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SYSTEMATIC WOOD ANATOMY OF *HUBERIA*, *MICONIA* AND *TIBOUCHINA* (MELASTOMATACEAE)

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ABSTRACT

The wood anatomy of *Huberia consimilis*, *Miconia amoena*, *M. mirabilis*, *M. rimalis* and *Tibouchina francavillana* (Melastomataceae) is described and compared with other species from the same genera. All taxa share vestured pits, absent or inconspicuous growth rings, septate fibres, parenchyma-like tangential bands, and fibres shorter than 900 µm which is characteristic of the family Melastomataceae. Each species exhibited a set of wood anatomical characteristics that enabled its identification. Some traits were more relevant in distinguishing genera, such as composition of parenchyma-like tangential bands, vessel-ray pits, ray width, rays per millimetre and fibre length. Parenchyma-like tangential bands are described in great detail, and we propose a more specific nomenclature for their anatomical classification.

Keywords: Parenchyma-like tangential bands, fibre bands, fibre dimorphism.

INTRODUCTION

Melastomataceae are a pantropical family with approximately 150 genera and 4,500 species (Renner *et al*. 2013). In Brazil, Melastomataceae constitute the sixth largest angiosperm family (Goldenberg *et al*. 2012), currently comprising approximately 67 genera and 1,320 species, 851 of which are endemic (Baumgratz *et al*. 2013). The members of this family are widely distributed and found in all Brazilian phytogeographic domains; however, they are most frequently found in the Atlantic Forest, the Amazon and Cerrado regions (including rocky formations) (Goldenberg 2000; Baumgratz *et al*. 2013).

The three studied genera belong to the subfamily Melastomatoideae and to three distinct tribes: Merianieae (*Huberia*), Miconieae (*Miconia*) and Melastomeae (*Tibouchina*).

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With this study we add to the wood anatomical knowledge of some Melastomataceae species from Bahia (Brazil), with special attention to the nature of their alternating tangential bands of fibres and parenchyma.

MATERIALS AND METHODS

Collections were carried out in stretches of the Atlantic Forest in Serra da Jiboia, a municipality of Elísio Medrado in the state of Bahia, Brazil, located at 12º 51' 49" S and 39º 28' 33" W coordinates. Part of the study area belongs to the Jequitibá Reserve. The vegetation is a montane forest. The climate is classified as sub-humid tropical, transitional and warm, with an average annual temperature higher than 18 ºC (Lomanto Neto 2002). The average annual rainfall is 1,278 mm (Silva 2013).

Five species were selected for this study. The criterion for inclusion in the study was a minimum number of 3 trunks that were greater than 6 cm in diameter at breast height (DBH) (Table 1). Healthy specimens with a straight trunk were selected. As all collections took place in a hillside region with often steep slopes, the samples were collected on the side of the tree facing the higher-located area. Trunks were sampled non-destructively according to Silva (2013).

Table 1. The selected Melastomataceae species of Serra da Jiboia with the respective accession numbers of each sample in the Xylarium Professor José Pereira de Sousa (PJPSw) and diameter at breast height (DBH).

Species	Nº (PJPSw)	DBH (cm)
Huberia consimilis Baumgratz	101, 102, 107	56.66; 51.57; 14.96
Miconia amoena Triana	093, 377, 378	10.50; 6.37; 7.64
Miconia mirabilis (Aubl.) L.O. Williams	360, 361, 362	23.24; 19.10; 15.92
Miconia rimalis Naudin	046, 075, 108, 374, 375	35.33; 31.20; 25.15; 18.14; 20.05
Tibouchina francavillana Cogn.	366, 367, 368	18.46; 18.78; 64.62

Macerations were prepared from samples near the bark according to Franklin (1945, modified by Kraus & Arduin 1997) for subsequent measurement of the fibre and vessel elements lengths.

From the macerations, fibres (length, width, lumen and pits) and vessel elements (length, width and pits) were measured (n = 25 for all parameters measured). Vessel density per mm^2 was measured in cross sections with a minimum area of 32.50 mm^2. The radial diameter and wall thickness of 30 cells within the parenchyma-like tangential bands and ground tissue were measured. Ray size and frequency were determined from tangential sections. The vessel density measurements were performed using ANATI QUANTI® software (Aguiar *et al*. 2007). The measurements of rays per millimetre and cells of parenchyma-like tangential bands and ground tissue were performed using the AxioVision 4.8® program. The microphotographs were captured with a Zeiss Axio ScopeA1® photomicroscope. The remaining measurements were carried out using an Olympus CX40® microscope with ocular micrometer. The anatomical description followed standards proposed by the IAWA Committee (1989 [Wheeler *et al*.]).

