

A TAXONOMIC STUDY OF THE GENUS MATONIA (MATONIACEAE)

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SUMMARY

A morphological comparison shows that *Matonia* consists of two species, *M. foxworthyi* and *M. pectinata*, which are distinguished by a few characters including the number of pinnae and the presence/absence of hairs on the costae.

INTRODUCTION

Matonia is a small genus which together with *Phanerosorus*, with two species (Kato & Iwatsuki, 1985), constitutes the phylogenetically and systematically isolated family Matoniaceae (Andrews & Boureau, 1970; Kramer, 1990). A few species have been described under *Matonia*. *Matonia pectinata* was first described from the Malay Peninsula by R. Brown (Wallich, 1829) who established the genus *Matonia*. *Matonia sarmentosa* was a second species, described by Baker (1887) and later transferred to the genus *Phanerosorus* by Copeland (1908). *Matonia foxworthyi* was described from Sarawak by Copeland (1908). *Matonia* differs distinctly from *Phanerosorus* in its pedate leaves with a central pinna.

The species taxonomy of *Matonia* is not settled. Christensen & Holttum (1934) and Kramer (1990) doubted distinctness of *M. pectinata* and *M. foxworthyi*, and Parris et al. (1992) combined the two species into *M. pectinata*. Copeland (1908), Holttum (1968) and Tan & Tolentino (1987) regarded them as independent species. The differences in these treatments are due to different evaluation of whether the variation of diagnostic characters is continuous or discontinuous between the species (Christensen & Holttum, 1934). The most disputed character is the shape of pinna-segments: they are falcate in *M. pectinata* and only weakly so in *M. foxworthyi*. In an attempt to revise the taxonomy of *Matonia*, the author tested in the present study whether the two species are morphologically separable or not.

MATERIALS AND METHODS

The following 16 characters were measured using herbarium specimens: the thickness (excluding hairs) of the rhizomes, the length of the internodes, the length of the petioles, the thickness of the basal portion of the petioles, the length and width of the lamina, the number of pinnae (Fig. 1), the length and width of the central pinna, the distance between two adjacent costules, the projected length of pinna-segments on

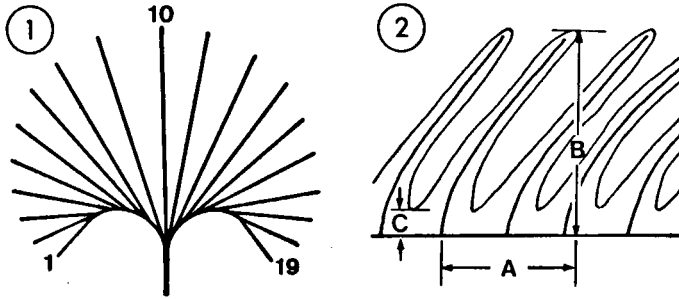


Fig. 1. Some of the characters examined. 1: Pedate ramification of leaf with 19 pinnae. 2: Part of pinna showing the projected length of pinna-segment on costa (A) and that on axis perpendicular to it (B) and the width of inter-segmental lamina (C).

the costa (A in Fig. 1) and that on the axis perpendicular to it (B), the width of the inter-segmental lamina (C), the diameter of the indusium, the width of the membranous indusial margin, and the number of indurated annulus cells of sporangia. The length of the pinna-segments relative to the width of the inter-segmental lamina (B/C) and the ratio of the two projected lengths of the pinna-segments (B/A) were evaluated based on these data. Spore size was also measured in two fully fertile specimens available of each species. Besides, the presence or absence of hairs on the costae was ex-

