Morphological aspects and taxonomical prospects of leaf idioblasts in Pandaceae and Caryocaraceae

T ANANDA RAO* and M C CHELUVIAH
Botany Department, Bangalore University, Bangalore 560 056, India
*Address for correspondence: 47/11, Srinivas, Mount Joy Extension, Hanumanthnagar, Bangalore 560 019, India

Abstract. Sclereids and tracheoids are found to be key characters to distinguish the taxa included under the Pandaceae. Their presence or absence appears to be a strong evidence that Microdesmis and Centroplacus, and Panda and Galearia can be grouped under two sections, anatomically. The vein termini sclereids in Anthodiscus and brachytracheoids in Caryocara of the Caryocaraceae are useful to distinguish the two genera from one another.

Keywords. Foliar idioblasts; sclereids; tracheoids; pandaceae; caryocaraceae; taxonomic prospects.

1. Introduction

A perusal of plant anatomical literature reveals that out of the 4 genera of Pandaceae viz. Centroplacus Pierre, Microdesmis Hook., Galearia Zool and Mor., and Panda Pierre, varied idioblasts, especially sclereids are recorded only in Centroplacus and Microdesmis. They are also recorded in Anthodiscus G F W May, Caryocar Allam. ex L. of the Caryocaraceae (Metcalf and Chalk 1950; Rao and Das 1979; Rao and Bhattacharya 1978). An investigation of the above taxa has been undertaken to examine the typology and distribution of leaf sclereids and tracheoids, with a view to record their potential systematic implications not so far made apparent by others (Silva 1968, 1969).

2. Materials and methods

Leaves of herbarium specimens were restored using Aerosol OT at 45°C for 3 days and washed in water before subjecting to clearing and staining by basic Fuchsin and KOH treatment as suggested by Page and Tan (1986) to produce a deeply stained 3-dimensional vascular skeletons of the leaf in-situ within a transparent whole leaf body. This technique is found to be helpful to study vein ramifications and their elements in greater details.

3. Pandaceae

3.1 Materials examined

The following herbarium leaf specimens belonging to 11 species of 4 genera were examined: Panda oleosa L. Africa, Gabon, Nkoulounga, G Touzet 154 (P); Galearia aristifera Miq., Borneo, Sulaiman 5 (L); G. celebica Koord, New Guinea, Schodde and Craven 4240 (L); G. fulva (Tul.) Miq., Malaya, s.l. FRI 2850 (L); Microdesmis
3.2 Observations

3.2a Panda is a tropical west African monotypic genus which is represented by a single species, *P. oleosa*.

The vein reticulum and the veinlets in the leaves are accompanied with a few slender thick-walled fibres. The borders of the areoles are sheathed with thin-walled parenchymatous cells which are rarely observed to accompany the veinlets. However, the vein endings along with brachytracheoids possess thin-walled more or less enlarged cells of parenchymatous nature (figure 1). Unlike these unspecified cells, the brachytracheoids possess sparsely to densely pitted cell walls.

3.2b Galearia, a genus in a confused state taxonomically is represented by a number of variable species spread all over the south east Asia and Malaysia to Soloman Islands.

The vein reticula and the veinlets of the 3 species, viz. *G. aristifera*, *G. celebica* and *G. fulva* are encased partially by elongated parenchymatous cells up to the apex of the veinlets. They are relatively thin-walled and more or less irregular in shape and size. However, at the vein ends there are thick-walled, irregularly shaped, pitted or non-pitted sclerotracheoids closely juxtaposed along with brachytracheoids. A striking trend of these terminal or sub-terminal cells observed is their close disposition with limited extension within the areole (figures 2-4).

3.2c Microdesmis is a tropical genus represented by 10 species spread over Africa, south east Asia and west Malaysia.