To compare measurements of radial diameter, wall thickness and radial diameter/wall thickness ratios in cells of parenchyma-like tangential bands and ground tissue, the normality of samples was verified with the Shapiro-Wilk test. The Mann-Whitney test for independent samples was used because some datasets did not have a normal distribution even after Box-Cox and logarithmic transformations. The analyses were performed using PAST 3.01® software.

RESULTS

Wood anatomical descriptions (for most quantitative data see Table 2)

Huberia consimilis Baumgratz (Fig. 1A, C, E; Table 2).

Growth ring boundaries faint, marked by thick-walled and radially flattened latewood fibres. Vessels diffuse; solitary and in radial multiples of 2–3 (solitary 36–48 %, radial

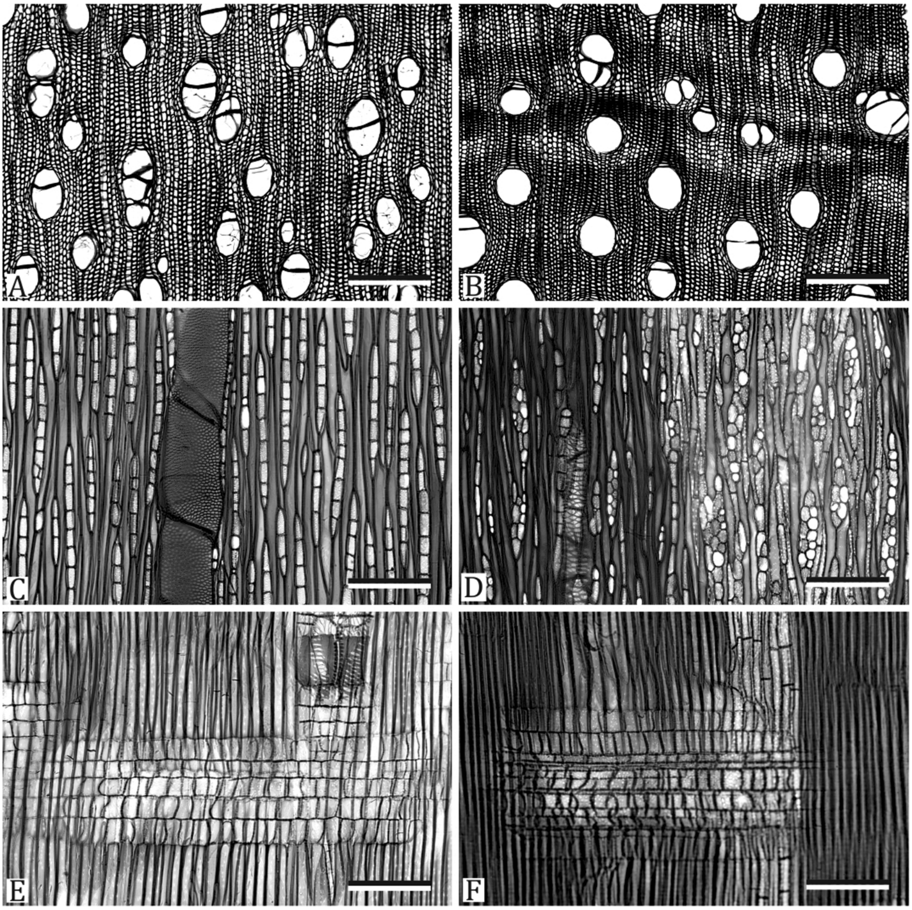

Figure 1. The wood anatomy of *Huberia consimilis* (A, C, E) and *Tibouchina francavillana* (B, D, F). A & B: Cross section. – C & D: Tangential section. – E & F: Radial section. — Scale bars: A–B = 400 μm, C–F = 200 μm.

Table 2. The quantitative characteristics of the wood anatomy of the selected Melastomataceae species of Serra da Jiboia. Mean ± standard deviation.

