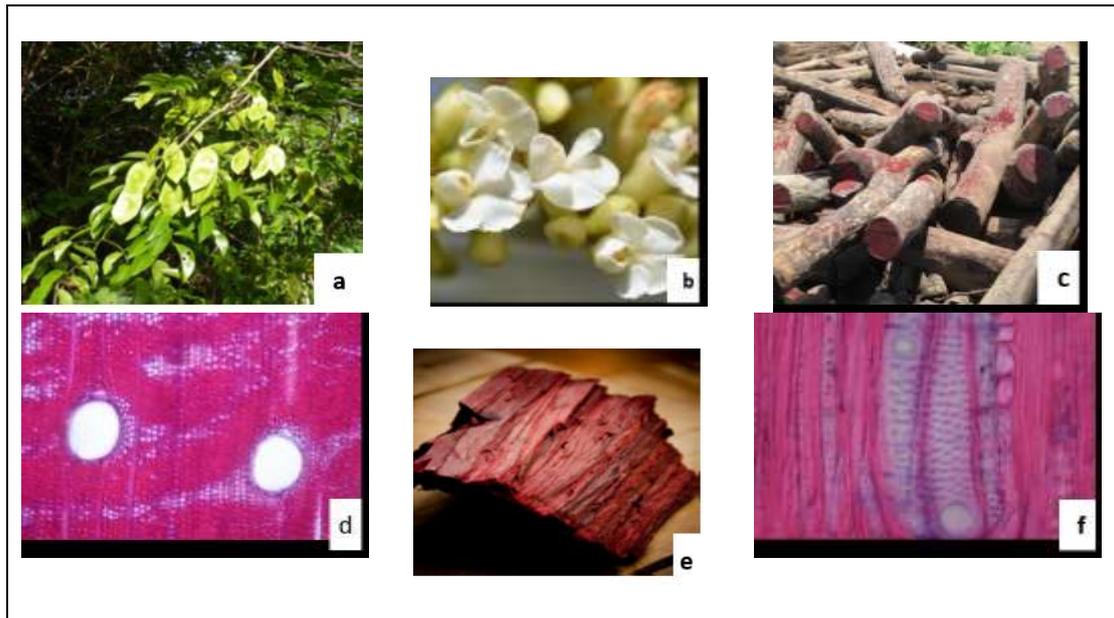




FINAL REPORT



Stem Anatomy of *Dalbergia* and *Diospyros* from Madagascar
With Special a Focus on Wood Identification

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Photos on the cover:

- a) *Dalbergia greveana* fruit
- b) *Dalbergia* flowers
- c) Rosewood logs
- d) *Dalbergia mollis* cross section
- e) *Dalbergia louvelii* heartwood

Acknowledgments

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I wish to thank my family, Rivo, Diary and Emily, for their patience and support.

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Bako Harisoa Ravaomanalina

INTRODUCTION

Wood anatomy has a major role in law enforcement to help protecting endangered tree species from illegal logging and to support the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which restricts international trade in endangered species. Madagascar is home for two commercially important precious woods: rosewood and palisander occurring in *Dalbergia* and ebonies in *Diospyros* species, populations of Madagascar, recently listing on Appendix II.

The international scope of the trade in precious woods necessitates that countries manage and enforce trade regulations and international agreements concerning these species, such as the Convention on international Trade in Endangered Species of Wild fauna and Flora (CITES). Although many precious woods are protected by CITES, the ability of the Parties (member countries of the Convention) to regulate their trade is impacted by the lack of designed to assist both with identifying CITES-listed Malagasy precious wood, and distinguishing them from those taxa are not listed.

Nowadays, controlling the international trade with illegally logged timber from Madagascar is currently not feasible because species identification and provenance assignment are not possible from logs (where morphological traits used in species identification such as flowers, bark and fruits have been removed).

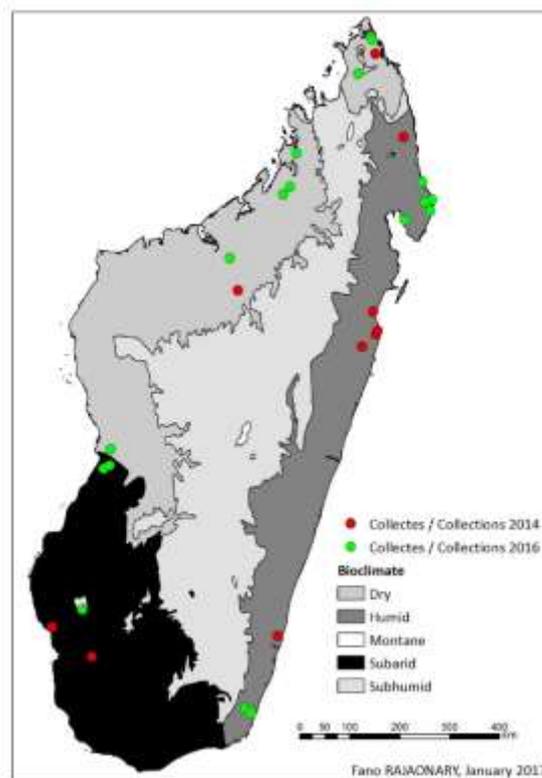
The aim is to contribute to control the legacy of precious wood trading by proper identification. This project tries to bring an overview of all Malagasy *Dalbergia* and *Diospyros* and look-alike wood anatomical descriptions intending by the international scientific community working on identification of these two genera. It tries to complete the existing work on (1) these genera “*Stem anatomy of Dalbergia and Diospyros from Madagascar, with a special focus on species identification*” (Ravaomanalina et al., 2017) by including more samples per species producing replicates for validation and many species as possible in the analysis and by including look-alike species of *Dalbergia* and *Diospyros* into the future identification system for both genera (Rakoto Joseph et al, 2016).

In order to allow reliable assignment of logs to species and provenance, a high quality reference database is a key. For this project, anatomical description priority was given for specimens where morphological traits used in species identification such as flowers, bark and fruits. We hope this publication will be the first comprehensive guide to the identification of Malagasy *Dalbergia* and *Diospyros*. The target audience is enforcement officers (eg: wildlife inspectors, customs inspectors etc...) that are responsible on the international trade in precious woods primarily, but not exclusively CITES. In addition, this guide will be available to forest managers and scientists who are involved with conservation of timber resources. This includes scientific, management and enforcement authorities in the areas occurrence of both genera.

2. Materials and Methods

2.1. Origin of the material studied

In addition to the plant material carried out in July 2013 and January 2014, material was added in order to include more samples per species and producing replicates for validation and many species as possible in the analysis. The sampling sites are indicated on the bioclimatic map. All the species were collected in their natural habitat. General botanical information were carried out by Missouri Botanical Garden Madagascar (2014, 2016). Data distributions were derived from the Catalogue of Vascular Plant of Madagascar (www.tropicos.org). Consequently, database concerning_additional_specimens used in the atlas second version are available on the same web site. Herbarium specimens of the presented material can be consulted at the international herbaria TAN, Missouri (MBG), Paris (MNHN) and Zürich (Botanical Garden) while wood specimens were available from wood collection of Plant anatomy lab in Antananarivo (LABAP). Macroscopic description and look-alike species to *Dalbergia* and *Diospyros* have been added into this project. This intermediate report shows only the descriptions from *Dalbergia* specimens. Species and their duplicates are summarized on the Table. Ecological conditions of the natural habitat as elevation, vegetation and bioclimate are extremely useful for the identification. The presence of the species on protected areas and other important sites contributes to the protection of these precious woods. The origin of the sampled species is always mentioned on the distribution map.



Sampling sites of Malagasy *Dalbergia* and *Diospyros* species.

Table 1. Descriptive information on *Dalbergia* samples analysed. 1) Number of species, 2) Scientific name; asterisks indicate species not exploited (liana or shrub); 3) Plant Author name; 4) General locality of sampling; 5) Forest type from which the plant was sampled; 6) Number of duplicates.

N°	Species	Author	Locality	Forest type	Duplicates
1	<i>Dalbergia orientalis</i>	Bosser et R. Rabev.	East	Humid	15
2	<i>Dalbergia louvelii</i>	R.Vig.	East	Humid	14
3	<i>Dalbergia greveana</i>	Baill.	West	Dry Decidious	10
4	<i>Dalbergia madagascariensis</i>	Vatke	East	Humid	5
5	<i>Dalbergia purpurascens</i>	Baill.	West	Dry Decidious	4
6	<i>Dalbergia mollis</i>	Bosser et R. Rabev.	West	Dry Decidious	4
7	<i>Dalbergia maritima</i>	R.Vig.	East	Humid	4
8	<i>Dalbergia emirnensis</i>	Benth.	West	Dry Decidious	3
9	<i>Dalbergia suaresensis</i>	Baill.	North	Dry Decidious	3
10	<i>Dalbergia chapelieri</i>	Baill.	East	Humid	3
11	<i>Dalbergia chlorocarpa</i>	R. Vig.	West	Dry Decidious	3
12	<i>Dalbergia tricolor</i>	Drake	West	Dry Decidious	3
13	<i>Dalbergia monticola</i>	Bosser et R. Rabev.	East	Humid	2
14	<i>Dalbergia abrahamii</i>	Bosser & R. Rabev.	North	D. Decidious	2
15	<i>Dalbergia lemurica</i>	Bosser & R. Rabev.	East	Humid	2
16	<i>Dalbergia masoalensis</i>	Bosser & R. Rabev.	East	Humid	2
17	<i>Dalbergia baronii</i>	Baker	East	Humid	2
18	<i>Dalbergia pervillei</i>	Vatke	North	Dry Decidious	2
19	<i>Dalbergia humbertii</i>	R.Vig.	North	Dry Decidious	1
20	* <i>Dalbergia peltieri</i>	Bosser & R. Rabev.	West	Dry Decidious	1
21	<i>Dalbergia davidii</i>	Bosser & R. Rabev.	West	Dry Decidious	1
22	<i>Dalbergia normandii</i>	Baill.	East	Humid	1
23	* <i>Dalbergia trichocarpa</i>	Baker	West	Dry Decidious	1
24	<i>Dalbergia bathiei</i>	R.Vig.	East	Humid	1

Table 2. Descriptive information on *Diospyros* samples analysed. 1) Number of species, 2) Scientific name; asterisks indicate species not exploited (liana or shrub); 3) Plant Author name; 4) General locality of sampling; 5) Forest type from which the plant was sampled; 6) Number of duplicates.

N°	Species	Author	Locality	Forest type	Duplicates
1	<i>Diospyros tropophylla</i>	(H. Perrier) G.E. Schatz & Lowry	West	Dry Deciduous	3
2	<i>Diospyros aculeata</i>	H. Perrier	West	Dry Deciduous	2
3	<i>Diospyros cupulifera</i>	H. Perrier	West	Dry Deciduous	2
4	<i>Diospyros squamosa</i>	Bojer ex A. DC.	West	Dry Deciduous	2
5	<i>Diospyros humbertiana</i>	H. Perrier	West	Dry Deciduous	2
6	<i>Diospyros haplostylis</i>	Boivin ex Hiern	West	Dry Deciduous	1
7	<i>Diospyros myriophylla</i>	(H. Perrier) G.E. Schatz & Lowry	East	Humid	1
8	<i>Diospyros toxicaria</i>	Hiern	East	Humid	1

Table 3. Descriptive information on look-alike species samples analysed. 1) Number of species, 2) Scientific name; asterisks indicate species not exploited (liana or shrub); 3) Plant Author name; 4) General locality of sampling; 5) Forest type from which the plant was sampled; 6) Number of duplicates.

N°	Species	Author	Locality	Forest type	Duplicates
1	<i>Calophyllum inophyllum</i>	L.	Est	Humid	1
2	<i>Cedrelopsis grevei</i>	Baill.	West	Dry Deciduous	8
3	<i>Chrysophyllum boivinianum</i>	(Pierre) Baehni			1
4	<i>Cryptocarya ovarifolia</i>	(Danguy) van der Werff	Est	Humid	1
5	<i>Dupuya madagascariensis</i>	(R. Vig.) J.H. Kirkbr.	West	Dry Deciduous	2
6	<i>Hymenaea verrucosa</i>	Gaertn	Est	Humid	1
7	<i>Intsia bijuga</i>	(Colebr.) Kuntze	Est	Humid	1
8	<i>Neobeguea mahafalensis</i>	J. F. Leroy	West	Dry Deciduous	1
9	<i>Sideroxylon gerrardianum</i>	(Hook. f.) Lecomte	Est	Humid	1
10	<i>Tamarindus indica</i>	L.	West	Dry Deciduous	3
11	<i>Tetrapterocarpon geayi</i>	Humbert	West	Dry Deciduous	1
12	<i>Tetrapterocarpon septentrionalis</i>	Du Puy & R. Rabev.	West	Dry Deciduous	1

2.2. Plant material preparation

Twig, branch and stem woods labelled stored in the wood anatomy lab were used. From each branch and stem sample, a 1 cm³ sample was split from the outermost wood, including the bark. For twig samples, special care was taken to preserve the bark and the pith on the same sample. The thin sections (15-25 µm) have been made using disposable blades and a GLS microtome (Gärtner and Schweingruber, 2013). The sections were stained with Astra blue and safranin, dehydrated with alcohol and xylene, and mounted in Canada balsam (Chaffey 2002, Gärtner and Schweingruber, 2013). Sections with bark were initially bleached in Eau de Javel for 10 to 15 minutes before staining. A transmission-light microscope was used to observe slides while polarized filter were applied for observing crystal presence and cell wall thickness. Sections were microscopically inspected using magnifications of 20-1000 times and photographed by using a digital camera mounted on the microscope (Olympus BX43). Magnifications are indicated in µm (0,001 mm) above a black scale bar in each picture. For all species the anatomy of pith, primary xylem, branch xylem, twig and stem bark and stem xylem was described. Differences between branch and stem xylem were determined.

4. Identification keys

How to use the keys

The present keys are focused on stem wood identification. In these keys, descriptions are provided in most cases for sapwood, but sometimes from the transition between sapwood and heartwood.

It was confirmed that geographic origin of the samples is the most important information to tell apart species within both genera. Samples from western-dry and eastern-wet parts of Madagascar give already a global overview about the wood structure especially about wood porosity and vessel elements arrangement. In the western region, distinct growth boundaries are present in *Dalbergia* wood structure, while small and numerous vessels in radial multiples can be found within *Diospyros* species. These characteristics are not so evident in the eastern species of both genera.

