

Aquifoliaceae—Holly family

***Ilex* L.**
holly

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Growth habit, occurrence, and use. The hollies—genus *Ilex*—include almost 400 species of deciduous or evergreen shrubs and trees that occur in temperate and tropical regions of both hemispheres (Brown and Kirkman 1990). About 20 species are native to eastern North America. Of the 7 species included in this book (table 1), most are highly valued for ornamental plantings and all are good food sources for wildlife. More than a thousand cultivars of American holly have been selected for their ornamental features (Grelen 1990). This species also hybridizes with dahoon (*Ilex cassine* L.) to produce Topel holly (*I. × attenuata* Ashe) (Little 1979). The wood of American holly is also used in cabinetry and for construction of novelties and specialized wood products (Vines 1960).

Flowering and fruiting. The small, axillary, white or greenish white, dioecious flowers appear in the spring on the current season's growth (table 2). Holly fruits are rounded, berrylike drupes that range from 6 to 13 mm in diameter (figure 1). Each fruit contains 2 to 9 bony, flattened seeds that are botanically defined as nutlets, or pyrenes (figure 2). The fruits mature in the fall (table 2), turning from green to various shades of red, yellow, or black (table 3). The seeds

contain a very small embryo in a fleshy endosperm (figure 3).

Collection, extraction, and storage. Ripe fruits may be picked by hand or flailed from the branches onto sheets spread on the ground. Seeds should be extracted by running the fruits through a macerator with water and floating or skimming off the pulp and empty seeds. For small seedlots, kitchen or laboratory blenders do a thorough job, although replacing the metal blades with plastic tubing propellers has been recommended to avoid damage to the seeds (Munson 1986). In another method, the fruits are fermented in warm water, then rubbed over a screen by hand to remove the pulp (Vines 1960). Seed yield data are summarized in table 4.

If the seeds are to be stratified immediately, drying is not necessary. If the seeds are to be stored, they should be dried to about 10% moisture content, placed in moisture-proof containers, and stored at temperatures near or below freezing. Viability of seeds after storage for more than 1 year has not been reported, but hollies are orthodox in storage behavior and should keep well at temperatures a few degrees above (or below) freezing. Storage foods in the embryo are primarily lipids and proteins (Hu and others 1979).

Table 1—*Ilex*, holly: nomenclature and occurrence

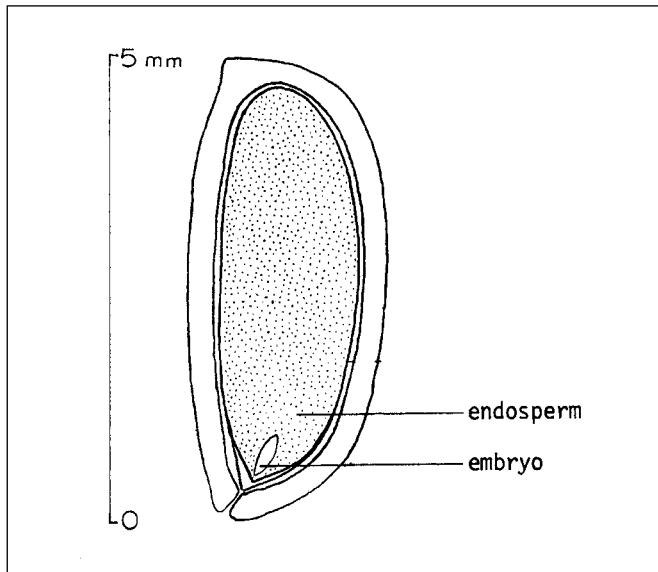
Scientific name & synonym	Common name(s)	Occurrence
<i>I. aquifolium</i> L.	English holly	Native to S Europe, N Africa, & W Asia to China; widely planted in SE & NW US
<i>I. decidua</i> Walt.	possumhaw, deciduous holly, winterberry, swamp holly	Maryland to Florida, W to Texas, Missouri, & Illinois
<i>I. glabra</i> (L.) Gray <i>I. monticola</i> Gray	inkberry, gallberry, smooth gallberry	Nova Scotia to Florida, W to Missouri & Texas
<i>I. montana</i> Torr. & Gray ex	Gray mountain holly, mountain winterberry	New York to Florida, W to Louisiana
<i>I. opaca</i> Ait.	American holly, holly, white holly	Massachusetts to Florida, W to Texas & Missouri
<i>I. verticillata</i> (L.) Gray	common winterberry, winterberry, black alder	Newfoundland to Minnesota, S to Louisiana & Florida
<i>I. vomitoria</i> Ait.	yaupon, cassena, Christmas-berry, evergreen holly	Virginia to central Florida, W to Texas & Oklahoma

Source: Little (1979).

