XIII. CRYPTOCOTYLY IN AUSTRALIAN DICOTYLEDONES

H.T. Clifford

Botany Department, University of Queensland
St. Lucia (Ql.) - 4067, Australia

Seedlings exhibit a great diversity in morphology as is well documented (Lubbock, 1892; De Vogel, 1980). As part of an ongoing study on the taxonomic importance of seedling characters and their possible phylogenetic significance the seedlings of about 320 endemic Australian genera ofDicotyledons have been raised. Here some comments on the taxonomic distribution of cryptocotyly and its correlation with other characters is considered in terms of this sample of genera.

The term cryptocotyly is applied to those situations in which the cotyledons remain entirely within the testa whether or not the seed is carried above ground during germination as well as those situations in which the testa ruptures and the cotyledons develop chlorophyll but remain at or below soil level but are still ensheathed in part by the testa (see fig. 1).

That cryptocotyly is part of a syndrome of characters associated with certain modes of seedling establishment has been hinted at by a number of writers. Thus Duke (1969) remarked that cryptocotylar species often have seedlings whose first leaves are cataphylls and Ng (1976) showed that for Malayan forest trees the seeds of the cryptocotylar species were in general larger and took longer to germinate than did those of phanerocotylar species. The same generalisations appear to apply to Australian species. Two other characters strongly associated with cryptocotyly are the lack of endosperm in the seed and the tree habit. There is also a tendency for the first formed leaves of the seedlings of the cryptocotylar species to be opposite rather than alternate (see table 1).

Fig. 1. Three species with cryptocotylar seedlings. — a. Alyxia ruscifolia; b. Xylocarpus granatum; c. Syzygium wilsonii.
Hence it may be that the character syndrome associated with cryptoco
tyly is a reflection of the evolutionary history of the taxa possessing it, a view supported by the taxonomic distribution of the syndrome. With few exceptions (Brachychiton, Drosera, Grevillea) the mode of germination is constant within genera and so the character may be held to be taxonomically useful at that level. A list of the cryptocotylar genera so far met with in the Australian flora is appended. From the list it is clear that the proportion of species with different modes of germination varies considerably between families and that many large families including Asteraceae and Chenopodiaceae have no cryptocotylar species. At higher taxonomic levels cryptocotyly is also far from randomly distributed. Of the 26 superorders proposed by Dahlgren (1980) 22 are represented in Australia. Of these 13 have genera with cryptocotylar species. The relative frequencies of these genera in the superorders is shown in table 2.

From table 2 it is clear that the superorders fall into three groups depending on their percentages of cryptocotylar species. Group A comprises the Magnoliiflorae alone, with a percentage of cryptoco
tyly about twice that of Group B. Group C includes a wide range of values most of which are about half those of Group B. Although further results may alter these values it is thought they will not do so dramati
cally, for any bias in the present sampling is against those superorders in which cryptocotyly is not known in Australia and in which it is not known amongst flowering plants at large.

Whether cryptocotyly is a primitive or advanced trait is difficult to decide in the absence of information as to the nature of the primitive flowering plant or the habitat in which the class evolved. Amongst other seed plants cryptocotyly is the only mode of germination known for the Cycadophyta and Ginkgophyta but occurs only rarely in the Pinophyta (Araucaria spp.). However, although these three classes are geologically...
older than the Magnoliophyta, none is an acceptable forerunner to the group and so it cannot have acquired cryptocotyly from that source.

The high proportion of cryptocotylar species in the Magnoliiflorae usually regarded as rich in primitive taxa suggests the character may be primitive a view already proposed by Grushvitskyi (1963). Furthermore it has been shown for a sample of the Australian flora that the mean value of Sporne's Advancement Index for families with cryptocotylar species only is less than that for families with phanerocotylar species only (Clifford, 1981). Accordingly the opinion that phanerocotyly is the primitive condition in flowering plants (Ehrendorfer, 1980; Eames, 1961) should not be accepted uncritically.

The adaptive role of cryptocotyly requires further study. However its ecologically widespread occurrence amongst species growing in such diverse habitats as heathlands, mangrove forests and rainforests suggests that either its adaptive role is of little significance, or that cryptocotyly plays a different role in each community.