Within genus *Dalbergia*, species are grouped by porosity, then by ray type (homogeneous, heterogeneous and both) and subsequently by ray width (exclusively uniseriate rays, uni- and biseriate rays and rays 2 to 3 cells wide). Additional features as width of banded parenchyma (up to three or more than three cells wide) as well as storied structure can be used (number of ray tiers per axial mm) if two or more species fall in the same category.

Within genus *Diospyros* species can be classified by ray width. Most of the species present uni- and biseriate rays at the same time. Even though the vessel size and number change according to environmental conditions, these features, these can be useful to separate the species. Species are grouped by vessel grouping. Then, the vessel density may be helpful for the species identification. Finally, additional features such as shape of ray upright and square marginal cells can be applied.

Stem wood identification key for *Dalbergia*

Origin	Ring porosity	Ray type	Ray width	Banded parenchyma (* more than 3 cells wide) (⊗ up to 3 cells wide)
West	Distinct	104	UNI	<i>D. abrahamii</i> , * <i>D. peltieri</i>
			BI	<i>D. humbertii</i>
			UNI & BI	<i>D. emirnensis</i>
		106	UNI	-
			BI	<i>D. tricolor</i>
			UNI & BI	-
		104-106	UNI	<i>D. neoperrieri</i> , * <i>D. trichocarpa</i>
			BI	<i>D. greveana</i> , <i>D. purpurascens</i> , <i>D. davidii</i> , * <i>D. chlorocarpa</i> , * <i>D. lemurica</i>
			UNI & BI	<i>D. mollis</i> , * <i>D. suaresensis</i>
East	Indistinct	104	UNI	<i>D. bathiei</i>
			BI	
			UNI & BI	
		106	UNI	⊗ <i>D. normandii</i> , <i>D. madagascariensis</i>
			BI	⊗ <i>D. masoalensis</i> , ⊗ <i>D. orientalis</i>
			UNI & BI	
		104-106	UNI	<i>D. chapelieri</i> , * <i>D. maritima</i> , ⊗* <i>D. louvelii</i> , <i>D. pervillei</i>
			BI	⊗ <i>D. monticola</i>
			UNI & BI	⊗ <i>D. baronii</i>

Stem wood identification key for *Diospyros*

Ray width	Vessels grouping	Species (*with duplicates)
1 cell	Vessels predominantly in SHORT radial multiples	*D. aculeata <i>D. acutiflora</i> <i>D. antongiliensis</i> <i>D. calophylla</i> <i>D. leucocalyx</i>
	Vessels predominantly in LONG radial multiples	<i>D. quadrangularis</i>
	Vessels predominantly in radial multiples	<i>D. analamerensis</i> <i>D. ankifiensis</i> <i>D. latispathulata</i> <i>D. maxima</i> <i>D. pervilleana</i>
1(2) cell(s)	Vessels predominantly in SHORT radial multiples	<i>D. bernieriana</i> <i>D. chitinophora</i> <i>D. fuscovelutina</i> *D. humbertiana <i>D. maculata</i> <i>D. microrhombus</i> <i>D. sclerophylla</i> *D. squamosa *D. cupilifera
	Vessels predominantly in LONG radial multiples	<i>D. brevipedicellata</i> <i>D. perrieri</i> <i>D. ferrea</i> <i>D. mangabensis</i> <i>D. occlusa</i> <i>D. olacinoïdes</i> <i>D. parifolia</i> <i>D. platycalyx</i> <i>D. tropophylloides</i> <i>D. velutipes</i> <i>D. vescoi</i> *D. myriophylla *D. tropophylla *D. haplostylis *D. toxicaria
2-3 cells	Vessels mostly solitary	<i>D. rubripetiolata</i>

Dalbergia



Dalbergia baronii



Dalbergia trichocarpa



Dalbergia purpurascens

A total of 48 species of Dalbergia are recognized, some of them produce rosewood and palissander timbers,

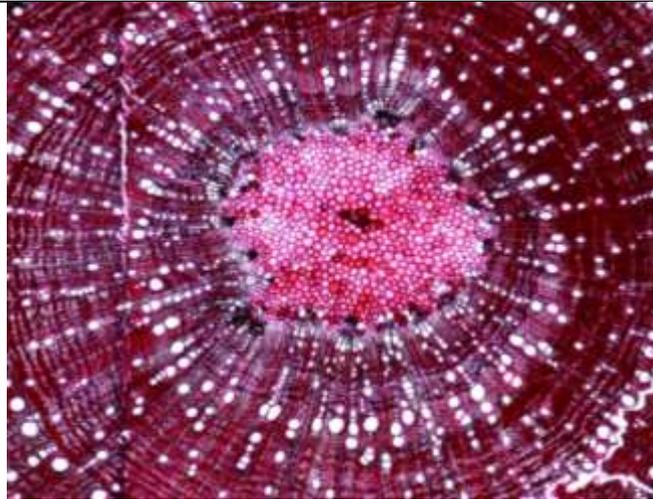
Here we describe the stem anatomy of 25 Dalbergia species, most of them are exploited species.

<i>Dalbergia orientalis</i> Bosser & R. Rabev.	FABACEAE
Synonymy : -	
Others specimens : SFR 258, CR 7296, CR 7297, CR 7308, CR 7309, CR 7311, CR 7312, CR 7313, CR 7314, CR 7316, RBE 2544, RBE 2554, RBE 2556, RBE 2557, RZK 8028	
Local names : Vimboa madini-dravina, Vimboa mena, Tombobitotsy (bois de rose), Voamboana, Hazovola, Voamboan-tsavoka, Manary mainty, Manary toloho, Sovoka	
PLANT DESCRIPTION Tree 7-16 m high 10-18 cm DBH. Endemic to Madagascar. Exploited species.	
DISTRIBUTION <i>Elevation</i> : 0-1500 m a.s.l. <i>Vegetation formation</i> : Forest <i>Bioclimate</i> : Humid <i>Protected areas</i> : Betampona <i>New protected areas</i> : Mahabo-Mananivo, Tsitongabarika	
STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2-3 elements. Apotracheal axial parenchyma in bands. Paratracheal axial parenchyma winged-aliform and confluent. Vessels large ¹ and very rare ² . Tylosis present in the vessels. Rays are thick ³ . ¹ Large: Distinct to the naked eye ² Very rare: < 5 vessels/mm ² ³ Thick: Distinct to the naked eye	 <p style="text-align: center;">SFR 258</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape square. Heterogeneous pith. Cells dimorphic. Cell contents present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles clearly separated, vessels solitary and in short radial multiples of 2 to 3 cells.



SFR 258 x 40

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 35-62-90 μm, 14-27-45 vessels/ mm². Vessel element length 120-156-200 μm. Intervessel pits small, 5-7-10 μm in diameter. Fibres thin to thick to very thick-walled. Paratracheal parenchyma diffuse, diffuse-in-aggregates and confluent. Two cells per parenchyma strand. Rays are predominantly uniseriate. Ray height 80-128-240 μm. Rays 12-14-17 /mm.

Anatomical differences to stem xylem: Mean tangential diameter in the stem is higher (35-62-90 / 115-203-330 μm). Vessel density is rare in the stem (14-27-45 / 2-15-33 vessels/mm²). Ray height and ray number in the stem are higher (80-128-240 / 80-154-260 μm) (12-14-17/ 6-9-12 mm).



SFR 258 x 100

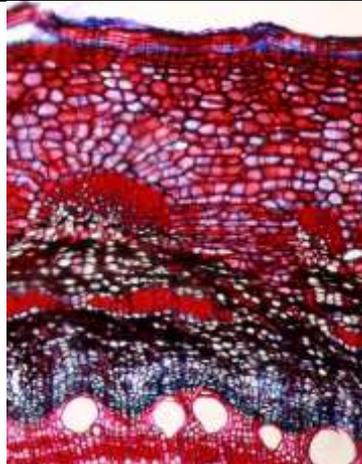


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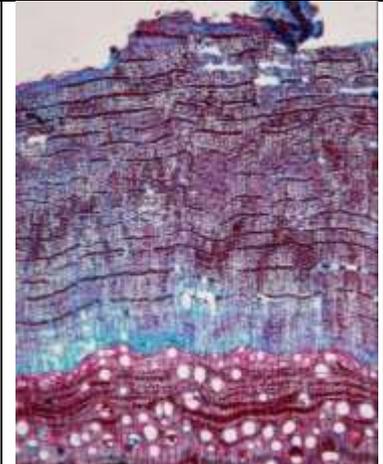
BARK ANATOMY

Branch bark: Collapsed sieve tubes alternating with groups of thick-walled fibres. The cortex consists of irregularly parenchyma cells and groups of tangentially dispersed fibres. Epidermis consists of regularly arranged rectangular cells distinct in polarized light.

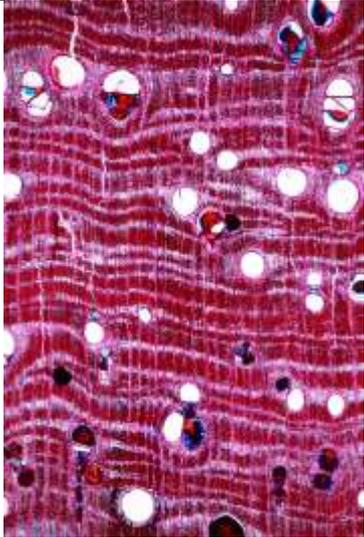
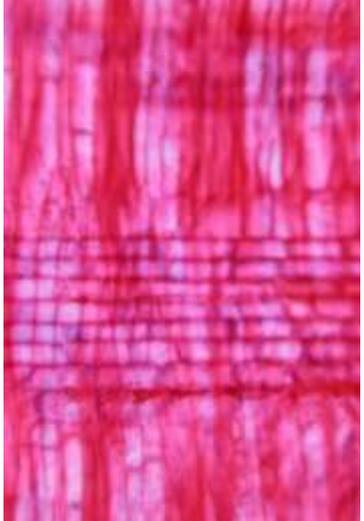
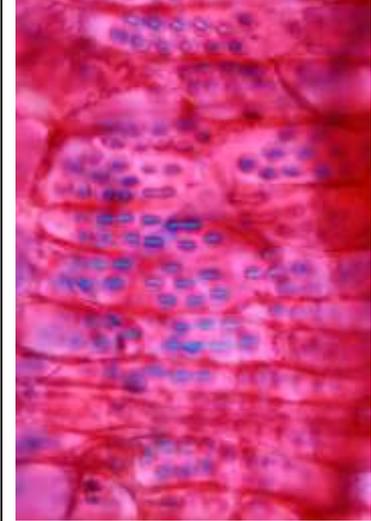
Stem bark: The phloem consists of alternating bands of fibres and collapsed and non-collapsed sieve tubes. Distinct ray dilatation, but only some rays become dilated. Sand crystals scattered or irregularly dispersed in phloem. The phellem is homogeneous, consists of regularly arranged rectangular cells. Lignified cells in phellem, distinct in polarized light.



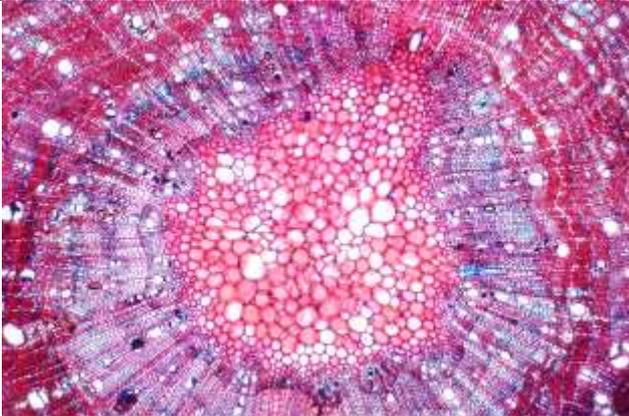
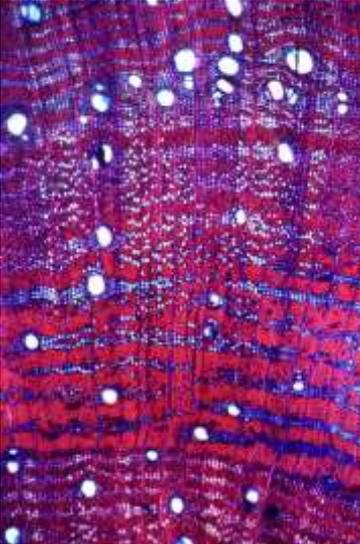
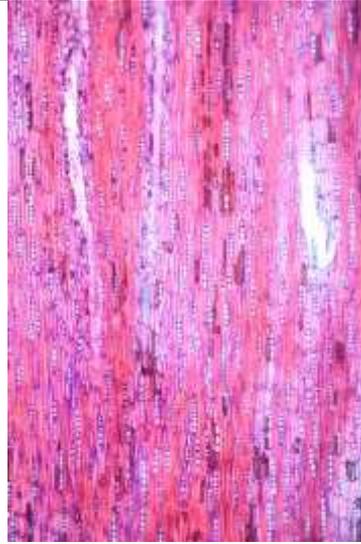
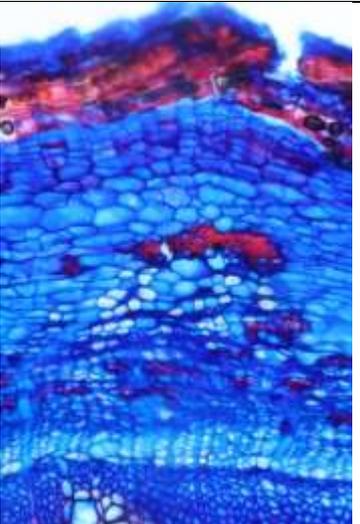
SFR 258 x 100



