

A NOTE ON STOMATAL TYPES AND CRYSTALS IN THE LEAVES OF MELASTOMATACEAE

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SUMMARY

Original data on leaf crystals and stomatal types in 25 genera of Melastomataceae are presented, and discussed with reference to the classification of the family as modified by Van Vliet et al. (1981, this issue). The heterogeneity of the abolished subfamily *Astronioideae* is confirmed and a separation of *Pternandra* from the *Astronieae* is also justified on the basis of leaf anatomical data. The *Astronieae* are characterized by large styloids and predominantly anomocytic stomata; this combination of characters also occurs in part of the *Melastomatoideae* (especially the *Miconieae*). Most other *Melastomatoideae* are characterized by polocytic to diacytic stomata and druses. The subfamilies *Memecyloideae* and *Crypteronioideae* remain rather heterogeneous leaf anatomically, but the evidence can be interpreted in support of mutual affinities.

INTRODUCTION

In conjunction with wood anatomical work on the Myrtales carried out at the Rijksherbarium over the last years, mainly by G. J. C. M. van Vliet, leaf anatomical slides of a miscellaneous representation of the constituent families had been prepared. For the Melastomataceae 40 specimens of 25 genera were sectioned according to standard techniques. Together with data in the literature this material showed such an interesting diversity, especially in crystal complement and stomatal type, of relevance in the debate on the delimitation of subfamilies within the Melastomataceae, that publication of this note seemed justified. A comprehensive leaf anatomical survey of the family is not envisaged at our institute.

Van Tieghem (1891a & b) made intensive use of anatomical features in his proposals for a new classification of the family (mainly included phloem in the wood, presence or absence of cortical and/or medullary bundles, and foliar sclereids). Van Vliet et al. (1981, this issue) emphasize the type of fibre tissue (fibre-tracheid or libriform) in their classification which is very much like the one proposed by Van Tieghem. In this note the alternative classifications will be tested on stomatal characters and crystal types in the leaves.

RESULTS AND DISCUSSION

The results as well as data from the literature are summarized in Table 1. In the subfamily *Memecyloideae*, the genera *Memecylon* and *Mouriri* are similar in crystal complement, although *Memecylon* stands out because of its rather unusual possession of

TABLE I. STOMATAL TYPES AND CELL INCLUSIONS IN LEAVES OF MELASTOMATACEAE

| Material studied and source of reference | Stomata | Crystals and silica bodies |
|--|--------------------------|---|
| Subfamily Memecyloideae | | |
| <i>Memecylon beccariana</i> Cogn. Borneo, SAN 22217 | para | druses, (sol., small styloids), sil. |
| <i>Memecylon edule</i> Roxb. Java, Kostermans 26A | para | druses-clusters, (small styloids), sil. |
| <i>Mouriri chamissoana</i> Cogn. Brazil, Hatschbach 20222 | in crypts | druses, (small styloids) |
| <i>Mouriri grandiflora</i> DC. Brazil, Martius s.n. | anomo-cyclo (para) | druses, (small styloids) |
| <i>Pternandra echinata</i> Jack. Malaya, HMB 1033 | anomo-cyclo | druses |
| <i>Pternandra rostrata</i> (Cogn.) Nay. Borneo, S 23610 | anomo-cyclo | druses |
| Subfamily Crypteronioideae | | |
| <i>Axinandra</i> (Van Vliet & Baas, 1975) | para | druses, small styloids |
| <i>Crypteronia</i> (Van Vliet & Baas, 1975) | para | druses, small styloids |
| <i>Dactylocladus</i> (Van Vliet & Baas, 1975) | anomo | druses and crystal sand |
| Subfamily Melastomatoideae | | |
| Tribe Astronieae | | |
| <i>Astrocalyx calycina</i> (Vid.) Merr. Philippines, Ramos 23537 | anomo (para, aniso) | styloids (mainly large) |
| <i>Astronia hollrungii</i> Cogn. New Guinea, BW 6899 | anomo (para) | styloids (mainly large) |
| <i>Astronia spectabilis</i> Bl. Bali, Kostermans et al. 122 | anomo (para) | styloids (mainly large) |
| <i>Beccarianthus</i> spec. New Guinea, Pullen 583 | anomo (para, dia, aniso) | styloids (mainly large) |
| Other tribes | | |
| <i>Allomorphia</i> spec. Borneo, Nootboom & Chai 02237 | polo (dia) | druses |
| <i>Anerincleisthus pauciflorus</i> Ridl. Malaya, Carrick 1520 | polo (dia) | druses |
| <i>Axinaea nitida</i> Cogn. California, Hutchinson & Wright 5590 | anomo-cyclo (aniso) | druses |
| <i>Bredia oldhamii</i> Hook. f. Taiwan, Mizushima & Liao 891 | polo | druses |
| <i>Catanthera</i> spec. New Guinea, Van Royen & Sieumer 7633 | polo (dia) | druses |
| <i>Centradenia floribunda</i> Planch. Cult. hortus Leiden | polo (dia) | druses (partly elongate) |
| <i>Clidemia hirta</i> (L.) D. Don. Malaya, Carrick 1417 | polo (dia, aniso, anomo) | druses |
| <i>Creochiton diptera</i> Elm. Philippines, Elmer 1419 | anomo | druses |
| <i>Creochiton ledermannii</i> Mansf. New Guinea, Ledermann 12943 | anomo | druses |
| <i>Creochiton pudibunda</i> (Bl.) Bl. Java, Reinwardt s.n. | anomo | druses |
| <i>Diplectria barbata</i> (C. B. Clarke) Franken & Roos. Thailand, Geesink & Santisuk 5098 | anomo (aniso, dia) | druses |