In summary it may be said that the cryptocotylar syndrome is well represented in the Australian flora and in particular is found in species

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**TABLE 2.**

<table>
<thead>
<tr>
<th>Superorder</th>
<th>% of cryptocotyly</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnoliiflorae</td>
<td>67</td>
<td>15</td>
</tr>
<tr>
<td>Group B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rutiflorae</td>
<td>35</td>
<td>43</td>
</tr>
<tr>
<td>Theiflorae</td>
<td>33</td>
<td>6</td>
</tr>
<tr>
<td>Nymphaeiflorae</td>
<td>33</td>
<td>3</td>
</tr>
<tr>
<td>Fabiflorae</td>
<td>31</td>
<td>36</td>
</tr>
<tr>
<td>Group C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primuliflorae</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Santaliflorae</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Myrtiliflorae</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Rosiflorae</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>Proteiflorae</td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td>Lamiflorae</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>Gentianiflorae</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Malviflorae</td>
<td>8</td>
<td>39</td>
</tr>
</tbody>
</table>

The percentage frequencies of cryptocotyly in Angiosperm superorders (Dahlgren, 1980) as determined from a sample of c. 320 Australian dicotyledonous genera. Superorders not listed lack cryptocotylar species in Australia or do not occur there; n is the number of genera raised.
of the Magnoliiflorae. As this superorder is most abundant in rainforest communities the cryptocotylar condition occurs frequently in those communities.

Literature cited:


APPENDIX

The genera of Australian indigenous dicotyledons known to have seedlings with cryptocotylar germination (after Dahlgren, 1980).

Magnoliiflorae

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\begin{align*}
\text{Annonales} & \\
\text{Annonaceae} & \text{Neouvularia}^1, \text{Polyalthia} \\
\text{Magnoliales} & \\
\text{Myristicaceae} & \text{Myristica} \\
\text{Laurales} & \\
\text{Lauraceae} & \text{Beilschmiedia, Cryptocarya, Endiandra} \\
\text{Idiospermaceae} & \text{Idiospermum} \\
\text{Hernandiaceae} & \text{Hernandia} \\
\text{Cassythaceae} & \text{Cassytha} \\
\text{Nymphaeflorae} & \\
\text{Nymphaeales} & \text{Nelumbo} \\
\text{Nymphaeaceae} & \\
\text{Malviflorae} & \\
\text{Malvales} & \\
\text{Sterculiaceae} & \text{Argyrodendron, Heritiera, Sterculia} \\
\text{Theiflorae} & \\
\text{Theales} & \\
\text{Clusiaceae} & \text{Calophyllum} \\
\text{Droserales} & \\
\text{Droseraceae} & \text{Drosera spp.}
\end{align*}
\]
(Appendix continued)

Ebenales
   Sapotaceae               Chrysophyllum

Fabiflorae
   Fabales
      Mimosaceae             Abarema, Archidendron, Entada
      Caesalpiniaceae        Caesalpinia
      Fabaceae               Atylosia, Castanospermum, Hanslia, Mil-letia, Mucuna, Pongamia, Sophora

Proteiflorae
   Cunoniaceae              Davidsonia

Myrtiflorae
   Myrtales
      Myrtaceae              Acmena, Syzygium
      Combretaceae           Lumnitzera
      Rhizophoraceae         Rhizophora

Rutiflorae
   Sapindales              Atalaya, Castanospora, Cupaniopsis, Diploglottis, Harpullia, Sarcopteryx, Toechima
      Sapindaceae

Rutales
      Rutaceae               Microcitrus
      Simaroubaceae          Guilfoylia, Quassia
      Meliaceae              Didymocheton, Dysoxylum, Pseudocarapa, Xylocarpus

Santaliflorae
   Santalales              Ximenia
      Olacaceae
      Opiliaceae             Opilia^3)

Gentianiflorae
   Gentianales             Alyxia, Cerbera
      Apocynaceae

Lamiiflorae
   Lamiales
      Verbenaceae           Clerodendron, Faradaya

^1) L. Jessup (pers. comm.).  
^3) B.P.M. Hyland (pers. comm.).