SFR 258 x 20

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-4 elements. Tangential diameter of the vessels 115-203-330 μm, 2-15-33 vessels/mm^2. Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-agregats. Paratracheal parenchyma winged-aliform, confluent, in bands up to three and more than three cells. Rays 6-9-12 /mm.</p>	 <p>SFR 258 x 100</p>	 <p>SFR 258 x 400</p>
<p>Radial section Simple perforation plates. Intervessel pits oval to circular, opposite and alternate, 7-8-9 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 155-196-235 μm. Fibres with distinctly bordered pits. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>	 <p>SFR 258 x 400</p>	 <p>SFR 258 x 400</p>
<p>Tangential section Rays uni-, bi- and triseriate simultaneously present. Rays predominantly biseriate. Ray height 80-154-260 μm, with 4-7-10 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied.</p>	 <p>SFR 258 x 100</p>	 <p>SFR 258 x 400</p>
<p><i>Dalbergia orientalis</i> Bosser & R. Rabev.: SFR 258, CR 7296, CR 7297, CR 7308, CR 7309, CR 7311, CR 7312, CR 7313, CR 7314, CR 7316, RBE 2544, RBE 2554, RBE 2556, RBE 2557, RZK 8028 IAWA feature numbers 2 5 13 21 22 26 29 30 43 47 52 56 62 66 69 70 76 77 82 83 85 86 90 91 97 104 106 115 122 136 142 180 189 190 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia louvelii</i> R.Vig.	FABACEAE
Synonymy : -	
Others specimens : RBE 2247, RBE 2538, RBE 2541, RBE 2542, RBE 2543, RBE 2545, RBE 2548, RBE 2550, RBE 2551, RBE 2552, RBE 2553, CR 7298, CR 7299, CR 7300, CR 7301, CR 7302, CR 7306.	
Local names : <i>Vimboa madini-dravina</i> , <i>Volombodipony</i>	
<p>PLANT DESCRIPTION Tree 8-10 m high up to 18 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-1000 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Humid <i>Protected areas</i>: Betampona, Mananara-Nord <i>New protected areas</i>: Mahabo-Mananivo</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 elements. Vessels large¹ and rare². Tyloses present in vessels. Paratracheal axial parenchyma winged-aliform. Apotracheal axial parenchyma in bands. Ray distinct with hand lens. ¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm²</p>	 <p style="text-align: center;">CR 7302</p>

<p>PITH AND PRIMARY XYLEM ANATOMY</p> <p>Pith: Shape of pith round to star-like. Cells dimorphic. Simple pits in transverse cell walls. Pith not visible in polarized light.</p> <p>Primary xylem: Vascular bundles clearly separated. Vessels solitary and in short radial multiples. Fibres thin-walled in radial rows.</p>		
<p>BRANCH XYLEM ANATOMY</p> <p>Description: Growth ring boundaries indistinct. Tangential diameter of vessels 50-90-120 μm, 9-17-22 vessels/mm^2. Vessel element length 140-184-230 μm. Intervessel pits small, 4-7 μm in diameter. Fibres thick- to very thick-walled. Axial parenchyma paratracheal, diffuse-in-aggregates, and in narrow lines up to 3 cells. Rays exclusively uniseriate. Ray height 40-114-180 μm, rays 8-11-16/mm.</p> <p>Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is smaller in the branch (50-90-120/110-161-260 μm). Vessel density is higher in the branch (9-17-22/5-13-20 vessels/mm^2). Rays are slightly shorter in the branch (40-114-180/50-190-410 μm) while ray number is similar (8-11-16/9-12-15 rays/mm).</p>		
<p>BARK ANATOMY</p> <p>Branch bark: Collapsed sieve tubes alternating with groups of thick-walled fibres. The cortex consists of irregularly parenchyma cells and groups of tangentially dispersed fibres. Epidermis consists of regularly arranged rectangular cells distinct in polarized light.</p> <p>Stem bark: The phloem consists of alternating bands of fibres and collapsed and non-collapsed sieve tubes. Distinct ray dilatation, but only some rays become dilated. Sand crystals scattered or irregularly dispersed in phloem. The phellem is homogeneous, consists of regularly arranged rectangular cells. Lignified cells in phellem, distinct in polarized light.</p>		

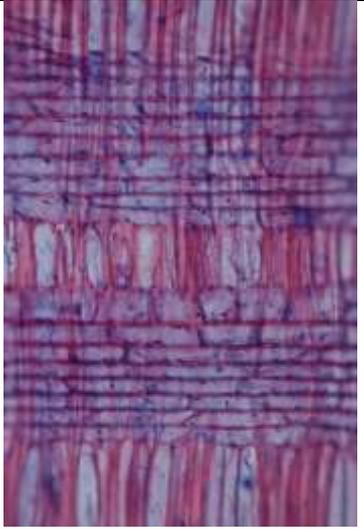
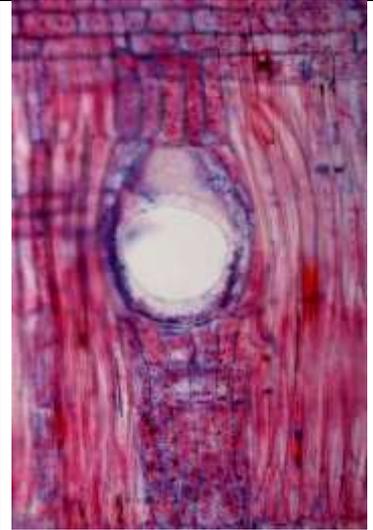
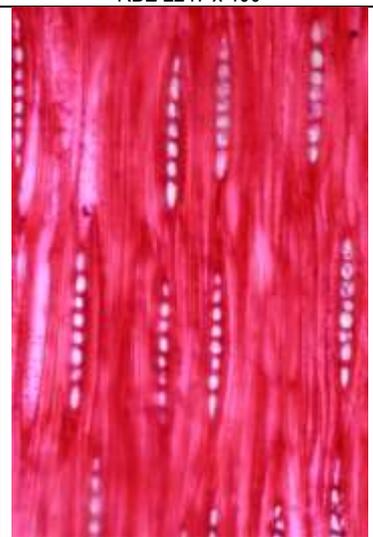
RBE 2447 x 100

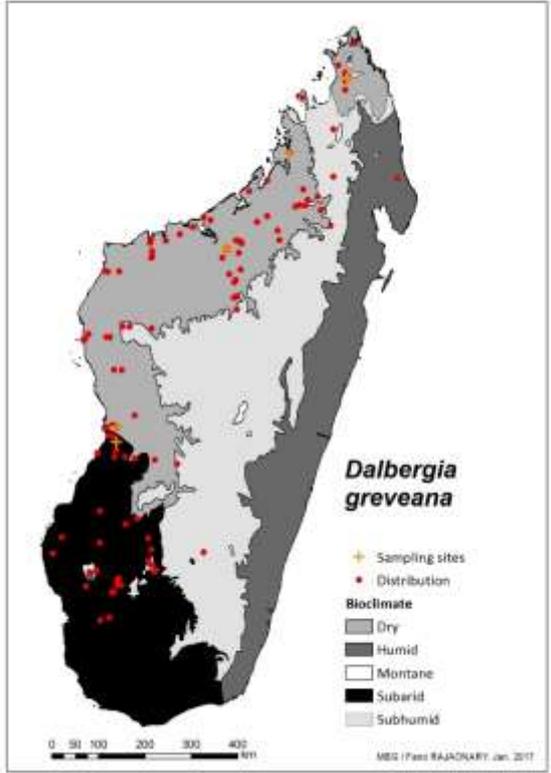
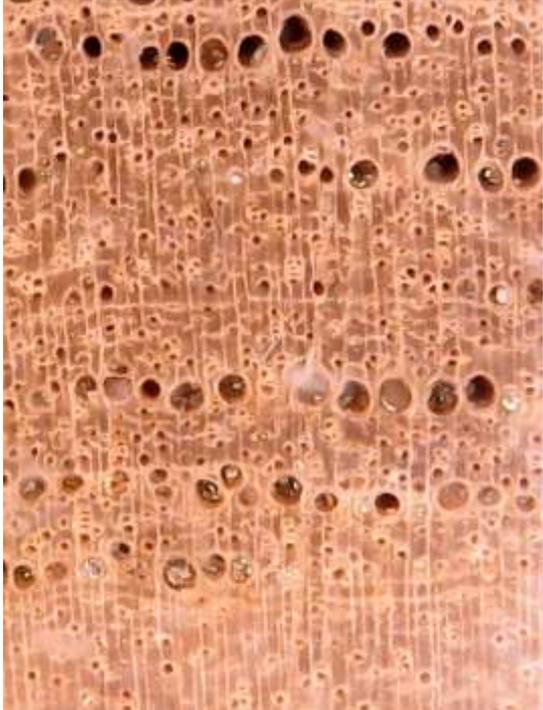
RBE 2247 x 100

RBE 2247 x 100

RBE 2247 x 400

RBE 2247 x 100

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries indistinct or absent. Wood diffuse-porous. Vessels predominantly solitary. Tangential diameter of vessels 110-161-260 μm, 5-13-20 vessels/mm^2. Vessels of two distinct diameter classes. Gums and/or other deposits in heartwood vessels. Fibres very thick-walled. Paratracheal parenchyma scanty to vasicentric. Apotracheal parenchyma diffuse-in-aggregates and in narrow bands up to three cells wide. Paratracheal parenchyma vasicentric. Rays 9-12-15/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits oval to circular and alternate, 7-10 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 90-162-330 μm. Fibres with simple to minutely bordered pits. Heterogeneous rays with body ray cells procumbent and one row of upright and square marginal cells.</p>		
<p>Tangential section Rays predominantly uniseriate, some rays partially biseriate. Ray height 50-190-410 μm. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays, vessels and axial parenchyma irregularly storied. Number of ray tiers par axial mm: 3-4-5.</p>		
<p>Dalbergia louvelii R. Vig.: RBE 2247, RBE 2538, RBE 2541, RBE 2542, RBE 2543, RBE 2545, RBE 2548, RBE 2550, RBE 2551, RBE 2552, RBE 2553, CR 7298, CR 7299, CR 7300, CR 7301, CR 7302, CR 7306 IAWA feature numbers 2 5 9 13 22 26 29 30 42 45 47 52 58 61 66 70 77 79 86 90 91 104 106 115 118 120 136 142 178 180 189 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<p><i>Dalbergia greveana</i> Baill.</p>	<p>FABACEAE</p>
<p>Synonymy : <i>D. ambongoensis</i> Baill., <i>D. eurybothrya</i> Drake., <i>D. myriabotrys</i> Baker., <i>D. perrieri</i> Jum., <i>D. ikopensis</i> Jum., <i>D. isaloensis</i> R.Vig</p>	
<p>Specimens : RIR 2416, CR 6688, RIR 2869, RIR 2861, RIR 2874</p>	
<p>Local names : Manary toloho, Manary bomby, Manary voraka, Manary boraka, Manary vantany, Manary mavo, Manipika, Manarimboraka, Manary avoha, Mendoravina, Manary havo, Maintsoririna, Manaritola, Ndramanindra, Maorarivavazanomby, Maevalafika, Magnary, Manary baomba, Manera, Hazomposa, Voamboana</p>	
<p>PLANT DESCRIPTION Shrub to tree 3-20 m high 15-80 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-1000 m a.s.l. <i>Vegetation formation</i>: Forest, grassland and woodland <i>Bioclimate</i>: Dry, sub-arid and sub-humid <i>Protected areas</i>: Ankarafantsika, Ankarana, Isalo, Bemaraha, Kirindy-Mitea, Namoroka, Tsaratanana and Zombitsy-Vohibasia <i>New protected areas</i>: Amoron'i Onilahy and Mt Français</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries distinct marked by differences in vessel diameter between latewood and earlywood and marginal parenchyma. Wood semi-ring-porous. Vessels solitary and in radial multiples of 2 to 3 elements. Vessels large¹ and very rare² to rare³. Tyloses present in vessels. Paratracheal axial parenchyma winged-aliform. Apotracheal axial parenchyma in thin bands. Rays are thick⁴.</p> <p>¹Large: Distinct to the naked eye ²Very rare: < 5 vessels/mm² ³Rare: 5-20 vessels/mm² ⁴Thick: Distinct to the naked eye</p>	 <p>CR 6688</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape rectangular. Heterogeneous pith. Thick-walled parenchyma cells present. Cells dimorphic. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles clearly separated, vessels solitary and in short radial multiples of 2 to 3 elements.



CR 6688 x 200

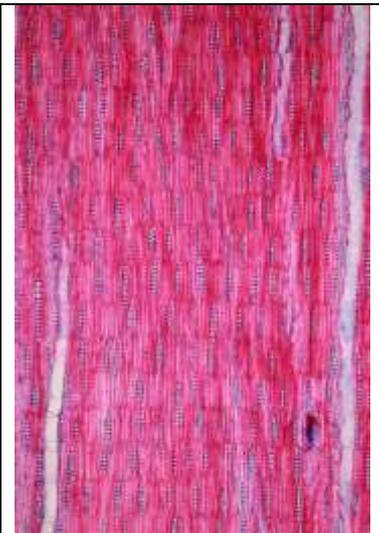
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries distinct marked by differences in vessels diameter. Tangential diameter of earlywood vessels large 60-126-220 μm and latewood vessels medium 40-55-80 μm . 24-28-32 vessels/ mm^2 . Vessel element length 90-126-170 μm . Intervessel pits small, 5-6-8 μm in diameter. Fibres thin-, thick- and very thick-walled. Apotracheal axial parenchyma diffuse, diffuse-in-aggregates. Paratracheal axial parenchyma scanty, vasicentric, confluent and in narrow bands up to three cells wide and more than three cells wide. Rays predominantly biseriate. Ray height 70-118-240 μm . Rays 10-11-13/mm.

Anatomical differences to stem xylem: Earlywood and latewood are larger in the stem (50-146-280 μm / 60-126-220 μm ; 40-68-95 μm / 40-55-80 μm) while vessel number is comparable (24-28-32 / 16-26-45 vessels/ mm^2). Ray height in the stem is higher (70-118-240 μm / 100-148-290 μm) while ray number is comparable (10-11-13 / 8-10-12 per mm).



CR 6688 x 100

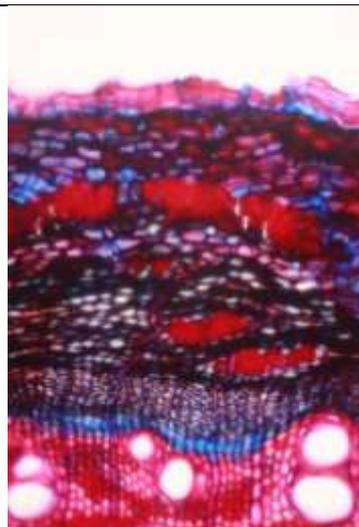


CR 6688 x 100

BARK ANATOMY

Branch bark: Collapsed sieve tubes alternating with groups of thick-walled fibres. The cortex consists of irregularly bluestained parenchyma cells and groups of tangentially dispersed fibres. Epidermis consists of regularly arranged rectangular cells distinct in polarized light.

