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

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

Source: Little (1979).
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 cold treatment.

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

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


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.

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).
cold (Dirr and Heuser 1987). For common winterberry, which may have a more permeable endocarp than other hol-
lies, 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 satisfac-
tory 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 indi-
rect estimates of viability are commonly used in place of
germination tests. Cutting tests give good estimates of via-
bility 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 recommend-
ed 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 prop-
agation is by rooted cuttings, especially for ornamental vari-
dies and selections. All species do not root equally or with
the same treatments, so a good manual on vegetative propa-
gation should be consulted (Dirr and Heuser 1987). A con-
siderable amount of research on embryo culture of several
holly species has also taken place (Hu 1975, 1977).

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

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


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

<table>
<thead>
<tr>
<th>Species</th>
<th>Range</th>
<th>Cleaned seeds/weight</th>
<th>Average</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/kg</td>
<td>/lb</td>
<td>/kg/lb</td>
<td></td>
</tr>
<tr>
<td><em>I. aquifolium</em></td>
<td>—</td>
<td>—</td>
<td>125,700</td>
<td>57,000</td>
</tr>
<tr>
<td><em>I. decidua</em></td>
<td>—</td>
<td>—</td>
<td>41,000</td>
<td>19,000</td>
</tr>
<tr>
<td><em>I. montana</em></td>
<td>—</td>
<td>—</td>
<td>63,900</td>
<td>29,000</td>
</tr>
<tr>
<td><em>I. opaca</em></td>
<td>48,500–80,150</td>
<td>22,000–36,350</td>
<td>62,700</td>
<td>28,400</td>
</tr>
<tr>
<td><em>I. verticillata</em></td>
<td>88,200–284,450</td>
<td>40,000–129,000</td>
<td>202,860</td>
<td>92,000</td>
</tr>
<tr>
<td><em>I. vomitoria</em></td>
<td>—</td>
<td>—</td>
<td>83,350</td>
<td>37,800</td>
</tr>
</tbody>
</table>

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

---

**H•I-J genera Layout 1/31/08 10:05 AM Page 599**
References