Table 2—*Ilex, holly*: phenology of flowering and fruiting

Species	Location	Flowering	Fruit ripening	Seed dispersal
<i>I. aquifolium</i>	—	May–June	Sept	Winter–spring
<i>I. decidua</i>	Gulf Coastal Plain	Mar–May	Fall	Winter–spring
<i>I. glabra</i>	—	Mar–June	Fall	Winter–spring
<i>I. montana</i>	Appalachian Mtns	May–June	Sept	—
<i>I. opaca</i>	—	Apr–June	Sept–Oct	Mar
<i>I. verticillata</i>	—	June–July	Sept–Oct	Fall–winter
<i>I. vomitoria</i>	Gulf Coastal Plain	Apr–May	Sept–Oct	Dec

Sources: Bonner (1974), Halls (1973), Little and Delisle (1962), Stupka (1964), Vines (1960).

Figure 1—*Ilex, holly*: fruits and leaves of *I. opaca*, American holly (top) and *I. vomitoria*, yaupon (bottom).**Figure 3**—*Ilex montana*, mountain holly: longitudinal section of a nutlet.

Pregermination treatment. Holly seeds exhibit a deep dormancy that is caused partly by the hard endocarp surrounding the seedcoat (figure 3) and partly by an immature embryo. In nature, germination of American holly is commonly delayed for as long as 3 years (Bonner 1974). This condition suggests that alternating warm and cold moist treatments may be the best approach. Reasonable germination of American holly has been reported after 12 months of warm treatment that is followed by 3 months of

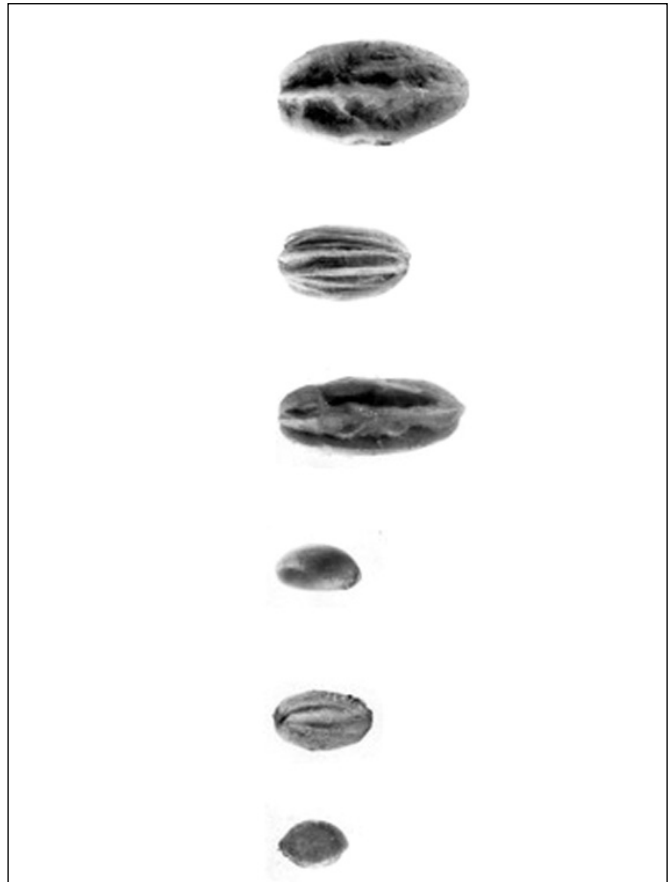
Figure 2—*Ilex, holly*: nutlets (pyrenes) of *I. aquifolium*, English holly (top); *I. montana*, mountain holly (second); *I. opaca*, American holly (third); *I. verticillata*, common winterberry (fourth); *I. vomitoria*, yaupon (fifth); and *I. glabra*, inkberry (bottom).

