period to 60 days for purple, 90 days for red, and 120

days for black chokeberry may increase germination in the nursery. Fall planting is done by some growers (Dirr and Heuser 1987). The recommended sowing depth is about 10 mm ( $\frac{1}{3}$  in) (Sheat 1948). Germination mostly takes place within a few days after sowing. As a rule of thumb, 0.45 kg (1 lb) of cleaned seed may yield about 10,000 usable plants (Van Dersal 1938). Outplanting may be done with 2-year-old seedlings (Sheat 1948).

Vegetative propagation is possible with red chokeberry (and perhaps the others). Softwood cuttings taken in July and treated with 4,000 ppm of indole-butyric acid solution root very well. Cuttings taken in December or January will root also (Dirr and Heuser 1987). Irrigation of the mother plant a few days before the cuttings are taken will help rooting (Dehgan and others 1989).

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