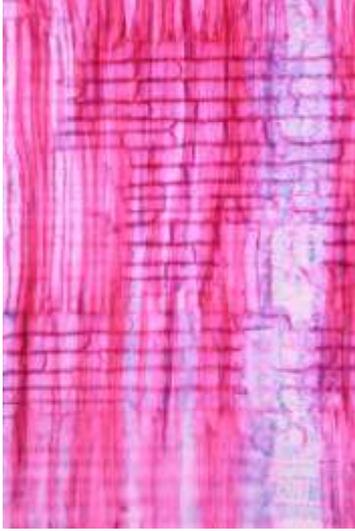
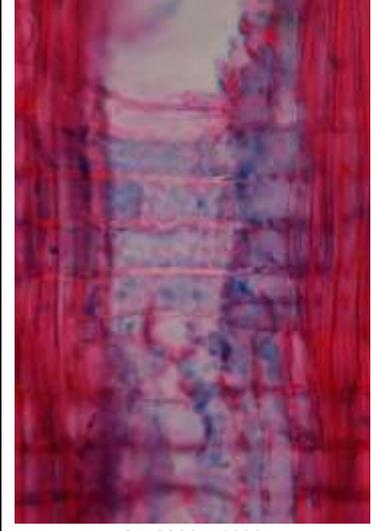
Stem bark: The phloem consist of alternating bands of fibre and collapsed and non-collapsed sieve tubes. Ray and parenchyma dilatations present. Crystal sand irregularly dispersed in the phloem. Phellem homogeneous consists of regularly arranged rectangular cells. Lignified cells in phellem, distinct in polarized light.

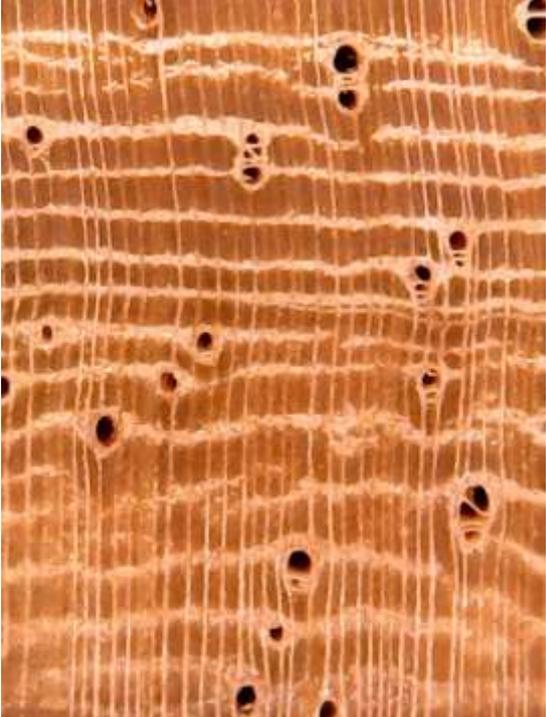


CR 6688 x 400



CR 6688 x 40

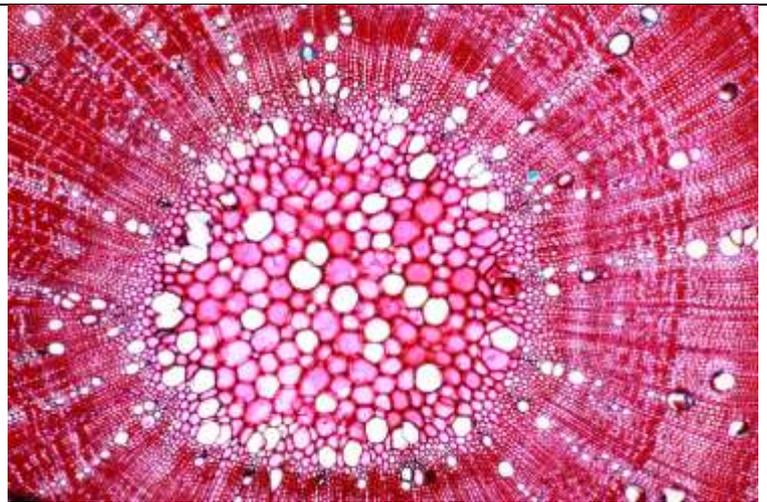
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct marked by differences in vessel diameter between earlywood and latewood. Wood semi-ring-porous. Earlywood and latewood vessels are solitary and in radial multiples of 2-5 elements. Tangential diameter of earlywood vessels large 100-184-305 μm and of latewood vessels medium 35-74-125 μm, 10-15-22 vessels per mm^2. Fibres very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma in narrow lines up to three cells. Rays 7-10-11 per mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 5-8-11 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 65-155-215 μm. Fibres with simple to minutely bordered pits. Heterogeneous rays with body ray cells procumbent and one row of upright and square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate simultaneously present. Rays predominantly biseriate. Ray height 85-146-390 μm, with 4-8-16 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements not storied.</p>		
<p><i>Dalbergia greveana</i> Baill.: RIR 2416, CR 6688, RIR 2869, RIR 2861, RIR 2874 IAWA feature numbers 1b 4 13 22 25 29 30 41 42 47 52 61 66 70 76 77 86 90 91 104 106 115 136 142 180 189 190 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia madagascariensis</i> Vatke	FABACEAE
Synonymy : -	
Specimens : SFR 247, SFR 248, RAF 13, RBE 2547, RBE 2562	
Local names : Manaribe, Manary bomby, Voamboana, Manary, Tsiandalana, Faralabikesa, Sovoka, Hazovola, Hazovolamena, Andramena, Masary, Hazovola fotsy, Manary boraka, Faho, Vimboa be ravina.	
<p>PLANT DESCRIPTION Tree 5-20 m high 20-45 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-1000 m a.s.l. <i>Vegetation formation</i>: Forest and freshwater wetland <i>Bioclimate</i>: Dry, humid and sub-humid <i>Protected areas</i>: Ankarana, Betampona, Lokobe, Loky Manambato (Daraina), Manongarivo, Marojejy and Montagne d'Ambre (including Fôret d'Ambre). <i>New protected areas</i>: Mt Français, Makirovana, Analalava and Mahabo-Mananivo.</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 4 elements. Vessels large¹ and very rare². Apotracheal axial parenchyma in bands. Paratracheal axial parenchyma confluent and rarely winged-aliform. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Very rare: <5 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">SFR 248</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape round. Heterogeneous pith. Cells dimorphic. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles separate, vessels solitary and in short radial multiples.



SFR 248 x 100

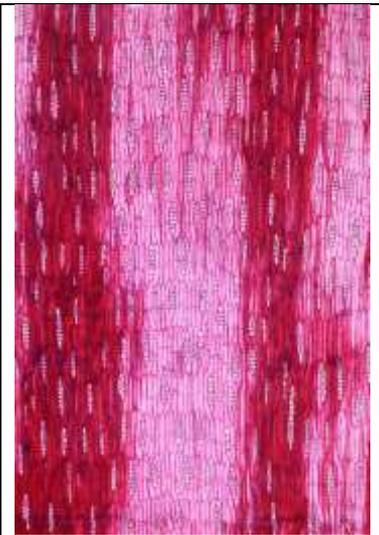
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 40-83-110 μm , 9-15-20 vessels/ mm^2 . Vessel element length 80-155-200 μm . Intervessel pits small, 5-7-8 μm in diameter. Fibres thin- to thick-walled. Apotracheal parenchyma diffuse-in-aggregates. Paratracheal parenchyma confluent, winged-aliform and in narrow lines up to three cells wide. Heterogeneous rays, body ray cells procumbent, one row upright and/or square marginal cells. Rays are predominantly biseriate. Ray height 70-114-180 μm . Rays 7-11-13 /mm. Rays and/or axial elements irregularly storied. Number of ray tiers per axial mm: 6.

Anatomical differences to stem xylem: Mean tangential diameter in the stem higher (40-83-110 / 80-122-150 μm). Vessel density rare in the stem (9-15-20 / 1-2-2 vessels/ mm^2). Ray height in the stem is higher (70-114-180 / 105-123-150 μm) while ray number is similar (7-11-13 / 8-11-13 rays/mm).



SFR 248 x 100

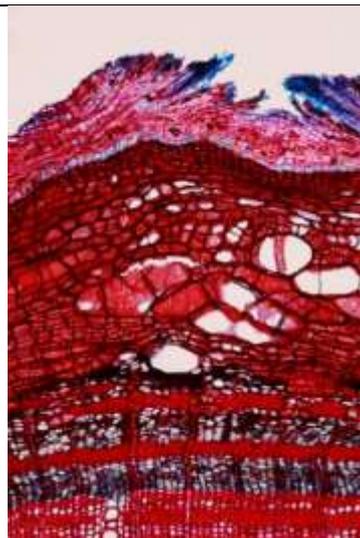


SFR 248 x 100

BARK ANATOMY

Branch bark: Sieve tubes, group of fibres and collapse sieve tubes present in the phloem. The cortex consists of irregular large parenchyma cells.

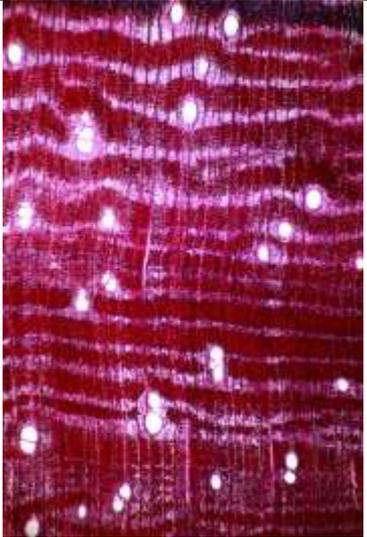
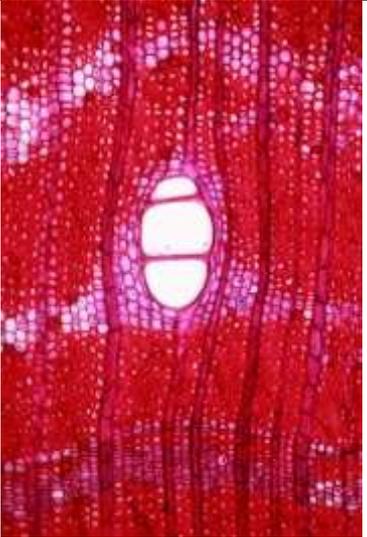
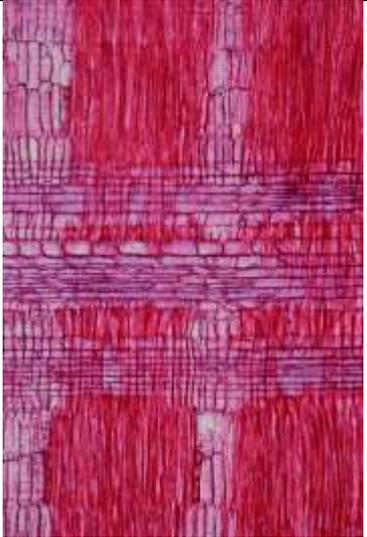
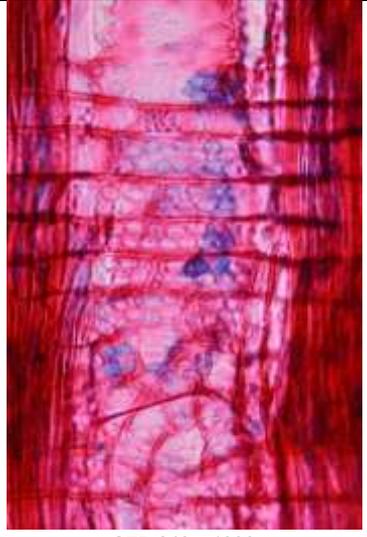
Stem bark: Phloem consists of alternating bands of fibre and collapsed and non collapsed sieve-tubes. Parenchyma dilatations present. Crystal sands irregularly dispersed and prismatic crystals present in the sclereids. The phellem is homogeneous, consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem, distinct in polarized light.

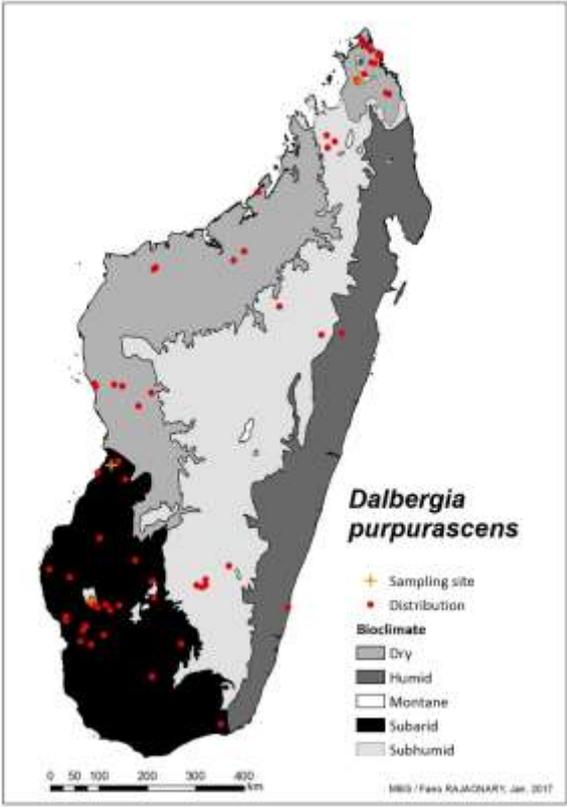
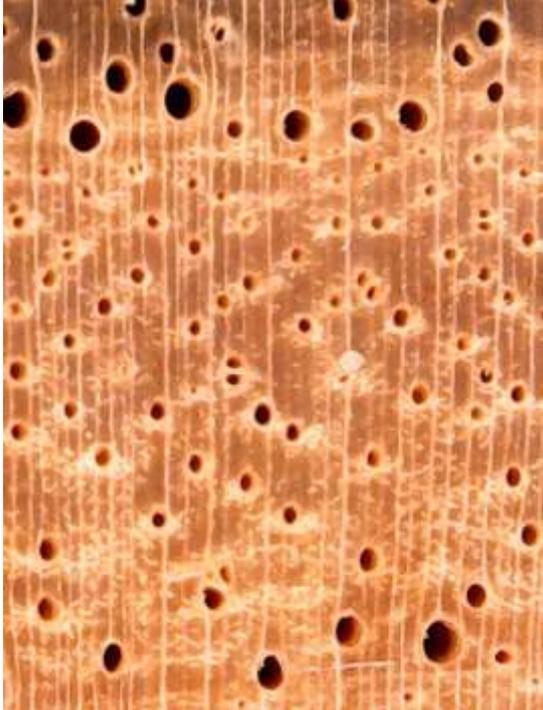