Table 3—*Ilex*, holly: height, seed-bearing age, and color of ripe fruit

Species	Height at maturity (m)	Year first cultivated	Minimum seed-bearing age (yrs)	Color of ripe fruit
<i>I. aquifolium</i>	15–24	Ancient times	5–12	Light red
<i>I. decidua</i>	6–9	—	—	Red, orange-red
<i>I. glabra</i>	4	1759	—	Black
<i>I. montana</i>	12	1870	—	Orange-red, rarely yellow
<i>I. opaca</i>	30	1744	5	Red, rarely orange or yellow
<i>I. verticillata</i>	8	1736	—	Red, orange or yellow
<i>I. vomitoria</i>	3–8	—	4–7	Red

Sources: Bonner (1974), Brown and Kirkman (1990), Grelen and Duvall (1966), Halls (1973), Little and Delisle (1962), Maisenhelder (1958), Rehder (1962), Vines (1960).

Table 4—*Ilex*, holly: seed yield data

Species	Cleaned seeds/weight				Samples
	Range		Average		
	/kg	/lb	/kg	/lb	
<i>I. aquifolium</i>	—	—	125,700	57,000	1
<i>I. decidua</i>	—	—	43,600	19,800	1
<i>I. glabra</i>	—	—	63,900	29,000	1
<i>I. montana</i>	—	—	77,200	35,000	1
<i>I. opaca</i>	48,500–80,150	22,000–36,350	62,700	28,430	4
<i>I. verticillata</i>	88,200–284,450	40,000–129,000	202,860	92,000	4
<i>I. vomitoria</i>	—	—	83,350	37,800	1

Sources: Bonner (1974), Swingle (1939).

cold (Dirr and Heuser 1987). For common winterberry, which may have a more permeable endocarp than other hollies, some benefit may be obtained by stratifying seeds at alternating temperatures of 20 °C (night) and 30 °C (day) for 60 days, followed by 60 days at 5 °C (Giersbach and Crocker 1929).

Germination and viability tests. Because of the extremely slow germination of hollies, there is no satisfactory method for testing germination directly. Germination of 70 to 95% has been reported for inkberry in tests that ran over 300 days (Hughes 1964), and 33 to 56% for American holly in tests that ran 2 1/2 years (Barton and Thornton 1947). Test periods of this length are not practical, and indirect estimates of viability are commonly used in place of germination tests. Cutting tests give good estimates of viability for freshly collected seeds, but for most purposes, tetrazolium staining is best. Procedures recommended for English holly by the International Seed Testing Association (1993) should work well with other holly species. Seeds should be cut longitudinally through the seedcoat and into the endosperm, or cut transversely at distal or both ends into the endosperm, to allow entry of the tetrazolium solution. Incubation for 24 hours at 30 °C in a 1.0% solution should

be sufficient for staining. All tissues, including the endosperm, should be fully stained in viable seeds.

Nursery practice. Holly seeds may be broadcast or sown in drills in fall or spring. Sowing immediately after collection has been recommended for American holly and inkberry (Afanasiev 1942; Hartmann and Kester 1968), but germination should not be expected until the second or even third spring (Bonner 1974). Seeds should be covered with 3 to 13 mm (1/8 to 1/2 in) of soil, and fall-sown beds should be mulched (Bonner 1974; Muir 1965). In another recommended procedure, seeds are sown in a flat of moist medium that is then covered with a plastic bag and placed in a warm (15 to 27 °C) shaded room until seedlings start to emerge. When this occurs, the bag should be removed and the flat moved to a spot with normal germination conditions (Dirr and Heuser 1987). Half-shade is recommended for beds of English holly during the first 2 summers, and field planting should be with 2+2, 2+3, or 2+2+2 stock (Bonner 1974). Because of the extreme dormancy in holly seeds, most propagation is by rooted cuttings, especially for ornamental varieties and selections. All species do not root equally or with the same treatments, so a good manual on vegetative propagation should be consulted (Dirr and Heuser 1987). A considerable amount of research on embryo culture of several holly species has also taken place (Hu 1975, 1977).

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