Anatomical characteristics / Species	Vessels					Fibres				Rays				
	V/mm^2	L (µm)	D (µm)	IVPS (µm)	VRPS (µm)	L (µm)	D (µm)	WT (µm)	PS (µm)	H (mm)	H (CN)	W (µm)	W (CN)	R / mm
Huberia consimilis	11 ± 2	698 ± 154	168 ± 35	8 ± 2	20 ± 7	913 ± 117	33 ± 5	5 ± 1	5 ± 1	0.5 ± 0.2	10 ± 5	25 ± 8	1 ± 0.4	11 ± 2
Miconia amoena	19 ± 6	576 ± 159	92 ± 19	4 ± 1	–	779 ± 129	22 ± 3	7 ± 1	5 ± 1	0.6 ± 0.4	12 ± 7	16 ± 5	1 ± 0.1	12 ± 1
Miconia mirabilis	9 ± 2	896 ± 278	149 ± 44	7 ± 4	19± 9	1.374 ± 58	58 ± 16	15 ± 7	10 ± 2	0.9 ± 0.4	18 ± 8	29 ± 7	1 ± 0.4	12 ± 1
Miconia rimalis	17 ± 4	580 ± 132	150 ± 34	4 ± 1	–	806 ± 119	26 ± 4	6 ± 2	5 ± 1	0.6 ± 0.3	17 ± 9	20 ± 7	1 ± 0.5	16 ± 2
Tibouchina francavillana	8 ± 1	639 ± 164	138 ± 42	7 ± 4	16 ± 6	980 ±137	28 ± 4	7 ± 2	7 ± 2	0.5 ± 0.1	16 ± 4	37 ± 12	2 ± 0.5	8 ± 1

Abbreviations of anatomical features: CN = cell number; D = diameter; H = height; IVPS = intervessel pit size; L = length; µm = micrometre; mm = millimetre; PS = pit aperture size; R / mm = rays per millimetre; V/mm^2 = vessels per square millimetre; VRPS = vessel-ray pit size; W = width; WT = wall thickness.

Table 3. Anatomical characteristics of parenchyma-like tangential bands and ground tissue of the selected Melastomataceae species of Serra da Jiboia.

Anatomical characteristics / Species	Parenchyma-like tangential bands								Ground tissue (fibres)				
	Distinction	Distribution*	Cellular composition	Thin-walled	Prominent lumina	Intercellular spaces present	Distended rays	Shape of cells	Thick-walled	Reduced lumina	Intercellular spaces absen	Radially flattened	Shape of cells
Huberia consimilis	BHV	T/D2-(4)-8	F	+	+	+	+	RN	+	+	+	+	SRP
Miconia amoena	RVW	T/D1-(3)-5	F + PC	+	+	+	–	RN	+	+	+	+	SRP
Miconia mirabilis	VPB	T/D1-(3)-5	F + PC	+	+	+	–	RN	+	+	+	+	SRP
Miconia rimalis	RVW	T/D3-(5)-7	F + PC	+	+	+	–	RN	+	+	+	+	SRP
Tibouchina francavillana	VPB	T/D3-(6)-12	F + PC	+	+	+	–	RN	+	+	+	+	SRP

Abbreviations of anatomical features: BHV = bands hardly visible; F = fibre; PC = parenchyma cells; RN = rounded; RVW =bands rather vague but well-visible; SRP = square, rectangular and / or polygonal; T/D = tangential and / or diagonal bands; VPB = very pronounced bands. * Width in number of cells.