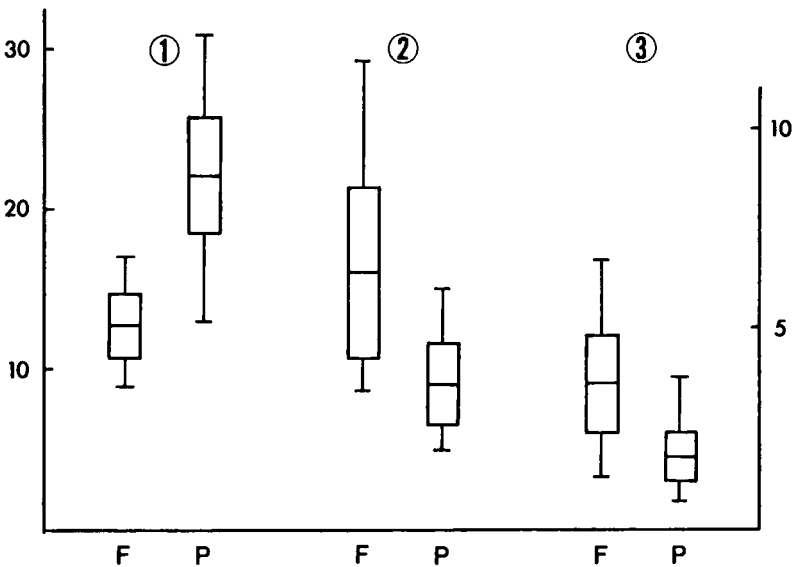


Fig. 2. Comparison of the three characters of *Matonia foxworthyi* vs. *M. pectinata*. Mean values, SD, maximum and minimum values are shown. 1: Number of pinnae. 2: Relative length of pinna-segments to width of inter-segmental lamina. 3: Ratio of projected lengths of pinna-segments. F, *Matonia foxworthyi*; P, *M. pectinata*. Data based on Table 1.

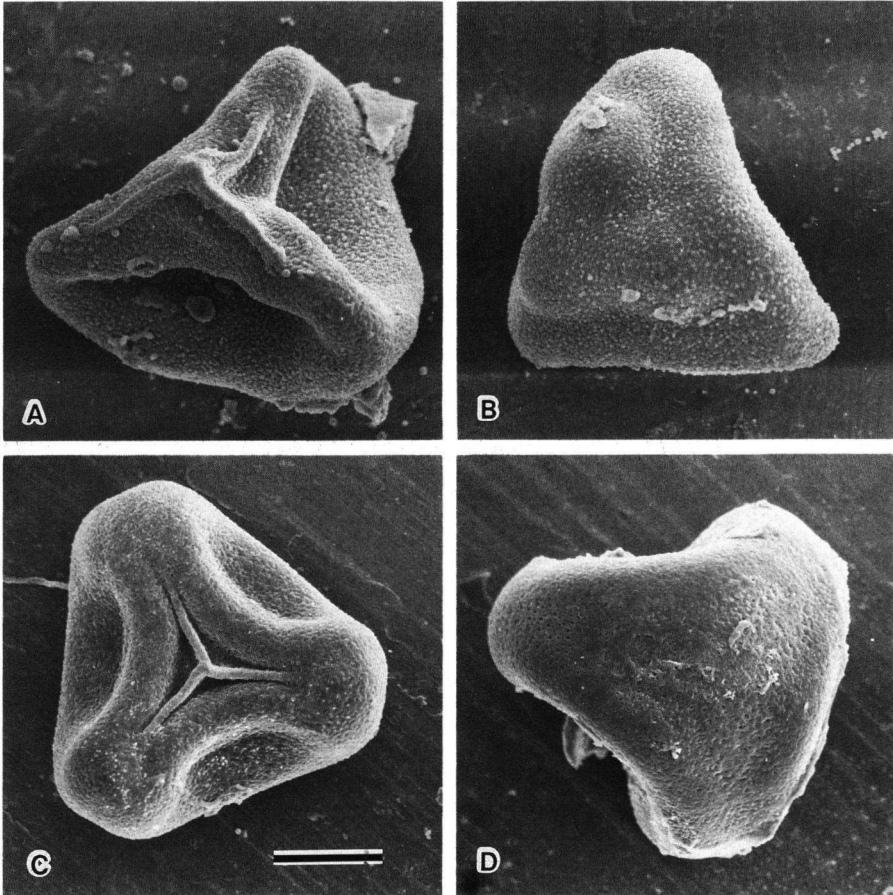


Fig. 3. SEM micrographs of spores. A, B: *Matonia foxworthyi* (Sarawak; Sinclair SFN 38365, K). C, D: *Matonia pectinata* (Malaya; Maingay 1975, L). A, C, proximal face; B, D, distal face. Scale bar = 20 μ m for all figures.

amined. The measurements are based on specimens kept in the following herbaria, B, BM, BO, GH, K, KYO, L, MICH, NY, P, SING, TI, U, UC, US, and Z.