| | | |
|---|---|-------------------------------------|
| Diplectria divaricata (Willd.) O. Ktze. Malaya, Flora of Malaya 2505 | anomo (aniso) | druses |
| Dissochaeta intermedia Bl. Sumatra, Bunnemeijer 8074 | anomo | clusters-druses |
| Dissochaeta pallida (Jack) Bl. Malaya, Maingay 793 | anomo | clusters-druses |
| Gravasia laxiflora (Naud.) Drake, Madagascar, Lam & Meeuse 6016 | polo (dia) | druses |
| Henriettea spruceana Cogn. Brazil, Ule 6049 | anomo | styloids (mainly large) |
| Huberia glabrata Cogn. Brazil, Glazitou 16815 | cyclo (anomo) | druses |
| Lavoisiera pulcherrima DC. Brazil, HLB 908.129.1727 | polo (dia, aniso) | druses |
| Leandra fragilis Cogn. Brazil, Hatschbach 20191 | polo (dia) | druses |
| Macrolenes nemorosa (Jack) Bakh. f. Sumatra, Rahmit si Toroes 3287, and Malaya, Maxwell 1177-397 | anomo (polo, dia) | druses |
| Medinilla barbata Bakh. f. New Guinea, Aet & Idjan 825 | polo | druses |
| Medinilla cauliflora Hemsl. Solomon Isl. BSIP 8871 | polo | druses |
| Medinilla intermedia Bl. Cult. hortus Leiden | polo | druses |
| Medinilla lorata Stapf. Borneo, Haviland 3388 | polo | druses |
| Medinilla magnifica Lindl. Cult. hortus Leiden | polo | druses |
| Medinilla spec. Santa Isabel, Hunt 2634 | polo | druses |
| Melastoma polyanthum Bl. Borneo, Kadir & Kambatan A 3560 | polo (dia) | druses |
| Plethiandra hookeri Stapf. Borneo, RSNB 1059 & 4950 | polo (dia) | druses |
| <i>Additional data from the literature on Melastomatoideae:</i> | | |
| Amphiblemma, Bertolonia, Centradenia, Lasiandra, Medimilla, Monocheatum, Nepsera, Phyllagathis, Sonerila and Spherogyne (Lignier, 1887) | polo (incl. dia?) dia (incl. polo?) anomo-aniso | druses (sol.) |
| Marcetia and Microlicia (Solereder, 1899) | polo | druses |
| Rhynchanthera cordata (Solereder, 1899) | dia (incl. polo?) | crystal sand |
| Medinilla from Madagascar (Cordemoy, 1914, numerous spp.) | dia, anomo (intermediate, para) | small needles |
| Oxyspora (Metcalfe & Chalk, 1950) | | styloids (mainly large) |
| Miconia theaezans (Costa, 1977) | | styloids |
| Actiotis annua (Solereder, 1899) | | elongated druses (as reported here) |
| Actiotis longifolia (Solereder, 1899) | | |
| Bellucia, Calycogonium, Henriettea, Henrietteella, Loreya and Myriasporea (Solereder, 1899) | | |
| Centradenia inequilatera Don. (Solereder, 1899) | | |
| Centradenia floribunda Planch. (Solereder, 1899) | | |

Legend: less common stomatal type or crystal type between brackets.