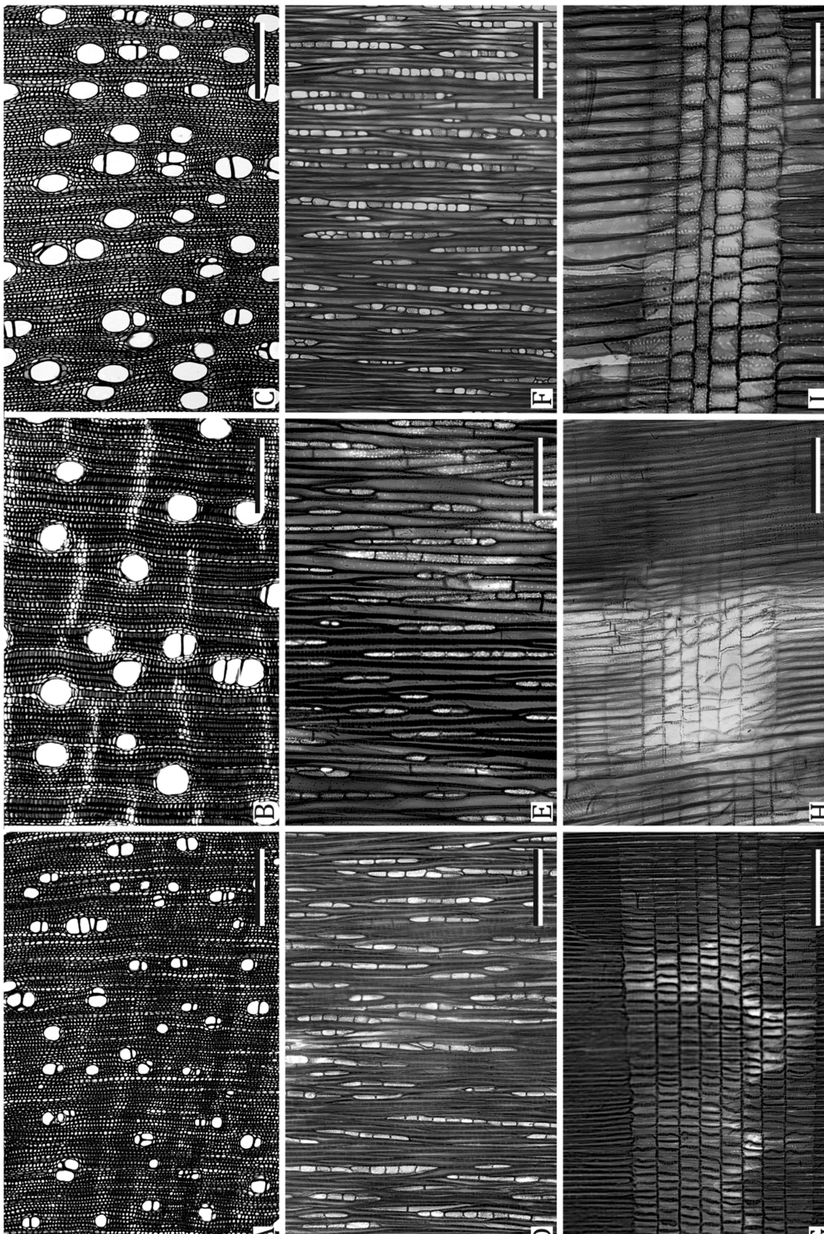

Figure 2. The wood anatomy of *Miconia amoena* (A, D, G), *M. mirabilis* (B, E, H) and *M. rimalis* (C, F, I). – A–C: Cross section. – D–F: Tangential section. – G–I: Radial section. — Scale bars: A–C = 400 µm, D–H = 200 µm, I = 100 µm.

multiples of two 41–50 %, of three 7–10 %), rarely in radial multiples of 4–5; simple perforation plates; intervessel pits alternate, polygonal, vestured; vessel-ray pitting with much reduced borders to apparently simple, rounded, horizontal and vertical; helical thickenings present only in narrower vessel elements; tyloses commonly present. Fibres very thin-walled; with simple to minutely bordered pits in both tangential and radial walls, being more abundant in the radial walls; septate and nonseptate fibres present; parenchyma-like fibre bands alternating with ordinary fibres; some fibres have deposits. Axial parenchyma absent or extremely rare. Rays uniseriate, occasionally 2-seriate and then 2-seriate portion(s) as wide as uniseriate portions; all ray cells upright and/or square. Rays and axial elements nonstoried. Pith flecks occasionally present. In one sample insect eggs were found associated with wood cells (in fibres, ray cells and vessel elements).

Miconia amoena Triana (Fig. 2A, D, G; Table 2)

Growth ring boundaries faint, marked by thick-walled and radially flattened latewood fibres. Vessels diffuse; solitary and radial multiples of 2–3 (solitary 33–39 %, radial multiples of two 36–52 %, of three 14–18 %); rarely in radial multiples of four; simple perforation plates; intervessel pits alternate, vestured; vessel-ray pitting similar to intervessel pits. Fibres thin- to thick-walled; with simple to minutely bordered pits in both tangential and radial walls, being more abundant in the radial walls; septate and nonseptate fibres present; parenchyma-like tangential bands with fibres and parenchyma mixed throughout alternating with ordinary fibres. Axial parenchyma scanty paratracheal; in 2(–4)–7 cells per parenchyma strand. Rays uniseriate, occasionally 2-seriate and 2-seriate portion(s) as wide as uniseriate portions; all ray cells upright and/or square. Rays and axial elements nonstoried.

Miconia mirabilis (Aubl.) L.O.Williams (Fig. 2B, E, H; Table 2)

Growth ring boundaries distinct, marked by thick-walled and radially flattened latewood fibres. Vessels diffuse; solitary and in radial multiples of 2–3 (solitary 44–58 %, radial multiples of two 22–39 %, of three 12–18 %), rarely in clusters or radial multiples of 4–5; simple perforation plates; intervessel pits alternate, vestured; vessel-ray pitting with much reduced borders to apparently simple, rounded, horizontal and vertical; tyloses commonly present. Fibres thin- to thick-walled; with simple to minutely bordered pits in both tangential and radial walls; septate and nonseptate fibres present; parenchyma-like tangential bands with fibres and parenchyma mixed throughout, alternating with ordinary fibres. Axial parenchyma scanty paratracheal; in 2(–4)–6-celled strands. Rays uniseriate, occasionally 2-seriate and then 2-seriate portion(s) as wide as uniseriate portions; all ray cells upright and/or square. Pith flecks present. Druses present.