Dried spores were coated with gold and observed in a scanning electron microscope (SEM) ABT-55 (14 kV).

RESULTS AND DISCUSSION

The results of measurements of the 18 characters are shown in Table 1. Although in 15 of the characters examined there are no apparent differences between *M. pectinata* and *M. foxworthyi*, significant differences (t-test, $p < 0.001$) are found in the

remaining three characters: the number of pinnae, the length of the pinna-segments relative to the width of the inter-segmental lamina and the ratio of the two projected lengths of the pinna-segments (Fig. 2). The present statistically tested data indicating that the pinnules of *M. pectinata* are more falcately oblique than those of *M. foxworthyi* accord with previous conclusions by Copeland (1909) and Tan & Tolentino (1987).

Another noteworthy character is the crisped, brown, multicellular hairs on the abaxial side of the costae. The hairs are usually present in *M. foxworthyi*, whereas they are lacking in *M. pectinata*. Rarely the old leaves of *M. foxworthyi* are glabrous and the young leaves of *M. pectinata* are hairy. The costal hairs of *M. foxworthyi* are an overlooked, taxonomically useful character (Tan & Tolentino, 1987).

The number of sporangia is 5–10 in one layer in each sorus in both species. The spores are $53 \pm 4 \mu\text{m}$ in diameter in *M. pectinata* (N = 64, 2 plants) and $61 \pm 5 \mu\text{m}$ in *M. foxworthyi* (N = 61, 2 plants). There appears to be a difference in spore size between the species, although a statistic comparison based on ample plants is needed. In both species the spores are tetrahedral and trilete, the three proximal facets being depressed and the distal one convex (Fig. 3), as described by Tryon & Lugardon (1991) for *M. pectinata*. The surface has granulate deposits, which are only slightly denser in *M. foxworthyi* than in *M. pectinata*.

These comparisons indicate that *M. pectinata* and *M. foxworthyi* are morphologically distinct from each other in a few characters, although the species are very similar in overall characters. Based on this evidence it is concluded that the two species are taxonomically distinct.

As described below, *M. pectinata* is distributed in the Malay Peninsula and Sumatra, while *M. foxworthyi* ranges from Borneo and the Philippines to the Moluccas and New Guinea. The distribution pattern suggests a geographical speciation in West Malesia. The range of *Matonia* is similar to that of *Phanerosorus*. *Phanerosorus sarmientosus* (Baker) Copel. occurs in West Malesia (Sarawak), while *P. major* Diels is distributed in East Malesia (Moluccas and New Guinea) (Kato & Iwatsuki, 1985), and thus the vicariance is in accord with the general floristic demarcation of Malesia (Van Steenis, 1950). The present range of Matoniaceae is a consequence of contraction from the much wider past range: Malesia is probably a refugium for this relict family. The fossils are known from scattered places in the Northern Hemisphere during the Upper Triassic and the Upper Cretaceous (Andrews & Boureau, 1970). The megafossils resemble *Matonia*.

KEY TO THE SPECIES

- 1a. Number of pinnae 15 or less, rarely up to 17; pinna-segments subpatent or oblique, straight or only moderately falcate; costae usually hairy beneath
 1. *M. foxworthyi*
- b. Number of pinnae 19 or more, rarely fewer in extremely small leaves; pinna-segments usually strongly oblique and falcate; costae glabrous beneath at maturity 2. *M. pectinata*

Table 1. Comparison of 18 characters between *Matonia foxworthyi* and *M. pectinata*.