In all the investigated species of *Microdesmis* the vein reticula and the veinlets are bordered with thin-walled parenchymatous cells. The veinlets and the vein ends show distinct categories of idioblasts chiefly in the form of tracheoids and sclereids of varied shapes and sizes. In *M. yafungana*, *M. pierlotiana* and *M. casearifolia* terminal sclereids and tracheoids are more or less tube-like and conspicuous (figures 6–8). In *M. puberula*, the terminal idioblasts are very much extended irregularly or sometimes they extend, especially the sclereids from one side of the reticulum to the opposite side following a serpentine course of orientation (figures 9, 11). They are strongly birefringent and their wall reaction is positive to phloroglucinol-HCl test. The tracheoids in this species are more or less strap shaped of varied length, uneven width and helically thickened with rounded ends. In the mesophyll profile they are observed to occupy and extend to different tissues. They are weakly birefringent under polarised light. They are comparable to that of loratotracheoids as observed in Penaeaceae (Rao and Das 1976, 1979; Rao 1987).

In *M. magallanensis*, however, there are distinct structural differences in veinlet syndrome when compared to the other species of *Microdesmis*. The vein endings possess sclerotracheoids or brachytracheoids in twos or threesome and short tube-like sclereids in close proximity (figures 5, 12). Apart from this, the other structural
differences which distinguish the other species of Microdesmis are the diamond or cube-shaped crystals only along the midrib profile, columnar spongy cells with plenty of air space and small sized thick-walled abaxial epidermal cells with depressed stomata (figure 12).

3.2d Centroplacus is a west African taxon represented by a single species, viz C. glaucinus.
The vein reticula and the veinlets are encased partially with irregularly shaped parenchymatous cells. The vein ends are characterised by sclereid-like cells. They vary from simple to oblong or tubular branched forms with rounded ends in close associations with the vein endings or closely accompanying the veinlet before protruding into adjacent mesophyll areas (figure 10). They extend often touching the vein reticula around the areoles. The varied forms have in them a sequence of intermediate forms. Notwithstanding their variations, they have relatively thin cell wall and large lumen. The outer cell wall is feebly undulating, weakly birefringent and positive to phloroglucinol-HCl test.
4. Caryocaraceae

A family of 2 genera *Anthodiscus* and *Caryocar* and about 25 species distributed mostly in tropical America and out of these only 4 species of *Anthodiscus* and 3 species of *Caryocar* have been examined.

4.1 Materials examined

*Anthodiscus amazonica* Gleenon, Brasil; Amazon, G T Prance et al 16435 (GH); *A. majorensis* Gilly, Surinam, Tafelbung, B Maguir 24576 (A); *A. montanus* Gleenon,
Colombia, A E Lawrence 802 (A); *A. obovatus* Benth. Brasil, Rionigro, R Spruce 3146 (CAL); Colombia, R E Schulter 14660 (GH); *A. peruanus* Baille. Columbia, R E Schulter and F Topez 9387 (GH).

4.2 Observations

4.2a *Anthodiscus* is a south American tropical genus represented by 10 species.

The vein reticulum and the veinlets are encased by a few thick-walled sclerenchymatous fibres. The borders of the areoles possess irregularly shaped parenchymatous cells which are also found juxtaposed up to the veinlets apex. The ultimate vein endings in all the investigated species possess ovoid to sub-spheroidal sclereids irregularly pitted with moderate cell wall and wide lumen. This terminal disposition of sclereids appears to be a salient feature in *A. amazonica*, *A. majoriensis*, *A. obovatus* (figures 13, 15) and *A. peruanus*. In *A. montanus*, however, they are restricted to vein endings occurring near the mid-vein portion of the leaf.

4.2b *Caryocar* is a genus of tropical America represented by 20 species (Pilger 1925).

4.3 Materials examined

*Caryocar glabrum* (Aubl.) Pers., R Spruce s.n. (CAL); Peru, Toreto, T Williams 4425 (GH); *C. microcarpum* Ducke, Brasil, Amazon, Prance et al 9112 (GH); *C. pallidium* A C Sm., Brasil, Amazon, Manaus, J E Paula 13 (INPA). *C. Villosum* (Aubl.) Pers. Brazil, Acre, Prance et al 2490 (GH).