Miconia rimalis Naudin (Fig. 2C, F, I; Table 2)

Growth ring boundaries faint to distinct, marked by thick-walled and radially flattened latewood fibres. Vessels diffuse, solitary and in radial multiples of 2–3 (solitary 35–62 %, radial multiples of two 33–40 %, of three 4–21%), rarely in radial multiples of 4–6; simple perforation plates; intervessel pits alternate, vestured; vessel-ray pitting similar to intervessel pits. Fibres thin- to thick-walled; with simple to minutely bordered pits in both tangential and radial walls, being more abundant in the radial walls; septate and nonseptate fibres present; parenchyma-like tangential bands with fibres and parenchyma mixed throughout alternating with ordinary fibres. Axial parenchyma scanty paratracheal; in 4(–5)–10-celled strands. Rays uniseriate, 2-seriate and then 2-seriate portion(s) as wide as uniseriate portions; with procumbent, square and upright cells mixed throughout the ray. Rays and axial elements nonstoried. Druses present in axial parenchyma cells.

Tibouchina francavillana Cogn. (Fig. 1B, D, F; Table 2)

Growth ring boundaries distinct, marked by thick-walled and radially flattened latewood fibres and/or lines of marginal parenchyma. Vessels diffuse; solitary and in radial multiples of 2–3 (solitary 39–45%, radial multiple of two 47–51%, of three 9–10%), occasionally in radial multiples of 4–6; simple perforation plates; intervessel pits alternate, polygonal, vestured; vessel-ray pitting with much reduced borders to apparently simple, pits rounded and horizontal. Fibres thin- to thick-walled; with simple to minutely bordered pits in both tangential and radial walls, being more abundant in the radial walls; septate and nonseptate fibres present; parenchyma-like tangential bands with fibres and parenchyma mixed throughout alternating with ordinary fibre bands. Axial parenchyma scanty paratracheal; fusiform and in 2–4-celled strands. Rays uniseriate and 2- to 4-seriate, occasionally uniseriate parts as wide as 2- to 4-seriate portions; with procumbent, square and upright cells mixed throughout the ray. Rays and axial elements nonstoried. Pith flecks occasionally present.

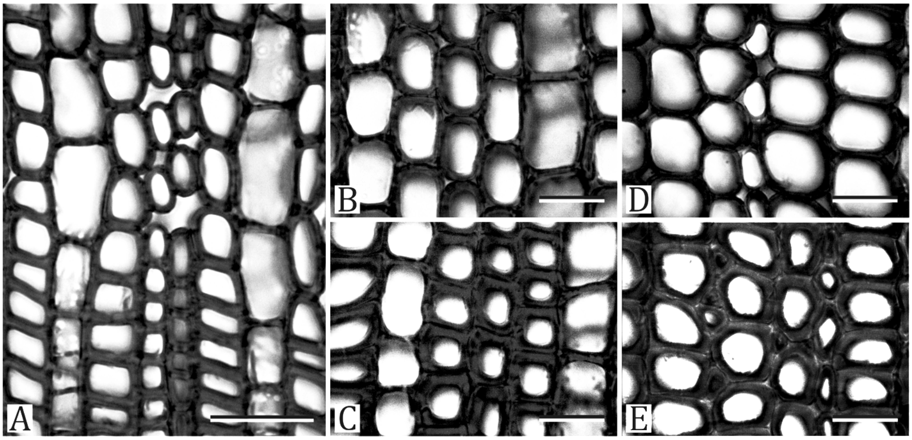

Figure 3. Comparison between the parenchyma-like tangential bands and ground tissue of *Huberia consimilis* (A), *Miconia rimalis* (B, C) and *Tibouchina francavillana* (D, E). – Note the difference between the outer contour and the wall thickness of cells from both tissues. – A: *H. consimilis*, transition between ground tissue (below) and parenchyma-like tangential bands (parenchyma-like fibre bands alternating with ordinary fibres - above); note the dilated rays and the large intercellular spaces. Parenchyma-like tangential bands (B–D) and ground tissue (C–E). — Scale bars: A = 50 μm, B–E = 25 μm.