Character	<i>M. foxworthyi</i>		<i>M. pectinata</i>	
	N	Mean \pm SD	N	Mean \pm SD
Rhizome thickness (mm)	30	5.8 \pm 1.4	20	6.4 \pm 1.4
Internode length (cm)	25	3.0 \pm 0.7	19	2.9 \pm 0.8
Petiole length (cm)	34	85.2 \pm 35.9	19	82.3 \pm 31.3
Petiole thickness (mm)	44	4.6 \pm 1.4	29	4.8 \pm 1.1
Lamina length (cm)	78	35.4 \pm 8.4	106	34.8 \pm 8.6
Lamina width (cm)	67	40.6 \pm 9.5	95	41.8 \pm 10.1
Number of pinnae	83	12.7 \pm 2.0*	100	22.1 \pm 3.6*
Length of central pinna (cm)	78	35.3 \pm 8.4	106	35.0 \pm 8.7
Width of central pinna (cm)	75	3.9 \pm 1.2	104	2.7 \pm 0.7
Distance of costules (mm)	79	5.3 \pm 0.8	106	5.4 \pm 0.7
Projected length of pinnules on costa (mm)	76	6.1 \pm 2.6	104	8.7 \pm 3.1
Projected length of pinna-segments on axis perpendicular to costa (mm)	76	19.8 \pm 5.7	103	14.0 \pm 3.7
Width of inter-segmental lamina (mm)	78	1.3 \pm 0.3	106	1.6 \pm 0.4
Indusium diameter (mm)	42	1.1 \pm 0.1	62	1.0 \pm 0.1
Width of membranous indusial margin (mm)	39	0.37 \pm 0.06	60	0.38 \pm 0.05
Number of annulus cells	33	18.7 \pm 2.5	31	19.3 \pm 2.1
Relative length of pinna-segments to width of inter-segmental lamina	76	16.0 \pm 5.4*	102	9.0 \pm 2.5*
Ratio of projected lengths of pinna-segments	76	3.6 \pm 1.2*	103	1.8 \pm 0.6*

*) Significantly different (t-test, $p < 0.001$).

1. *Matonia foxworthyi* Copel.

Matonia foxworthyi Copel., Philipp. J. Sci. 3C (1908) 343, pl. 2; Sarawak Mus. J. 2 (1917) 388; Alderw., Philipp. J. Sci. 11C (1916) 114; Christensen & Holttum, Gard. Bull. Str. Settl. 7 (1934) 223; Iwatsuki & Kato, Acta Phytotax. Geobot. 35 (1984) 61; Tan & Tolentino, Philipp. J. Sci. 116 (1987) 536, pl. 2. — Type: Borneo: Sarawak, Mt Poé (Rumpu), alt. 1700 m, *Foxworthy 372* (holo destroyed; iso MICH).

Distribution — Borneo (Sarawak, Sabah, Kalimantan), Philippines (Mindoro, Sibuyan), Moluccas (Ambon), New Guinea (Irian Jaya). New Guinean specimens (Vogelkop Peninsula, *Van Royen & Sleumer 7204*, L; Arfak Mts, *Kanehira & Hatu-sima 14039*, BO) have small leaves with 11 pinnae and hairy costae. One specimen (anonymous collector, BM) was collected from Mt Ophir, Malay Peninsula, where many specimens of *M. pectinata* were collected; detailed field observations and new collections are required.

Habitat — In open places, often in clearings, and in and at edge of mossy forest on mountain ridges or summits; altitude (420–)750–2100 m.

2. *Matonia pectinata* R. Br.

Matonia pectinata R. Br. in Wall., Pl. Asiat. Rar. 1 (1829) 16, t. 16; Bedd., Ferns Brit. Ind. 2 (1866) 186, pl. 186; Handb. Ferns Brit. Ind. (1883) 19, f. 8; Copel., Sarawak Mus. J. 2 (1917) 388; Holttum, Rev. Fl. Mal. 2nd ed., 2 (1968) 59, f. 13; Parris et al., Pl. Mt Kinabalu 1 (1992) 93, p. p., excl. specim. ex Kinabalu. — Type: Peninsular Malaysia: Malacca, Mt Ophir (at present Johor, G. Ledang), alt. 1200 m, *Farquhar* anno 1815.

Distribution — Malay Peninsula, Sumatra, Lingga Archipelago, Riau Archipelago. One specimen (*Lobb 481*, BM) was collected in Java but without indication of exact locality. The report from New Guinea (Tan & Tolentino, 1987) is perhaps due to misidentification.

Habitat — In exposed areas or in scrub on mountain ridges or summits; altitude (90–)750–2000 m.

ACKNOWLEDGEMENTS

I am grateful to Dr. H. Akiyama for his assistance with SEM examination, to Dr. K. Inoue for his assistance with statistics, and to the Directors of B, BM, BO, GH, K, KYO, L, MICH, NY, P, SING, U, UC, US, and Z for sending specimens on loan for my study. This study was supported in part by a Grant under the Monbusho International Scientific Research Program.

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