SFR 248 x 200



SFR 248 x 20

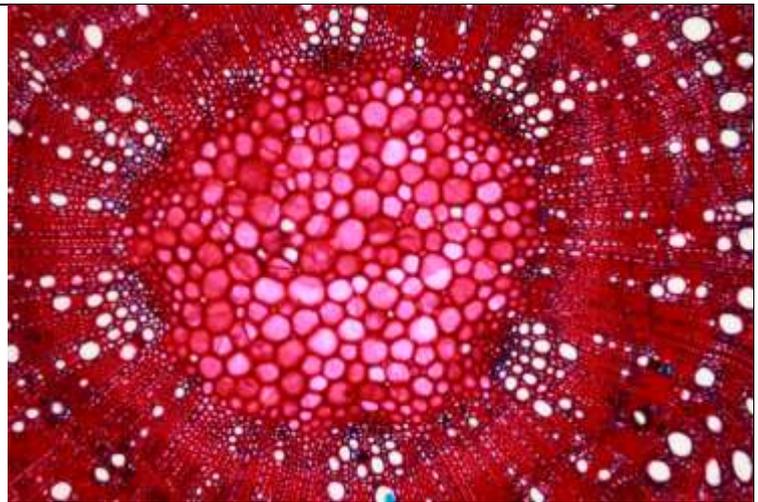
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-3 elements. Tangential diameter of the vessels 80-122-150 μm, 1-2-2 vessels/mm^2. Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse. Paratracheal parenchyma confluent and in bands more than 3 cells wide. Rays 8-11-13 /mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits oval to circular, opposite to alternate, 7-8-10 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 105-180-230 μm. Fibres with simple and minutely borders pits. Heterogeneous rays, body ray cells procumbent with one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni-, biseriate simultaneously present. Rays predominantly biseriate. Ray height 105-123-150 μm, with 3-6-8 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied. Number of ray tiers per axial mm : 5.</p>		
<p><i>Dalbergia madagascariensis</i> Vatke: SFR 247, SFR 248, RAF 13, RBE 2547, RBE 2562 IAWA feature numbers 2 5 13 21 22 26 29 30 42 46 52 61 66 69 70 77 83 85 90 91 106 115 122 136 142 180 189 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia purpurascens</i> Baill.	FABACEAE
Synonymy : -	
Specimens : RBE 2452, CR 6679, RIR 2418, CR 6679, RIR 2875	
Local names : Manary toloho, Manarimboraka, Hazovola, Magnary mavo, Manary boty, Sovoka, Manary avoha, Tsimahasabary, Manary fotsy, Manary bomby, Manary mainty, Manary tsiatondro	
<p>PLANT DESCRIPTION Tree 8-25 m high 20-80 cm DBH Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-1000 m a.s.l. <i>Vegetation formation</i>: Forest and woodland <i>Bioclimate</i>: Dry, sub-arid and sub-humid <i>Protected areas</i>: Andringitra, Ankarafantsika, Isalo, Ankarana, Bemaraha, Kirindy-Mitea, Namoroka, Zahamena and Zombitsy-Vohibasias <i>New protected areas</i>: Montagne des Français and Sahafary</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries distinct marked by differences in vessel diameter between latewood and earlywood of the following ring. Wood semi-ring porous. Solitary vessels and in radial multiples of 2 elements. Axial parenchyma diffuse-in aggregates. Paratracheal axial parenchyma winged-aliform. Vessels large¹ and rare². Tyloses present in the vessels. Rays are thick³.</p> <p>¹ Large: Distinct to the naked eye ² Rare: 5-20 vessels/mm². ³ Thick: Distinct to the naked eye</p>	 <p>RBE 2452</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape round. Heterogeneous pith. Thick-walled parenchyma cells present. Cells dimorphic. Prismatic crystals present. Simple pits in transverse cell walls. Vascular bundles clearly separated. Pith visible in polarized light.

Primary xylem: Vessels solitary and in long radial multiples of 2 to 4 elements.

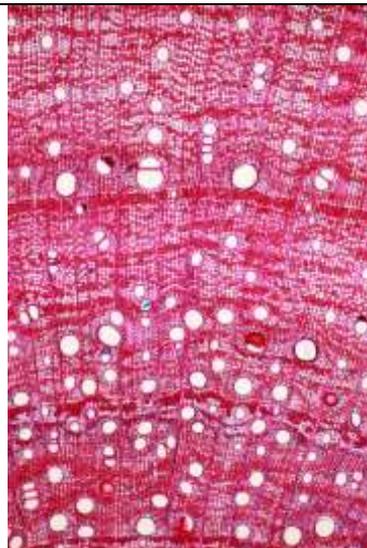


RBE 2452 x 200

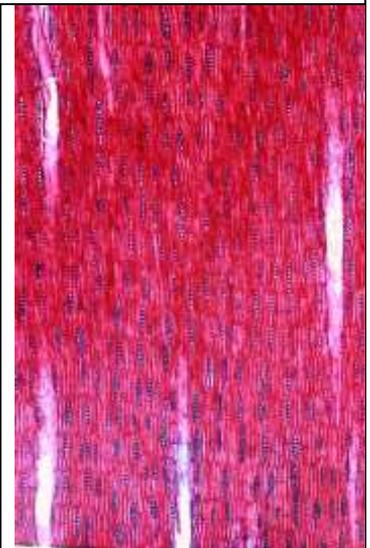
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries distinct marked by differences in vessels diameter. Tangential diameter of earlywood vessels medium 70-98-140 µm and latewood vessels small 40-54-90 µm. 39-63-108 vessels/mm². Vessel element length 90-126-150 µm. Intervessel pits small, 4-5-7 µm in diameter. Fibres thin-, thick- and very thick-walled. Gums present in heartwood vessels. Apotracheal axial parenchyma diffuse, diffuse-in-aggregates. Paratracheal axial parenchyma winged-aliform, confluent, and in narrow bands up to three cells and more than three cells wide. Rays predominantly uniseriate. Ray height 60-111-240 µm. Rays 10-15-16/mm.

Anatomical differences to stem xylem: Earlywood and latewood in the stem are larger (50-140-250 µm / 70-98-140 µm; 50-67-80 µm / 40-54-90 µm). Vessel number is higher in the branch (34-63-108 / 7-14-24 vessels/mm²). Ray height is higher in the stem (60-111-240 µm / 70-138-350 µm) while ray number is higher in the branch (10-15-16 / 9-12-15 per mm).



RBE 2452 x 100

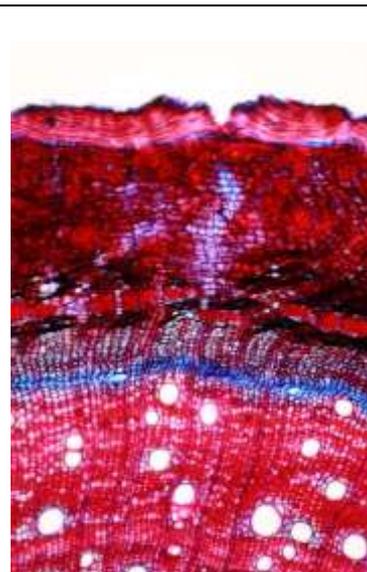


RBE 2452 x 100

BARK ANATOMY

Branch bark: Sieve tubes arrangement in tangential row. Collapsed sieve tubes alternate with groups of thick-walled fibres in tangential bands. The cortex consists of square and rectangular blue-stained parenchyma cells. Ray dilatations present. The cortex consists of irregularly lignified parenchyma cells. Lignified cells in phellem, distinct in polarized light.

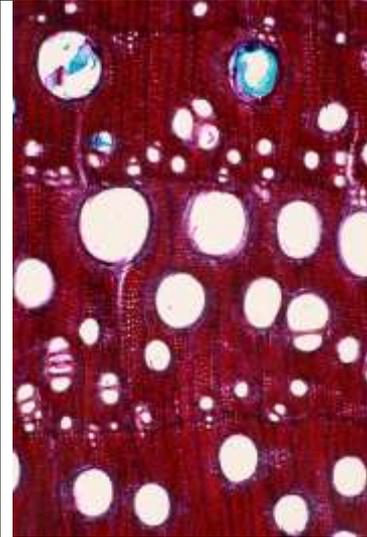
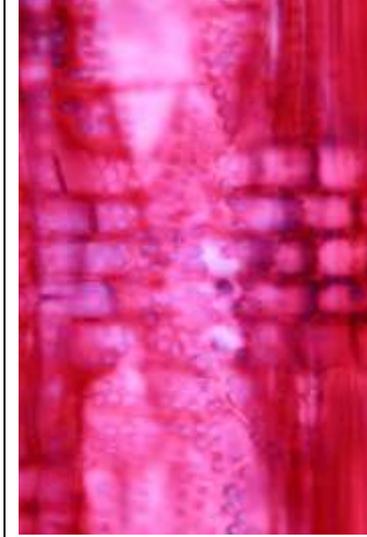
Stem bark: The phloem consist of alternating bands of fibre and collapsed and non-collapsed sieve tubes. Ray and parenchyma dilatations present. Crystal sand irregularly dispersed in the phloem. Phellem homogeneous consists of regularly arranged rectangular cells. Lignified cells in phellem, distinct in polarized light.

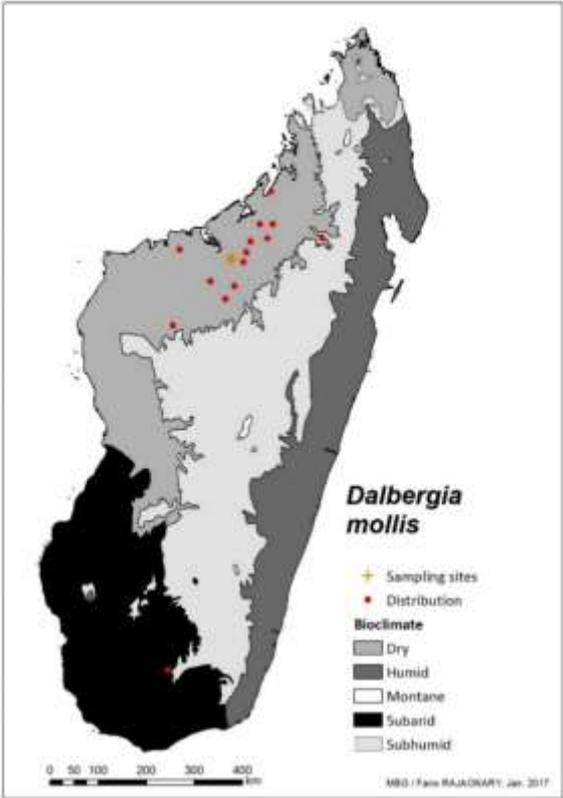


RBE 2452 x 200



RBE 2452 x 40

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct, marked by thick-walled and radially flattened latewood fibres and by differences in vessel diameter between earlywood and latewood. Wood semi-ring-porous. Vessels mostly solitary. Tangential diameter of earlywood vessels 50-140-250 and latewood vessels 50-67-80 μm, 7-14-24 vessels/mm^2. Gums and/or other deposits in heartwood vessels. Fibres thick- to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma in marginal bands. Rays 9-12-15 per mm.</p>	 <p>RBE 2452 x 40</p>	 <p>CR 6679 x 200</p>
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 6-9-12 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 110-162-210 μm. Fibres with simple to minutely bordered pits. Homogeneous all ray cells procumbent. Prismatic crystal in chambered axial parenchyma cells.</p>	 <p>RIR 2418 x 400</p>	 <p>RBE 2452 x 1000</p>
<p>Tangential section Rays uni-, bi- and triseriate simultaneously present. Rays predominantly biseriate. Ray height 70-138-350 μm, with 3-7-18 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied.</p>	 <p>RBE 2452 x 100</p>	 <p>RBE 2452 x 400</p>
<p><i>Dalbergia purpurascens</i> Baill.: RBE 2452, CR 6679, RIR 2418, CR 6679, RIR 2875 IAWA feature numbers 1b 4 13 22 26 29 30 41 42 47 52 58 62 66 68 69 70 76 77 90 91 104 106 116 136 142 180 189 190 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia mollis</i> Bosser & R. Rabev.	FABACEAE
Synonymy: <i>D. stenocarpa</i> var. <i>typica</i> R. Vig.	
Specimens : RIR 2478, CCR 6678, CR 6686, CR 6697	
Local names : Manary vazanomby, Manaritoloho, Manary bomby, Sandraza, Manarimbato, Manary fotsy, Manary tomboditotse, Manary, Manary vato	
<p>PLANT DESCRIPTION Shrub to tree 2-20 m high up to 22 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation:</i> 0-1000 m a.s.l. <i>Vegetation formation:</i> Forest and woodland <i>Bioclimate:</i> Dry, sub-arid and sub-humid <i>Protected areas:</i> Ankarafantsika, Zombitsy-Vohibasia and Mikea <i>New protected areas:</i> Sahafary</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries distinct marked by differences in vessel diameter between latewood and earlywood. Wood semi-ring-porous. Vessels solitary and in radial multiples of 2 rarely in clusters. Apotracheal axial parenchyma in short lines. Paratracheal axial parenchyma confluent and winged-aliform. Vessels large¹ and to rare². Tyloses present in vessels. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">CR 6686</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape round. Heterogeneous pith. Cells dimorphic. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles not distinct, vessels solitary and in short radial multiples.