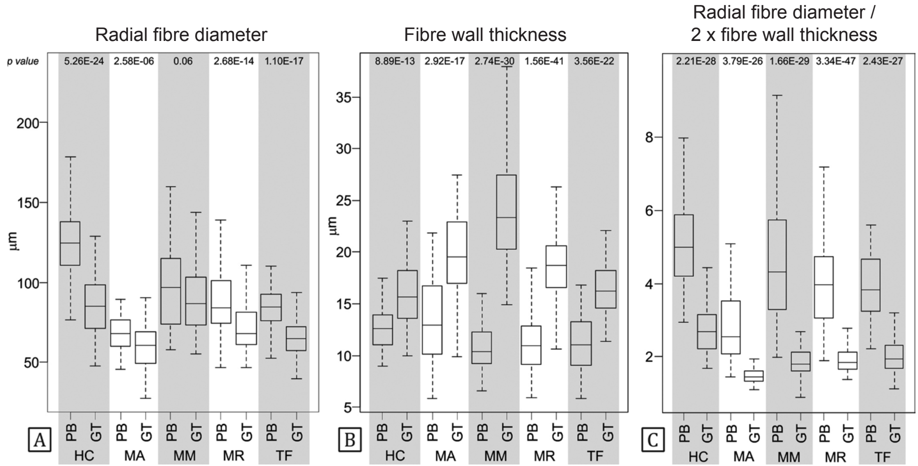

Figure 4. Comparison of cell measurements from ground tissue (GT) and parenchyma-like tangential bands (PB) in *Huberia consimilis* (HC), *Miconia amoena* (MA), *M. mirabilis* (MM), *M. rimalis* (MR) and *Tibouchina francavillana* (TF). Using the Mann-Whitney test, *p*-values below 0.05 were considered significant.

A detailed anatomical characterization of parenchyma-like bands and ground tissue is shown in Table 3 (Fig. 3, 4). The measurements of radial diameter (RD), wall thickness (WT) and the RD/WT ratio of cells in the parenchyma-like tangential bands all differed significantly from values in the ground tissue fibres, except for RD in *Miconia mirabilis* cells (Fig. 4A).

All species of the same genera that were qualitatively compared (ter Welle & Koek-Noorman 1981; ter Welle & Détienne 1993; Barros & Callado 1997; Marcon & Costa 2000; Sonsin *et al*. 2012; InsideWood 2013), including those described in this study, exhibited simple perforation plates, intervessel pits alternate and vestured, fibres with simple to minutely bordered pits and non-storied rays and axial elements. A high frequency (greater than 75 %) was observed for the following characteristics: absent or inconspicuous growth rings, diffuse porosity, average vessel element length between 350–800 µm, presence of septate fibres, parenchyma-like tangential bands, average fibre length smaller than 900 µm and more than 12 rays per millimetre.

DISCUSSION

Wood anatomy shows significant plasticity and homoplastic tendencies that are often revealed in ecological tendencies, convergence of certain anatomical features associated with specific biomes, and latitudinal and altitudinal gradients. Despite this limitation, several taxa may have combinations of typical microscopic anatomical features (Baas *et al*. 2000).Vestured pits, absent or inconspicuous growth rings, presence of septate fibres, parenchyma-like tangential bands, an average fibre length less than 900 µm and usually more than 12 rays per millimetre were found to be characteristicfor Melastomataceae (ter Welle & Koek-Noorman 1981; ter Welle & Détienne 1993; Barros &

Callado 1997; Marcon & Costa 2000; Sonsin *et al*. 2012; InsideWood 2013). Other characteristics that showed high frequencies have a wide distribution in angiosperms, giving these features a reduced systematic value (Wheeler *et al*. 2007).

Parenchyma-like tangential bands in Melastomataceae

The term "parenchyma-like tangential bands" was proposed by ter Welle and Koek-Noorman (1978) about these bands in *Miconia* (actually, this terminology was used first by Janssonius, in 1908). The bands are composed of parenchyma strands, fusiform parenchyma cells and fibres, and also occur in some other genera of Melastomataceae, as well as in other families that belong to the Myrtales and several other orders. According to the authors, intermediate forms between parenchyma cells and fibres can occur.

Fibre dimorphism, another term often used in this case, in the usual sense was regarded as the coexistence of zones of wide, thin-walled, shorter fibres and zones of narrower, longer, thicker-walled fibres, and corresponds to a great extent to parenchyma-like fibre bands. However, Carlquist (2014) extended this concept and included other categories in fibre dimorphism. Besides lumen diameter, wall thickness, cell shape and fibre length, the following character states were also included: gelatinous/non-gelatinous, living/dead, crystalliferous/non-crystalliferous, storied/non-storied, transitional fibres, and imperforate tracheary elements with or without intercellular spaces between them. Parenchyma-like tangential bands were considered by Carlquist as just one kind of fibre dimorphism.

