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Foliar sclereids in *Rhizophora* L. and their taxonomic implications

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Abstract. One of the most interesting internal features of the several species of *Rhizophora* has been the presence of varied types of foliar sclereids. This feature has been examined with a view to find out their utility in the satisfactory revision of this genus.

Keywords. Foliar sclereids; *Rhizophora*.

1. Introduction

It is evident from the published anatomical literature that very little is known about the foliar sclereid in the genus *Rhizophora* as a whole (Solereder 1908; Metcalfe and Chalk 1950; Rao 1950; Shah and Sunderraj 1965; Gill and Tomlinson 1969, 1971). Their constancy in every investigated species has led us to make an attempt to see how far sclereidal typology for individual species of specimens or even group differences would be useful in satisfactory revision of this genus.

2. Materials

The leaf specimens for this investigation were through the courtesy of the Director of the following herbaria which are listed following the symbols published by Holmgren and Kekuen (1974); Central National Herbarium (CAL), Indian Botanic Garden, Howrah; Herbarium of the Komarov Botanical Institute (LE), Prof. Popov Street, 2, Leningrad, USSR; Herbarium Moscow (MHA), Moscow Botanic Garden, Moscow 127276, USSR; Herbarium (LAE), Division of Botany, Dept. of Forests, P.O. Box 314, Lae, Papua New Guinea.

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R. candelaria DC, Philippine Island, Merril 365 (CAL); Philippine Island, Alambra *s.n.* (CAL); Mesa De 26246 (CAL); Sumatra, Batis Bahra, H. S. Yates 1879 (LE); Peninsular India, Wight 1041 (LE). *R. conjugata* L. Philippine, Palawan, H. W. Currang 3495 (LE); Philippines, Mindano, Elmer 12017 (LE); Philippine Island, Mina, Acc. no. 15059 (CAL); Siam, Kerr. 2093 (CAL); Andaman Island, Kurz *s.n*

(CAL); Burma, Falconar 387 (CAL); Musanpa Island, Rogers 423 (CAL); Madras, Lawson *s.n.* (CAL). *R. harrisonii* Leechm., Guinee, Forecaria, H. Jacques 7148 (LE). *R. latifolia* Miq. Arehipal. Ind. Teysman. *s.n.* (CAL); *R. mangle* L. Panama, Seeman, Acc. no. 162292 (CAL); USA, Florida, Curtis 5438 (CAL); Mexico, S. Juzepesuk 1311 (LE); British Gyana, S. A. Harris 414 (MHA); Bermuda, Moseley *s.n.* (LE). *R. mucronata* Poir. Formosa, Henry *s.n.* (CAL); Andaman, Nicobar, Dr. King's collector, *s.n.* (CAL); Burma, Tenasserim, Proudlock 91 (CAL); Travancore, Gamble 14804 (CAL); Java, Prain *s.n.* (CAL); Orissa, Cuttack delta, Haines 4115 (CAL), Manilla Luzon, Merril 18 (CAL); Great Cocos Island, Prain *s.n.* (CAL); N. W. Caledonia, E. Korener *s.n.* (MHA). *R. lamarckii* Montr. Papua, Fairfax harbour, Lae, B. Conn *et al* 6615 (LAE). *R. racemosa* G.F.W. Meyer. Guinee, Forcaria, H. Jacques 7057 (LE). *R. stylosa* Griff. Ex. Musc. Protanico Berolinensi, 142 Weruland, Acc. no. 162296 (CAL). The classification of sclereids is after Rao and Bhupal (1973).

3. Typology

The noteworthy feature in all the 35 cleared specimens belonging to seven species, namely *R. apiculata* Bl., *R. harrisonii* Leechman, *R. lamarckii* Montr., *R. mangle* L., *R. mucronata* Lamk., *R. racemosa* C.F.W. Meyer and *R. stylosa* Griff. is the presence of sclereids of varied form and size ranging from Palosclereids to complex Zosterosclereids. Their surface distribution differs from one another in their density and frequency. Mostly they are disposed parallel to the surface or vertically or obliquely inside the merophyll. Further they are unrelated to veinlet endings, thereby showing diffuse pattern of distribution. Another unique feature is the occurrence of different types of sclereids with innumerable intermediary types within the mesophyll of a single species. This seems to be a rule rather than an exception in all investigated members of this genus.

Table 1. Surface distributional pattern of foliar sclereids in *Rhizophora*.

