

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 of Dicotyledons 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).

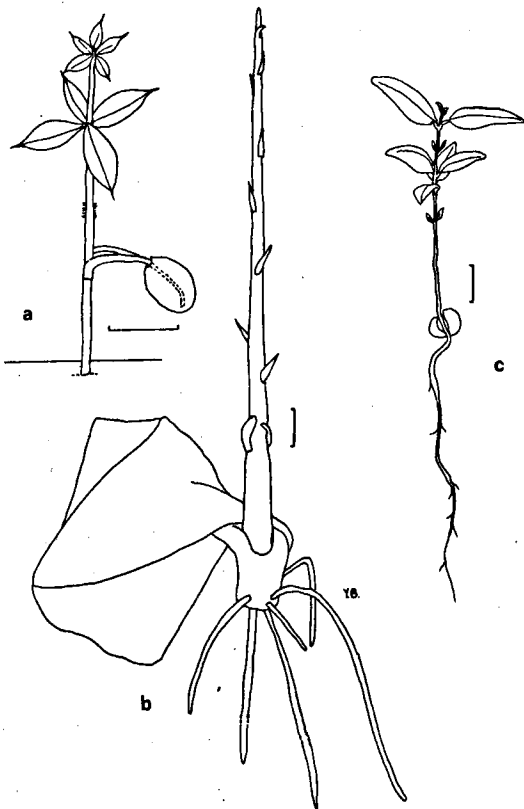


Fig. 1. Three species with cryptocotylar seedlings. — a. *Alyxia ruscifolia*; b. *Xylocarpus granatum*; c. *Syzygium wilsonii*.

TABLE 1.

<u>Character</u>	<u>Germination</u>	
	Cryptocotylar	Phanerocotylar
Seed non-endospermic	85	41
Cataphylls present	69	1
First formed leaves alternate	52	40
Tree habit	96	23
Germination rapid (%)*	50	73
Mean seed size (cm)*	2-3	1-2

The percentage frequencies of some seedling or seed characters in a sample of c. 320 Australian genera with cryptocotylar or phanerocotylar germination. (* after Ng, 1976.)

Hence it may be that the character syndrome associated with cryptocotily 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 cryptocotily 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 cryptocotily 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 dramatically, for any bias in the present sampling is against those superorders in which cryptocotily is not known in Australia and in which it is not known amongst flowering plants at large.

Whether cryptocotily 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 cryptocotily 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

TABLE 2.

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

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 cryptocotyly species in Australia or do not occur there; n is the number of genera raised.

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 cryptocotyly 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 cryptocotyly species only is less than that for families with phanerocotyly 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 cryptocotyly syndrome is well represented in the Australian flora and in particular is found in species

of the Magnoliiflorae. As this superorder is most abundant in rainforest communities the cryptocotylar condition occurs frequently in those communities.

Literature cited:

- Clifford, H.T. 1981. Seedlings and the Australian flora. *Vict. Nat.* 98: 75-79.
- Dahlgren, R.T.M. 1980. A revised system of classification of the Angiosperms. *Bot. J. Linn. Soc.* 80: 91-124.
- Duke, J.A. 1969. On tropical tree seedlings. 1. Seeds, seedlings, systems and systematics. *Ann. Missouri Bot. Gard.* 56: 125-161.
- Eames, A.J. 1961. *Morphology of the Angiosperms.* New York.
- Ehrendorfer, F. 1980. *Spermatophyta, Seed plants,* in Strasburger, *Textbook of Botany.* London.
- Grushvitskyi, I.V. 1963. Subterranean germination and the function of the cotyledons. *Bot. Zhurn.* 48: 906-915 (in Russian).
- Lubbock, J. 1892. *A contribution to our knowledge of seedlings.* Vol. 1 & 2. London.
- Ng, F.S.P. 1976. Strategies of establishment in Malayan forest trees, in P.B. Tomlinson & M.H. Zimmerman, *Tropical trees as living systems:* chapter 5. Cambridge.
- Vogel, E.F. de. 1980. *Seedlings of dicotyledons.* Wageningen.

APPENDIX

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

Magnoliiflorae

 Annonales

 Annonaceae

 Neouvularia¹), Polyalthia

 Magnoliales

 Myristicaceae

 Myristica

 Laurales

 Lauraceae

 Beilschmiedia, Cryptocarya, Endiandra

 Idiospermaceae

 Idiospermum

 Hernandiaceae

 Hernandia

 Cassythaceae

 Cassytha

Nymphaeiflorae

 Nymphaeales

 Nymphaeaceae

 Nelumbo

Malviflorae

 Malvales

 Sterculiaceae

 Argyrodendron, Heritiera, Sterculia

Theiflorae

 Theales

 Clusiaceae

 Calophyllum

 Droserales

 Droseraceae

 Drosera spp.

(Appendix continued)

Ebenales		
	Sapotaceae	Chrysophyllum
Fabiflorae		
	Fabales	
	Mimosaceae	Abarema, Archidendron, Entada
	Caesalpiniaceae	Caesalpinia
	Fabaceae	Atylosia, Castanospermum, Hanslia, Mil- letia, Mucuna, Pongamia, Sophora
Proteiflorae		
	Cunoniales	
	Cunoniaceae	Davidsonia
	Proteales	
	Proteaceae	Grevillea spp. ²⁾ , Hicksbeachia, Maca- damia
Myrtiflorae		
	Myrtales	
	Myrtaceae	Acmena, Syzygium
	Combretaceae	Lumnitzera
	Rhizophoraceae	Rhizophora
Rutiflorae		
	Sapindales	
	Sapindaceae	Atalaya, Castanospora, Cupaniopsis, Diploglottis, Harpullia, Sarcopteryx, Toechima
	Rutales	
	Rutaceae	Microcitrus
	Simaroubaceae	Guilfoylia, Quassia
	Meliaceae	Didymocheton, Dysoxylum, Pseudocarapa, Xylocarpus
Santaliflorae		
	Santalales	
	Olacaceae	Ximenia
	Opiliaceae	Opilia ³⁾
Gentianiflorae		
	Gentianales	
	Apocynaceae	Alyxia, Cerbera
Lamiiflorae		
	Lamiales	
	Verbenaceae	Clerodendron, Faradaya

¹⁾ L. Jessup (pers. comm.).

²⁾ Grushvitskyi (1963).

³⁾ B.P.M. Hyland (pers. comm.).