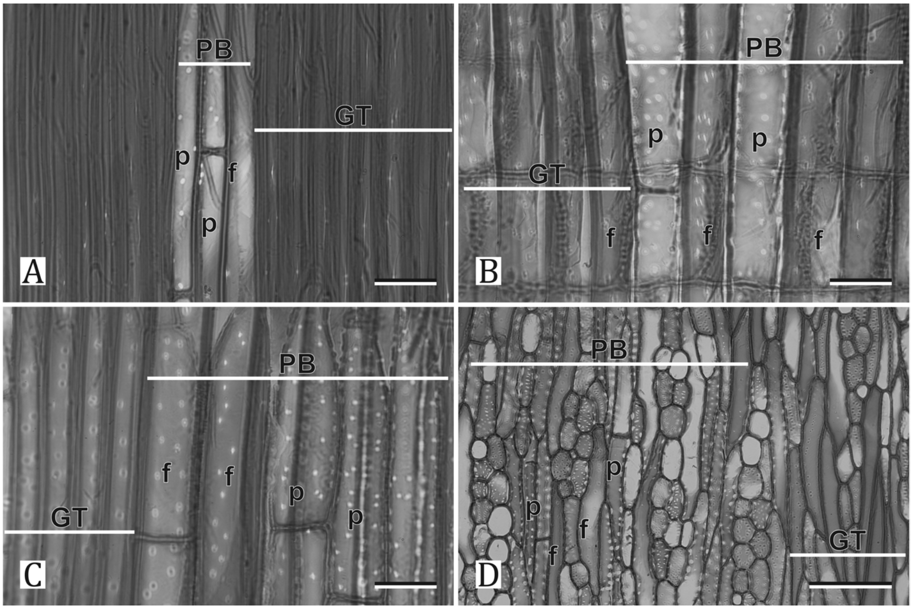

Figure 5. Parenchyma-like tangential bands (PB) and ground tissue (GT) of *Miconia amoena* (A), *M. mirabilis* (B), *M. rimalis* (C) and *Tibouchina francavillana* (D). Note the fibre width (f) and parenchyma cells (p) in the parenchyma-like tangential bands. Radial section (A–C) and tangential section (D). — Scale bars: A–C = 30 µm, D = 100 µm.

Parenchyma-like tangential bands occur widely in the Melastomataceae (ter Welle & Koek-Noorman 1978; van Vliet 1981; ter Welle & Koek-Noorman 1981; ter Welle & Détienne 1993; Barros & Callado 1997; Marcon & Costa 2000; InsideWood 2013) and are present in a limited number of families (Carlquist 2014; IAWA Committee 1989 [Wheeler *et al*.]). The general definition proposed by the IAWA Committee does not account for the large variation observed in the cell composition, distinction and distribution of these bands. Many species of Melastomataceae have varying amounts of fibres and parenchyma cells in the parenchyma-like tangential bands (ter Welle & Koek-Noorman 1978; ter Welle & Koek-Noorman 1981) and would be mistakenly described as "parenchyma-like fibre bands alternating with ordinary fibres" (Fig. 5).

We propose a new and more detailed classification to this wood anatomical feature in Melastomataceae to allow for more precise recording of the wood structural diversity in this family, and hopefully to improve the possibilities of wood identification:

1. Parenchyma-like tangential bands present
   1.1. Parenchyma-like fibre bands alternating with ordinary fibres
   1.2. Parenchyma-like tangential bands with fibres and parenchyma mixed throughout alternating with ordinary fibres

Parenchyma-like tangential bands can be characterized in contrast with the ground tissue by analyzing certain cell details in each tissue, such as wall thickness, total fibre diameter to lumen diameter ratio, and intercellular spaces (ter Welle & Koek-Noorman 1978; ter Welle & Koek-Noorman 1981; van Vliet 1981). In this study, we added the presence of dilated rays, the outer contour of the cells and radial flattening (Table 3). The distinction of the parenchyma-like tangential bands is due to differences in wall thickness and the radial diameter of these cells compared to the ground tissue in the species studied here (Fig. 3–5).

Septate fibres can play the same functional role as axial parenchyma, and the absence or small amount of the latter is often associated with the presence of the former (Alves & Angyalossy-Alfonso 2002; Wheeler *et al*. 2007).

The presence or combination of certain characteristics allowed the separation of 3 genera in this study. Species of *Huberia* showed parenchyma-like tangential bands formed only by fibres. *Huberia* and *Tibouchina* did not show vessel-ray pits similar to the intervessel pits, a characteristic that is common in *Miconia*. Exclusively uniseriate rays and more than 12 rays per millimetre were found in *Miconia* and *Huberia*, and *Tibouchina* showed rays that were 1–3 cells wide, with 4–12 rays per millimetre.