Names of stomatal type abbreviated (without ending 'cytic'); stomata are classified according to definitions and illustrations by Wilkinson (1979, in Metcalfe & Chalk).

sol. = solitary rhomboidal crystals; sil = silica bodies in epidermal cells; incl. = including.

globular silica bodies in the epidermis. It is difficult to assess the stomatal type in the crypts of *Mouriri*, but transverse sections (where the stomata can be seen in oblique surface view) give the impression of anomocytic stomata. *Pternandra* only shares the druses of *Memecylon* and *Mouriri* as far as the leaves are concerned, but all three genera are on record to have large styloids in the stem tissue (the small styloids in the leaves of *Memecylon* and *Mouriri* are confined to the phloem of the midrib and major veins and are very inconspicuous). Solereder (1899) and Metcalfe & Chalk (1950) give reason for some confusion by either treating stem and leaf crystals together, or citing stem crystals under the heading leaf anatomy respectively. The combination of druses and styloids thus links *Pternandra* with the traditional *Memecyloideae*. The *Astronieae*, with which *Pternandra* is being treated in subfamily *Astronioideae* in many traditional classifications (but not by Van Tieghem, 1891b), share the stomatal type and large styloids (also in the leaves) but lack druses. For the leaf anatomical characters concerned *Pternandra* can thus be considered intermediate between *Astronieae* and *Memecyleae*.

Within the subfamily *Crypteronioideae*, *Axinandra* and *Crypteronia* are mutually very similar and share stomatal types and most of the crystal complement with *Memecylon* (also with large styloids in the stems). *Dactylocladus* takes an isolated position for both characters.

The subfamily *Melastomatoideae* is also heterogeneous for stomatal type and crystal complement, but there is a clear tendency for polocytic to diacytic stomata (these types are ontogenetically probably very similar) to predominate and to restrict oxalate crystals to the druse type. *Henriettea* and *Astronieae* deviate in having predominantly anomocytic stomata and large styloids; for the genus *Henriettea* the occurrence of styloids is not an isolated phenomenon; several related genera – all in the tribe *Miconieae* – are on record to have styloids (see data from literature in Table 1). Apart from *Astronieae* and some *Miconieae*, anomocytic stomata (or the related cyclocytic type) were found in 8 genera, with exclusively druses for leaf crystals. *Centradenia* presents an interesting case with polocytic stomata and elongated (more or less styloid-like) druses or styloids (record cited by Solereder). *Acioties* (like *Centradenia* belonging to the tribe *Tibouchineae*) is also outstanding within the material studied so far of the *Melastomatoideae* in having either crystal sand or small acicular (needle-shaped) crystals.

Obviously, our limited data do not allow for a detailed discussion of tribal delimitation, nor should the two different leaf anatomical characters be used to propose new or amend older classifications based on a combination of more characters. However, it is very well possible to interpret the present results against the background of Van Vliet et al.'s hypothetical phylogeny for the family and even support their major groupings within the family. The ancestral 'Protomelastomataceae' as well as their direct offshoots, viz. the *Memecyloideae* and *Crypteronioideae* can then be pictured with anomocytic and/or paracytic stomata and a complex crystal complement of druses and styloids (the latter present in both stems and leaves, or restricted to the stems). Within these taxa *Dactylocladus* presumably lost styloids in favour of crystal sand. One major line of specialization (or two parallel lines) are exemplified in the *Astronieae* and several representatives of the *Miconieae* where the crystal complement in the leaves became specialized to consist exclusively of styloids (mainly large ones).

Another major type of specialization (possibly in different independent lines) would be

the development of polocytic to diacytic stomata concomittant with the loss of styloids resulting in the most common type of *Melastomatoideae* with only druses and polocytic to diacytic stomata.

The scattered occurrence of anomocytic and related stomatal types throughout the *Melastomatoideae* is not in conflict with this speculative evolutionary reconstruction, in view of its supposedly primitive nature. That anomocytic or paracytic stomata are more primitive within the Melastomataceae than other types can be supported by two arguments: 1. these are the most common types in the related families Lythraceae (almost exclusively anomocytic; personal observation) and Myrtaceae (mostly anomocytic, fairly often paracytic; Metcalfe & Chalk, 1950; Johnson, 1980) which are also basic families within the order Myrtales; and 2. in several other families with a great diversity in stomatal types, anomocytic and/or paracytic stomata are usually found in the most primitive groups of the family (e.g., Baas, 1974).

The leaf anatomical evidence also supports several details of Van Vliet et al.'s hypothetical phylogeny such as: 1. the slightly isolated positions of *Dactylocladus* and *Pternandra* within their respective subfamilies; 2. the common ancestry and fairly close affinity of *Astronieae* and *Miconieae*; and 3. the marginal position of *Astronieae* within *Melastomatoideae* close to *Pternandra* of the *Memecyloideae*.

Apart from the characters treated here, Melastomataceae are very diverse in a number of other leaf anatomical characters as well such as indumentum, hypodermal development, sclereids of several types, petiole vasculature, etc. In future studies, concerned with specific, generic, and tribal delimitation, leaf anatomy could significantly contribute, especially in parts of this family where the variation of some characters (including those from wood anatomy) is limited.

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