Sl. No.	Name of the taxa	Typology of sclereids
1.	*R. candelaria* DC.	Ramiform to polyramous sclereids fusiform sclereids, trichosclereids
2.	*R. conjugata* L.	Fusiform sclereids, rhizosclereids, polyramous sclereids.
3.	*R. harrisonii* Leechman	Palosclereids, rhizosclereids.
4.	*R. lamarckii* Montr.	Rhizosclereids, ramiform sclereids, gnarly-form sclereids.
5.	*R. latifolia* Miq.	Polyramous sclereids with short branches.
6.	*R. mangle* L.	Rhizosclereids, ramiform, astro and polyramous sclereids.
7.	*R. mucronata* Poir.	Osteosclereids, rhizosclereids, ramiform sclereids, astrosclereids, polyramous and zosterosclereids.
8.	*R. racemosa* C. F. W. Mey	Rhizo, ramiform and polyramous sclereids.
9.	*R. stlyosa* Griff.	Osteosclereids, ramiform sclereids astrosclereids.

4. Taxonomic notes

The current taxonomic treatment of *Rhizophora* is based on the investigations of Salvoz (1936) and Hou Ding (1958, 1960). Tomlinson and Womersley (1976) considered that the present classification of *Rhizophora* is provisional as it has been based mainly on materials from several herbaria and absence of field knowledge. Further, they emphasize that many of the existing diagnostic features are of little value to the field worker confronted with a wide range of variations.

Following, Tomlinson and Womersley's diagnostic key, as enumerated below, an attempt is made to point out the diverse foliar sclereids of the studied taxa to assess their taxonomic or diagnostic value.

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Section I	*Aerope* BL.	
	R. apiculata Bl	Fusiform sclereids, trichosclereids
	Syn: *R. candelaria* DC.	
	Syn: *R. conjugata* L.	

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Section II	*R. lamarckii* Montr.	Rhizosclereids, ramiform sclereids, gnartyform sclereids
	R. harrisonii Leechman	Palosclereids, rhizosclereids
	R. samoensis (Hochr.) Salvoz.	Not available for study
	R. mangle L.	Polyramous sclereids densely oriented between the epidermal layers.
	R. mucronata Poir.	Polymorphic sclereids; zosterosclereids
	R. stylosa Griff.	Polymorphic sclereids
	R. racemosa G.F.W. Meyer	Polymorphic sclereids, zosterosclereids

5. Implication of sclereid morphology on taxonomy

The heterogeneity of the sclereid types supports the different sections established and at the same time emphasizes the affinities of the grouped taxa in cases where the sclereidal evidence has obvious taxonomic implications.

Section I: *Aerope* Bl.

From the standpoint of the sclereidal features the recognised taxa, namely *R.apiculata* Bl. possess fusiform to trichosclereids relevant for the establishment of this section.

Section II: *Rhizophora* L.

Only seven taxa have been studied of this section. The presence of sclereids strongly supports the naturalness of the section. Their diversity, however does provide good diagnostic value for characterisation of the individual species.

Of the varied types of sclereids found within the mesophyll of a few specimen of *R. mucronata* Poir the following interesting features have been observed. The specimens from Formosa (Henry *s.n.*, CAL) have Osteo and rhizosclereids as the common prevailing type in the mesophyll. Whereas the specimens of the same species collected from Travancore (Gamble, 14804, CAL) exhibit fusoid, ramiform or polyramous sclereids as the dominating type within the mesophyll. The specimen from Cocos Island (Prain *s.n.*, CAL), showed Gnarlyform sclereids. Thus from the above variations one could see that the dominating type within the specimens of one region is less common in the specimen examined from other regions in respect of *R. mucronata* Poir.

The similarity of sclereidal typology of the two species, namely *R. mucronata* Poir. and *R. latifolia* Miq. outweighs points of differences. Thus their synonymy holds well.

From the standpoint of the typology of sclereids and their surface distribution pattern the reduction of *R. conjugata* L. and *R. candelaria* DC. to a synonymy of *R. apiculata* Bl. holds well. Based on sclereidal features similar reasoning may be expressed in respect of *R. mangle* L. and *R. mangle* L. var. *racemosa* (Meyer) A. Engl. The distinct zosterosclereids of *R. racemosa*, however supports its specific status.

The erection of *R. mucronata* var. *stylosa* Griff. to a status of a species seems in an probability justified on sclereids typology. The varied typology of sclereids including the occurrence of zosterosclereids is very characteristic of *R. mucronata*. Whereas in *R. stylosa* the sclereids are mostly of ramiform to polyramous types and the occurrence of zosterosclereid has not been observed. Furthermore the recent descriptive account on *R. stylosa* supports the taxa as a distinct species (Tomlinson and Womersley 1976).

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