CR 6697 x 200

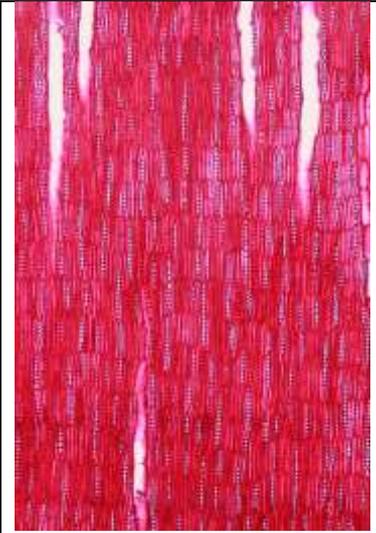
BRANCH XYLEM ANATOMY

Description: Growth ring boundaries distinct, marked by differences in vessel diameter between earlywood and latewood and by marginal parenchyma. Wood semi-ring-porous. Tangential diameter of earlywood vessels 35-46-80 μm and latewood vessels 70-102-170 μm , 32-45-55 vessels/ mm^2 . Vessel element length 100-132-150 μm . Intervessel pits small, 6-8-10 μm in diameter. Fibres thick to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma scanty, vasicentric, winged-aliform and in narrow lines up to three cells wide. Homogeneous rays, all rays are procumbent. Rays are predominantly biseriate. Ray height 70-126-220 μm . Rays 11-12-15 /mm.

Anatomical differences to stem xylem: Earlywood vessels in the stem are larger (70-102-170 / 100-155-230 μm). Vessel density is higher in the branch (32-45-55 / 15-21-28 vessels/ mm^2). Ray height in the stem is higher (70-126-220 / 30-346-720 μm) while ray number is comparable (11-12-15 / 9-10-12 rays/mm).



CR 6686 x 100

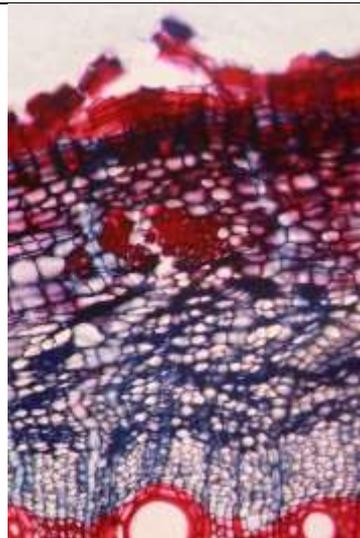


CR 6686 x 100

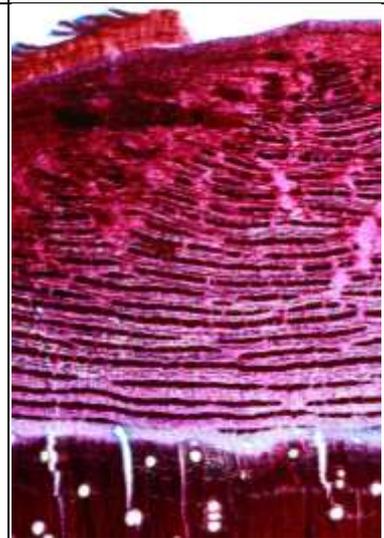
BARK ANATOMY

Branch bark: Collapsed sieve tubes and grouped fibre in tangential bands group present in the phloem. The cortex consists of irregular parenchyma cells.

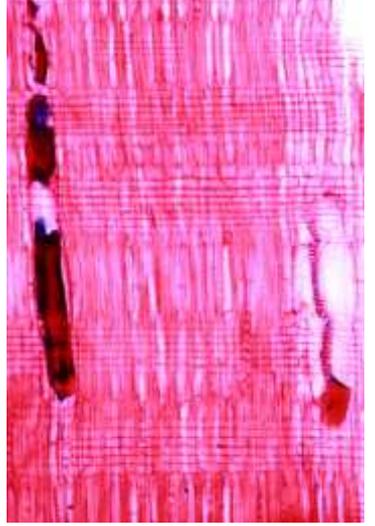
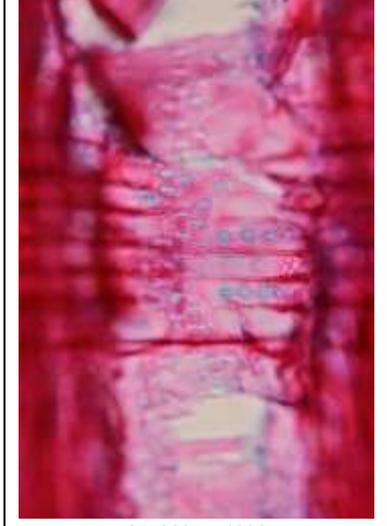
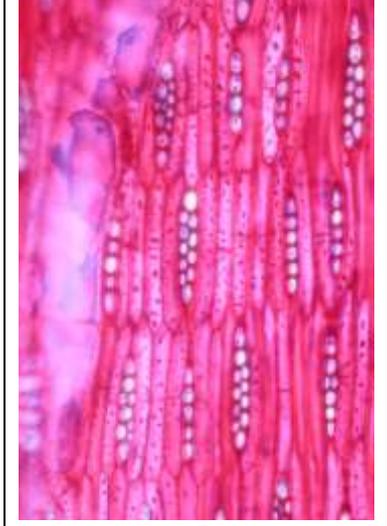
Stem bark: The phloem consists of alternating bands of fibres and collapsed and non-collapsed sieve tubes. Distinct ray and parenchyma dilatations present. Only some rays become dilated. Groups of fibres irregularly dispersed in the cortex. Prismatic crystals present in the sclereids. The layer phellem is homogeneous, consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem, distinct in polarized light.

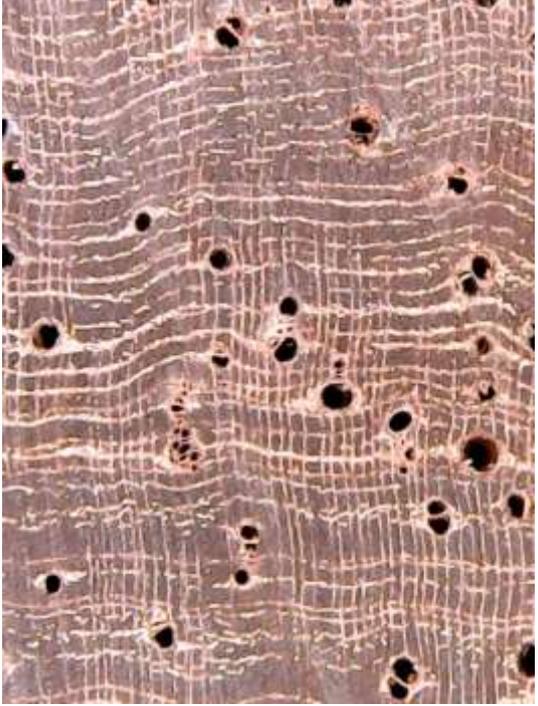


CR 6697 x 400



CR 6697 x 40

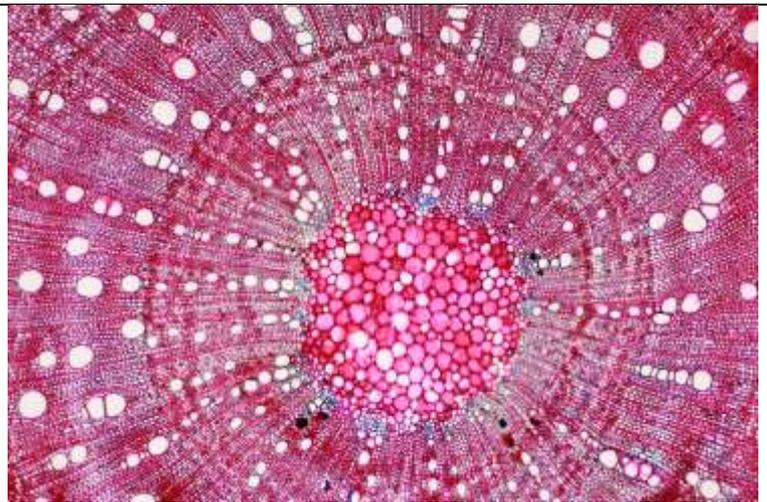
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct, marked by differences in vessel diameter between earlywood and latewood and by marginal parenchyma. Wood semi-ring-porous. Earlywood and latewood vessels solitary and in radial multiples of 2-4 cells present. Tangential diameter of earlywood vessels 30-64-95 μm and latewood vessels 100-155-250 μm, 15-21-28 vessels/mm^2. Fibres thick- to very thick-walled. Apotracheal parenchyma diffuse-in-aggregates. Paratracheal parenchyma rarely winged-aliform. Marginal or seemingly marginal parenchyma bands present. Rays 9-10-12 per mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 6-9-12 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 110-162-210 μm. Fibres with simple to minutely bordered pits. Homogeneous and heterogeneous, in some body rays cells procumbent with one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni-, bi- and triseriate simultaneously present. Rays predominantly biseriate. Ray height 30-346-720 μm, with 2-17-41 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements not storied.</p>		
<p><i>Dalbergia mollis</i> Bosser & R. Rabev.: RIR 2478, CCR 6678, CR 6686, CR 6697 IAWA feature numbers 1bc 4 13 22 25 29 30 41 42 48 52 61 66 69 70 77 82 90 91 97 104 115 136 142 180 189 190 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia maritima</i> R. Vig.	FABACEAE
Synonymy : -	
Specimens : SFR 255, RZK 8040, RZK 8035, RZK 7704	
Local names : Manary beravina, Volombodipony, Bandro, Voafaria, Andramena madinidravina Tombobitsy, Bois de rose, Manary tombombintsy, Tambobitsy	
<p>PLANT DESCRIPTION Tree 4-15 m high 8-30 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-1000 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Humid <i>Protected areas</i>: Analamazaotra, Andohahela, Mananara Nord and Betampona <i>New protected areas</i>: Makirovana-Tsihomanaomby</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 elements. Apotracheal axial parenchyma diffuse-in-agregates. Paratracheal axial parenchyma winged-aliform and confluent. Vessels large¹ and very rare². Tyloses present in vessels. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">SFR 255</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape round. Heterogeneous pith. Cells dimorphic. Thick-walled parenchyma cells present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles distinct, vessels solitary and in short radial multiples.



SFR 255 x 100

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 60-104-160 μm, 26-42-69 vessels/ mm². Vessel element length 100-165-210 μm. Intervessel pits small, 5-5-6 μm in diameter. Fibres thick- and very thick-walled. Apotracheal parenchyma diffuse-in-aggregates. Paratracheal parenchyma vasicentric, winged-aliform, confluent and in lines up to 3 cells wide. Body ray cells procumbent, one row upright and/or square marginal cells. Rays are predominantly uniseriate. Ray height 80-128-260 μm. Rays 12-14-17 /mm.

Anatomical differences to stem xylem: Mean tangential diameter in the stem larger (60-104-160 / 90-145-230 μm). Vessel density in the branch higher (26-42-69 / 2-4-6 vessels/mm²). Ray height in the branch is higher (80-128-260 / 25-113-200 μm) while ray number is similar (12-14-17 / 8-13-16 rays/mm).



SFR 255 x 100



SFR 255 x 100

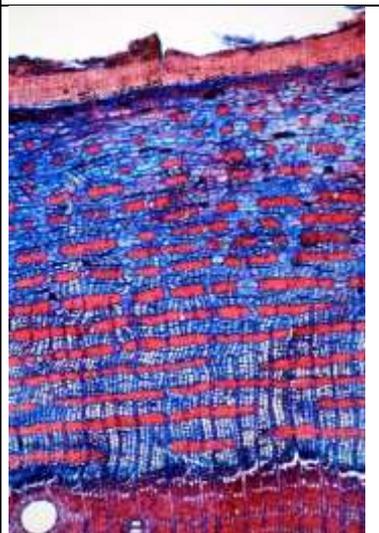
BARK ANATOMY

Branch bark: Sieve tubes, groups of fibre and collapsed sieve tubes present in the phloem. The cortex consists of rectangular parenchyma cells and group of tangentially distributed fibres.

Stem bark: The phloem consists of alternating bands of fibres and collapsed and non collapsed sieve tubes. Ray and parenchyma dilatations present. Prismatic crystals irregularly dispersed in the phloem. The phellem is homogeneous, consists of regularly arranged rectangular cells. Lignified cells in phellem, distinct in polarized light.



SFR 255 x 200



RZK 7704 x 100

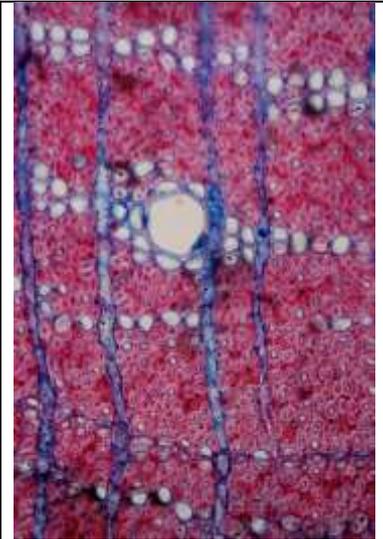
STEM XYLEM ANATOMY

Transverse section

Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-3 elements. Tangential diameter of the vessels 90-145-230 µm, 2-4-6 vessels/mm². Fibres very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma winged-aliform and in narrow bands up to three cells wide. Rays 8-13-16 /mm.



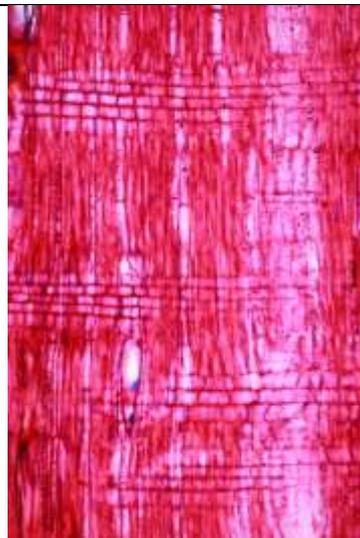
SFR 255 x 40



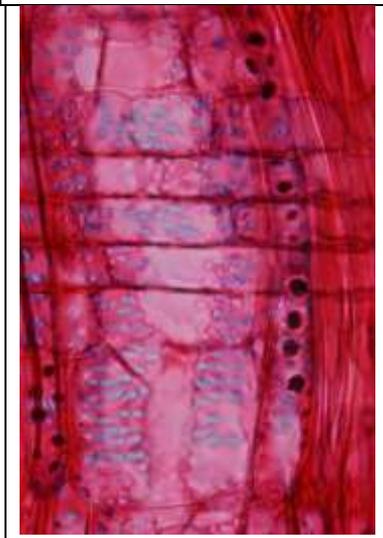
RZK 7704 x 400

Radial section

Simple perforation plates. Intervessel pits oval to circular and alternate, 6-8-10 µm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 130-187-220 µm. Fibres with simple and minutely borders pits. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.