4.4 Observations

The vein reticula and the veinlets in all the investigated species are accompanied by elongated sclerenchymatous fibres to a great extent. The veinlets have a few elongated fibres adjoining the veins. The vein endings possess short tubular ovoid brachytracheoids either solitary or in twos or threesome (figure 14). Further, it is not uncommon to observe a few disjointed brachytracheoids in the vicinity of veins. The brachytracheoids are thin-walled, weakly or strongly sclerified and apparently appears to be of diagnostic feature of this genus.

Another noteworthy feature in the mesophyll is the absence of sclereids of any category. However, the reported occurrence of sclereids in the vicinity of veins, and also along the leaf margins of *C. nuciferum* (Blank 1939) can be of exceptional diagnostic interest for this species.

5. Conclusion

It is clear that the morphological features of the vein systems of the Pandaceae especially the varied idioblasts form an additional feature of diagnostic interest at generic level. Based on their typological features the following tentative key is prepared as an aid in the identification of the genera of this family.

Vein terminal:

1. Sclereids present
   2. Veinlets with sclereids and tracheoids ......... *Microdesmis*.
   2. Veinlets with sclereids .............. *Centroplacus*.
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1. Sclereids absent
2. Veinlets with brachytracheoids ........ *Panda*.
2. Veinlets with sclerotracheoids ........ *Galearia*.

The present study revealed that idioblasts, chiefly sclereids and tracheoids are the key characters to distinguish the 4 taxa included under this family. Their presence or
absence appears to be a strong evidence that *Microdesmis* and *Centroplacus*, and *Panda* and *Galearia* can be separated under two sections, anatomically.

*Microdesmis* in general stands distinctly apart from *Galearia* and *Panda*. However, *M. magallanensis* shares vein ends similar to that of *Galearia* and *Panda*, and serves as a link with those genera. In this context the structural differences of *M. magallanensis* is all the more of taxonomic interest in view of its reduction from *Worcesteranthus* Merr. of the Olacaceae (Merrill 1914) to *Microdesmis* of the Pandaceae (Steenis 1955).

The vein termini idioblasts and their typological features in *Anthodiscus* and *Caryocar* of the Caryocaraceae are sufficient to distinguish the two genera from one another. The occurrence of terminal sclereids in *Anthodiscus* and terminal brachytracheoids in *Caryocar* are more or less distinct and can be utilised for generic circumscription and sub-division despite their shared anatomical features in respect of hairy covering, idioblasts and sub-epidermal origin of cork. Further, it is observed that these idioblasts conform to sclereids or tracheoids, and at no instance any intermediary hybrid forms as reported in a few species of *Memecylon* (Rao 1957), *Lijindinia* (Rao et al 1983) and *Mouriri* (Foster 1946) of the Melastomataceae were observed in any of the species examined. However, these tracheoid idioblasts are comparable with those described in *Reaumuria* of the Tamaricaceae (Rao and Chakraborti 1982), *Capparis* of the Capparidaceae (Rao and Das 1978, 1979, 1981), *Fouquieria* of the Fouquieriaceae (Lersten and Carvey 1974), *Boronia* of the Rutaceae (Rao and Bhattacharya 1978, 1981), *Euphorbia* of the Euphorbiaceae (Sehgal and Paliwal 1974), a few other species of the Scrophulariaceae (Verghese 1969) and the Cunoniaceae (Rao and Dickison 1985a, b).

Notwithstanding the minor tracheoidal differences at the vein termini of the investigated species of *Caryocar*, it is certain that they cannot be used to distinguish them at specific levels. It is clear, however that they form a part of syndrome of characters at generic level for any thorough taxonomic analysis. On the other hand, in *Anthodiscus*, the occurrence of sclereids relates well to the alliance of this taxon to the Theaceae in which, however almost all the taxa possess diffuse pattern of leaf sclereids. The orderly terminal pattern of sclereid idioblasts in *Anthodiscus* not only justifies its diagnostic value but also its separate identity as it has been possible to build a key at generic level.

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