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REFERENCES

Aguiar TV, Sant'anna-Santos BF, Azevedo AA & Ferreira RS. 2007. ANATI QUANTI: Software de análises quantitativas para estudos em anatomia vegetal. Planta Daninha 25: 649–659.

Alves ES & Angyalossy-Alfonso V. 2002. Ecological trends in the wood anatomy of some Brazilian species. 2. Axial parenchyma, rays and fibres. IAWA J. 23: 391–418.

Baas P, Wheeler E & Chase M. 2000. Dicotyledonous wood anatomy and the APG system of angiosperm classification. Bot. J. Linn. Soc. 134: 3–17.

Barros CF & Callado CH [org.]. 1997. Madeiras da Mata Atlântica – Anatomia da lenho de espécies ocorrentes nos remanescentes florestais do Estado do Rio de Janeiro – Brasil. Jardim Botânico do Rio de Janeiro, Rio de Janeiro.

Baumgratz JFA, Rodrigues KF, Chiavegatto B, Goldenberg R, Guimarães PJF, Kriebel R, Martins AB, Michelangeli FA, Reginato M, Romero R, Souza MLDR, Woodgyer E & Caddah MK. 2013. Melastomataceae *in* Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB1619. Accessed 22 August 2013.

Carlquist S. 2014. Fibre dimorphism: cell type diversification as an evolutionary strategy in angiosperm woods. Bot. J. Linn. Soc. 174: 44–67.

Goldenberg R. 2000. O gênero *Miconia*. Ruiz & Pav. (Melastomataceae): I. Listagem analítica, II. Revisão taxonômica da Seção *Hypoxanthus*. Dissertation, Universidade Estadual de Campinas.

Goldenberg R, Baumgratz JFA & Souza MLDR. 2012. Taxonomia de Melastomataceae no Brasil: retrospectiva, perspectivas e chave de identificação para gêneros. Rodriguésia: 63: 145–161.

IAWA Committee (eds. Wheeler EA, Baas P & Gasson PE). 1989. IAWA List of microscopic features for hardwood identification. IAWA Bull. n.s. 10: 219–332.

InsideWood. 2013. Published on the Internet. http://insidewood.lib.ncsu.edu/search. Accessed 1 October 2013.

Kraus JE & Arduin M. 1997. Manual básico de métodos em morfologia vegetal. EDUR, Rio de Janeiro.

Lomanto Neto R. 2002. Caracterização da degradação e resposta de pastagens com *Brachiaria decumbens* Stapf, à interação N:P na região de Amargosa-BA. Dissertation, Universidade Federal da Bahia.

Marcon ML & Costa CG. 2000. Anatomia da madeira de quatro espécies do gênero *Miconia* Ruiz & Pavón (Melastomataceae). Rodriguésia 51: 5–20.

Renner SS, Triebel D, Almeda F, Stone D, Ulloa CU, Michelangeli FA, Goldenberg R & Cifuentes HM. 2013. Melastomataceae. Net: a site with information on the biodiversity of Melastomataceae. http://www.melastomataceae.net/. Accessed 15 August 2013.

Silva MS. 2013. Anatomia ecológica e potencial econômico da madeira de espécies nativas da Mata Atlântica, Serra da Jiboia, Bahia, Brasil. Dissertation, Universidade Estadual de Feira de Santana.

Sonsin JO, Gasson PE, Barros CF & Marcati CR. 2012. A comparison of the wood anatomy of 11 species from two cerrado habitats (cerrado *s.s.* and adjacent gallery forest). Bot. J. Linn. Soc. 170: 257–276.

ter Welle BJH & Koek-Noorman J. 1978. On fibres, parenchyma and intermediate forms in the genus *Miconia* (Melastomataceae). Acta Bot. Neerl. 27: 1–9.

ter Welle BJH & Koek-Noorman J. 1981. Wood anatomy of the Neotropical Melastomataceae. Blumea 27: 335–394.

ter Welle BJH & Détienne P. 1993. Wood and timber. In: Görts-Van Rijn ARA (ed.), Flora of the Guianas 99. Melastomataceae: 337–363. Koeltz Scientific Books, Konigstein.
van Vliet GJCM. 1981. Wood anatomy of the palaeotropical Melastomataceae. Blumea 27: 395–462.
Wheeler EA, Baas P & Rodgers S. 2007. Variations in dicot wood anatomy: a global analysis based on the InsideWood database. IAWA J. 28: 229–258.

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