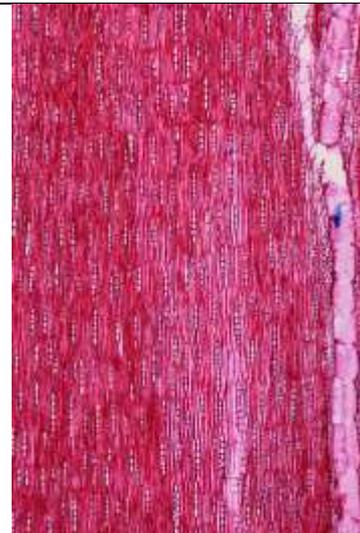
RZK 8040 x 200



RZK 8040 x 1000

Tangential section

Rays uni- and biseriate simultaneously present. Rays predominantly uniseriate. Ray height 25-113-200 µm, with 4-6-8 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements storied. Number of ray tiers per axial mm: 5-6.



RZK 8040 x 100

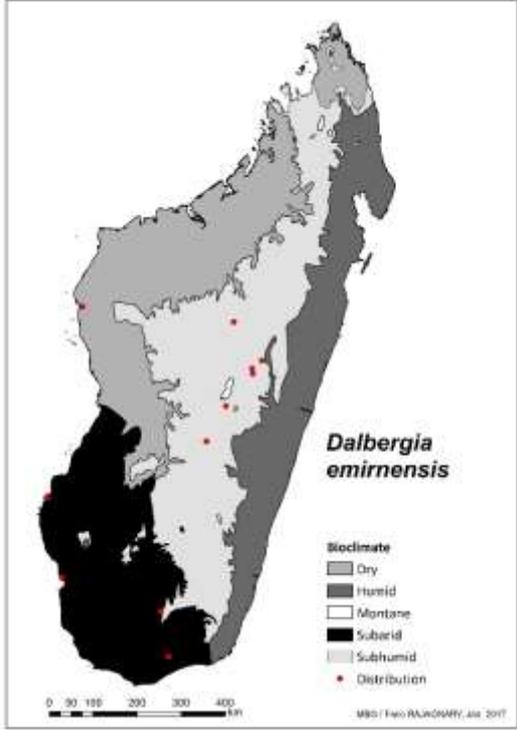
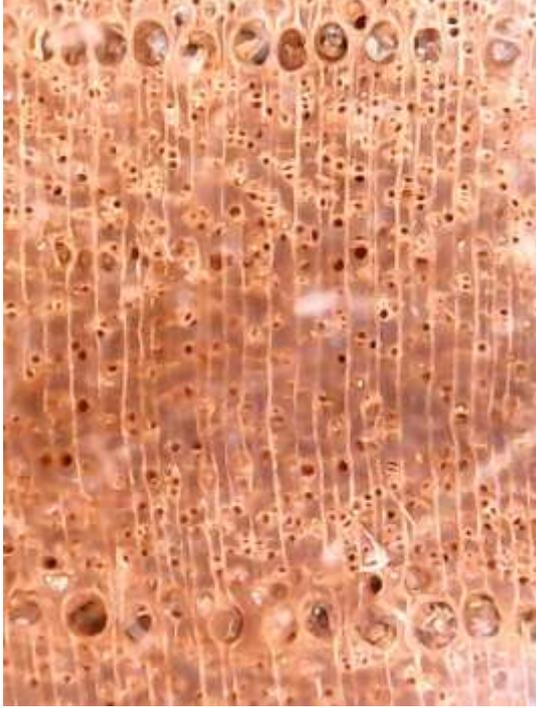


RZK 8040 x 400

Dalbergia maritima R. Vig.: SFR 255, RZK 8040, RZK 8035, RZK 7704

IAWA feature numbers 2 5 13 22 26 29 30 42 46 52 61 66 70 76 77 79 82 86 90 91 104 106 115 118 120 121 136 142 180 189 192 196

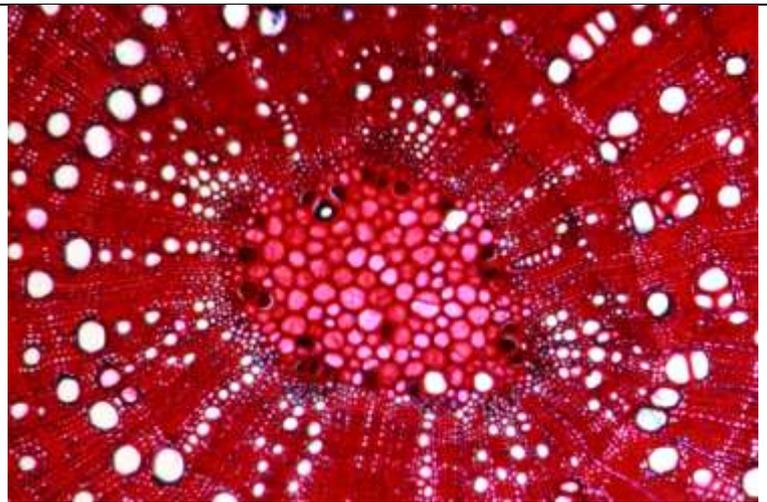
Additional features: 9.1 12.1 96.1 102.2

<i>Dalbergia emirrensis</i> Benth	FABACEAE
Synonymy : -	
Specimens : CR 6668, CR 6682, T24	
Local names : Manary vatany, Vohimboa, Manariborika, Manary belity, Manarintsaka, Manarinalafia	
<p>PLANT DESCRIPTION Shrub to tree 11-15 m high. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-1500 m a.s.l. <i>Vegetation formation</i>: Forests, freshwater wetland, inselberg/rock face and thicket <i>Bioclimate</i>: Dry, sub-arid and sub-humid <i>Protected areas</i>: Andohahela, Kirindy <i>New protected areas</i>: Mt Franais and Itremo/ Ambatofinandrahana</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries distinctly marked by differences in vessel diameter between latewood and early wood. Wood ring-porous. Vessels solitary, in radial multiples of 2 to 3 elements, in small clusters, large¹, rare². Tyloses present in vessels. Paratracheal axial parenchyma winged-aliform. Ray distinct with hand lens. ¹large: Distinct to the naked eye ²rare: 5-20 vessels/m²</p>	 <p style="text-align: center;">CR 6682</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape round. Heterogeneous pith. Cells dimorphic. Cells contents present. Thick-walled parenchyma cells present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles not distinct, vessels solitary and in long radial multiples of 2 to 4 elements.



CR 6668 x 200

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries distinct marked by differences in vessel diameter. Wood ring-porous. Tangential diameter of earlywood vessels 70-148-250 µm and latewood vessels 35-56-80 µm; 47-57-72 vessels/mm². Vessel element length 50-107-160 µm. Intervessel pits medium 4-6-7 µm in diameter. Fibres thick- to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma scanty and in marginal parenchyma bands. Ray height 80-220-505 µm. Rays 7-10-12/mm.

Anatomical differences to stem xylem: Mean tangential diameters of early wood and latewood vessels of the stem are larger (70-148-250 / 110-202-310 µm) (35-56-80 / 60-77-90 µm). Vessel density in the stem is higher 47-57-72 / 74-92-118 vessels/mm². Rays in the stem are predominantly biseriate while in the branch uniseriate. Rays in the stem are higher (80-170-370 / 80-220-505 µm). Ray number is higher in the branch (11-12-14 / 7-10-12 rays/mm).



CR 6682 x 100

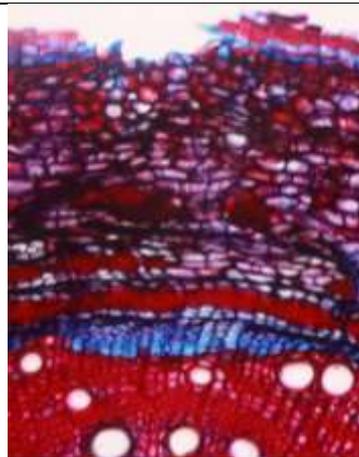


CR 6682 x 100

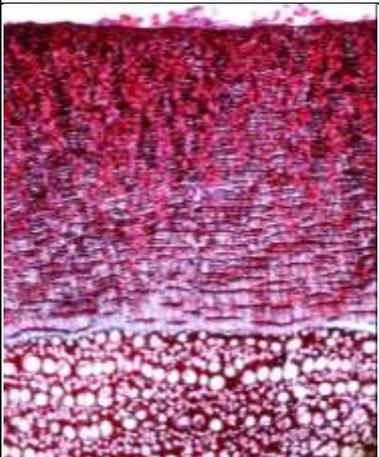
BARK ANATOMY

Branch bark: Sieve tubes, groups of fibre and collapsed sieve tubes present in the phloem. The cortex consists of irregular parenchyma cells and group of tangentially distributed fibres.

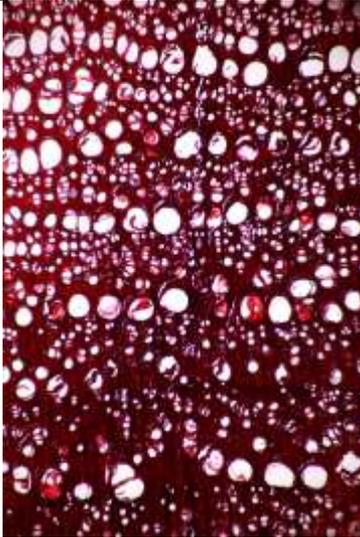
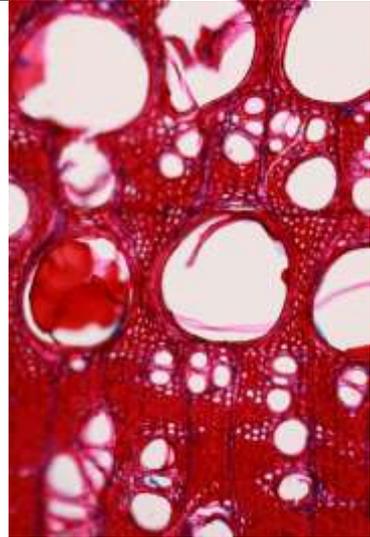
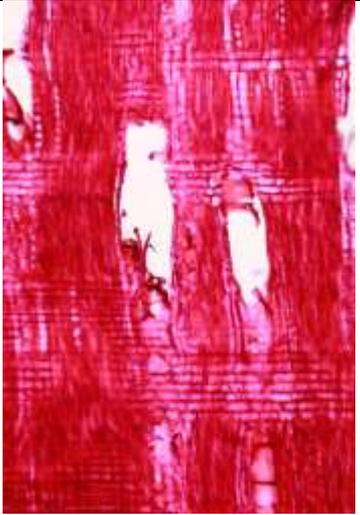
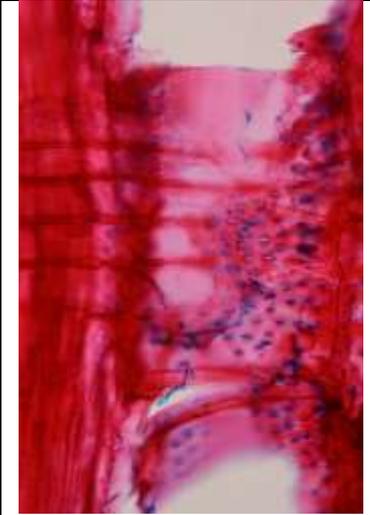
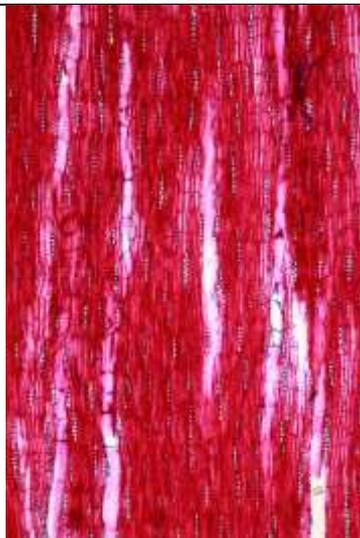
Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non collapsed sieve-tubes. Distinct ray and parenchyma dilatations present. Crystal sand irregularly dispersed in the phloem and cortex. The phellem is homogeneous, consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem, distinct in polarized light.

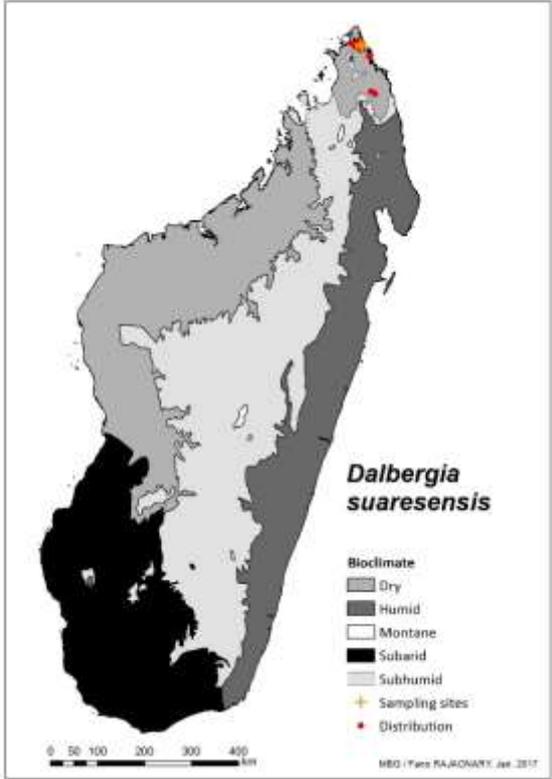


CR 6668 x 400



CR 6668 x 20

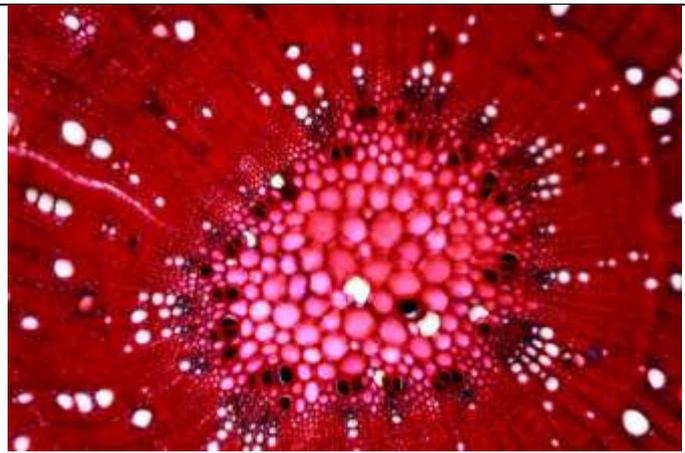
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct, marked by differences in vessel diameter between latewood and earlywood. Wood ring-porous. Earlywood vessels solitary, latewood vessels in radial multiples of 2-4 cells present. Tangential diameter of earlywood vessels 110-198-285 μm and of latewood vessels 35-65-100 μm, 50-89-121 vessels per mm^2. Fibres very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Rays 8-10-12/ mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits oval to circular, opposite to alternate, 6-8-10 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 50-189-450 μm. Fibres with distinctly bordered pits. Homogeneous rays, all rays cells are procumbent. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate simultaneously present, rarely triseriate Rays predominantly biseriate. Ray height 80-220-505 μm, with 3-11-33 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements not storied.</p>		
<p><i>Dalbergia emirrensis</i> Benth: CR 6668, CR 6682, T24 IAWA feature numbers 1b 3 13 22 26 29 30 41 42 49 52 56 61 66 69 70 77 78 90 91 97 104 115 136 142 180 189 190 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia suaresensis</i> Baill.	FABACEAE
Synonymy : <i>D. bernieri</i> Baill.	
Specimens : RIR 2446, RIR 2837, RIR 2843	
Local names : Manary mavo, Manary tsiandalana, palissandre, Manary	
<p>PLANT DESCRIPTION Tree 6-8 m high 8 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-500 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Dry <i>New protected areas</i>: Montagne des Français and Orangea/Rigny</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary and in radial multiples in 2 to 3 elements. Apotracheal axial parenchyma in narrow lines. Paratracheal axial parenchyma winged-aliform. Vessels large¹ and rare², tyloses present in vessels. Rays are thick³.</p> <p>¹large: Distinct to the naked eye ²rare: 5-20 vessels/m² ³thick: Distinct to the naked eye</p>	 <p>RIR 2837</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape round. Heterogeneous pith. Cells dimorphic. Cells contents present. Thick-walled parenchyma cells present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles not distinct, vessels solitary and in long radial multiples.



RIR 2837 x 200

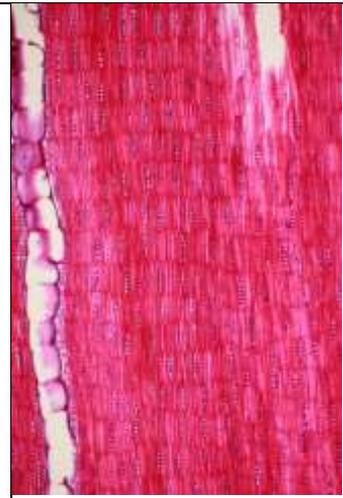
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 60-105-210 µm, 14-19-25 vessels/ mm². Vessel element length 115-153-230 µm. Intervessel pits medium, 6-7-8 µm in diameter. Fibres thin-, thick- and very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma vasicentric, winged-aliform and in lines up to 3 cells wide. Homogeneous rays. Rays are predominantly uniseriate. Ray height 65-100-150 µm. Rays 7-9-12 /mm. Number of ray tiers par axial mm: 6-6-7.

Anatomical differences to stem xylem: Mean tangential diameters in the stem larger (60-105-210 / 125-224-388 µm) (35-56-80 / 60-77-90 µm). Vessel density in the branch is higher 14-19-25 / 9-16-26 vessels/mm². Rays in the stem are predominantly biseriate while in the branch uniseriate. Rays height and number in the stem are higher (65-100-150 / 60-150-298 µm) (7-9-12 / 9-11-14 rays/mm).



RIR 2837 x 100

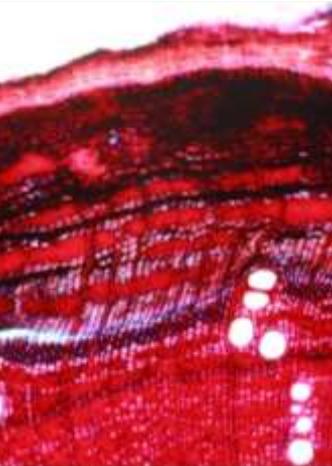


RIR 2837 x 100

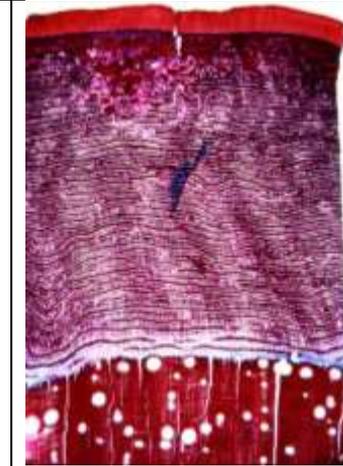
BARK ANATOMY

Branch bark: Sieve tubes, groups of fibre and collapsed sieve tubes present in the phloem. The cortex consists of irregular parenchyma cells and group of tangentially distributed fibres.

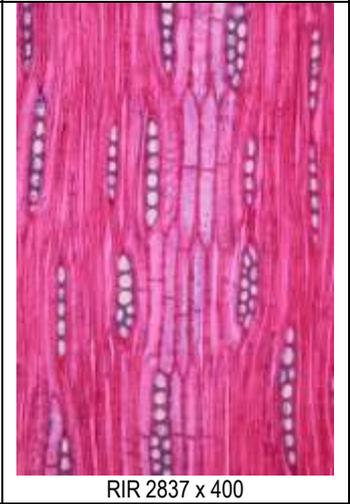
Stem bark: Phloem consists of alternating fibre bands and collapsed and non collapsed sieve-tubes. The cortex is characterized by groups of sclereids tangentially distributed. Distinct ray and parenchyma dilatations present. Prismatic crystals present in the sclereids. The phellem is homogeneous, consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem, distinct in polarized light.

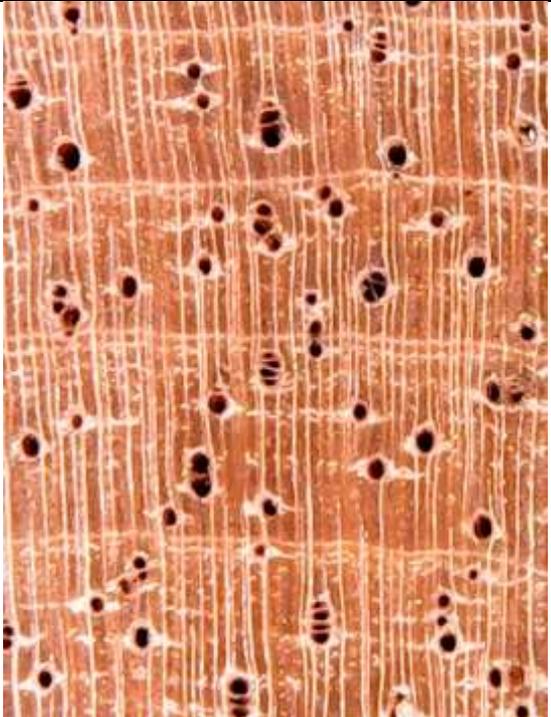


RIR 2837 x 400



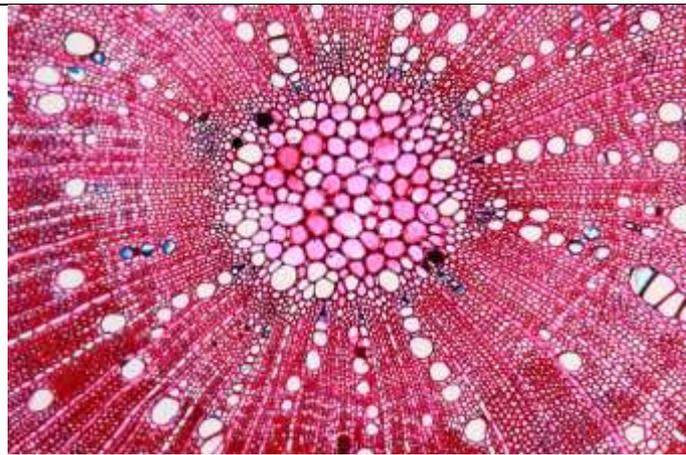
RIR 2837 x 20

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-4 elements. Vessels of two distinct diameter classes. Tangential diameter of the vessels 125-224-388 μm, 9-16-26 vessels/mm^2. Gums and/or other deposits in heartwood vessels. Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma vasentric, rarely winged-aliform and in narrow bands up to three cells. Rays 9-11-14 /mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits oval to circular and alternate, 4-6-8 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 97-152-220 μm. Fibres with distinctly bordered pits. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of spare marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate simultaneously present. Rays predominantly biseriate. Ray height 60-150-298 μm, with 2-7-14 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements not storied.</p>		
<p>Dalbergia suaresensis Baill.: RIR 2837, RIR 2843, RIR 2446 IAWA feature numbers 2 5 13 22 25 29 30 43 47 52 56 61 66 69 70 76 77 79 82 86 90 91 104 106 115 136 142 180 189 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia chapelieri</i> Baill.	FABACEAE
Synonymy : <i>D. pterocarpiflora</i> Baker	
Specimens : RZK 8026, SFR 257, RZK 7712	
Local names : Vimboa, Tsiatondro, Voamboatoholo, Magnaritoloho, Manaribe, Voamboana, Manary toloho, Hazovola, Hazovola fotsy, Sovoka	
<p>PLANT DESCRIPTION Shrub to tree 4-15 m high 11-22 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-1000 m a.s.l. <i>Vegetation formation</i>: Degraded formation and forests <i>Bioclimate</i>: Humid Protected areas: Analamazaotra-Périnet, Andasibe, Andohahela, Andringitra, Betampona, Manombo, Midongy du Sud, <i>New protected areas</i>: Analalava, Sahafary and Tampolo</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 4 elements. Apotracheal axial parenchyma in short lines and marginal bands. Paratracheal axial parenchyma winged-aliform. Vessels large¹ and rare². Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">SFR 257</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape round. Heterogeneous pith. Cells dimorphic. Cell contents. Simple pits in transverse cell walls. Pith visible in polarized light.
Primary xylem: Vascular bundles non separate, vessels solitary and in short radial multiples.

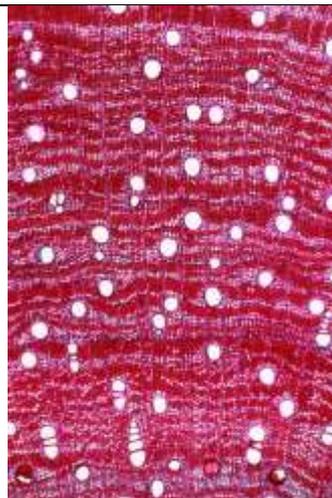


SFR 257 x 200

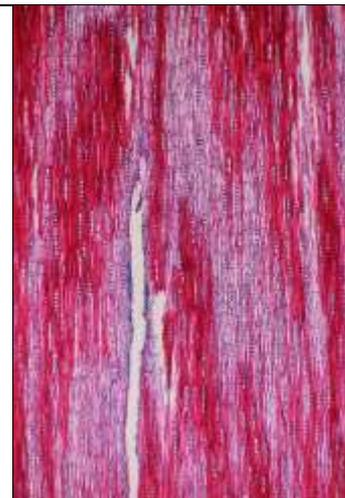
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 50-70-110 μm , 44-60-74 vessels/ mm^2 . Vessel element length 50-141-200 μm . Intervessel pits small, 4-6-7 μm in diameter. Fibres thin to thick to very thick-walled. Paratracheal parenchyma winged-aliform, confluent, in bands up to three and more than three cells wide. Two, four (3-4) cells per parenchyma strand. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Rays are predominantly uniseriate. Ray height 60-117-230 μm . Rays 11-13-17 /mm.

Anatomical differences to stem xylem: Mean tangential diameter in the stem is higher (50-70-110 / 70-100-1450 μm). Vessel density is rare in the stem (44-60-74 / 4-5-7 vessels/ mm^2). Two, four (3-4) cells per parenchyma strand in the branch. Ray height and ray number in the stem are higher (60-117-230 / 90-157-360 μm) (6-11-16/ 11/13/17 mm).



SFR 257 x 100

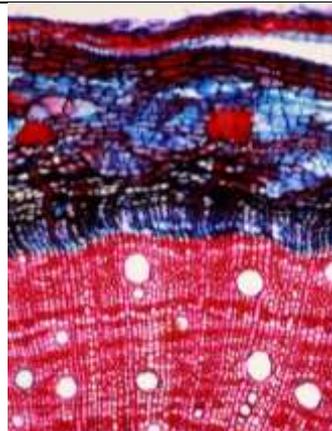


SFR 257 x 100

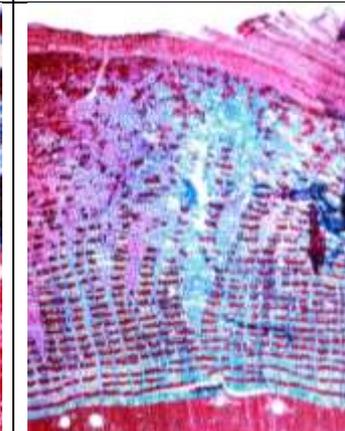
BARK ANATOMY

Branch bark: Collapsed sieve tubes alternating with groups of thick-walled fibres. The cortex consists of irregularly rectangular parenchyma cells.

Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non-collapsed sieve tubes. Parenchyma dilatation present. Only some rays become dilated. The phellem is homogeneous and it consists of regularly arranged rectangular cells. Lignified cells in phellem with prismatic crystals, distinct in polarized light.



SFR 257 x 200



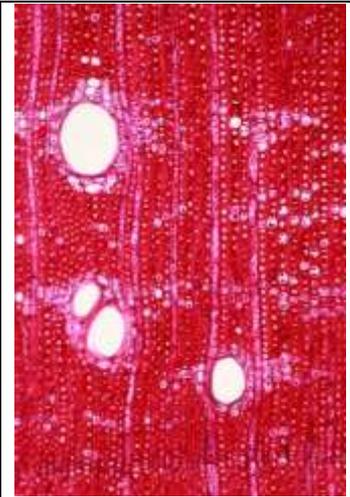
SFR 257 x 40

STEM XYLEM ANATOMY**Transverse section**

Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-5 elements. Tangential diameter of the vessels 70-100-145 μm , 4-5-7 vessels/ mm^2 . Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma winged-aliform. Seemingly parenchyma marginal bands present. Rays 6-11-16 /mm.



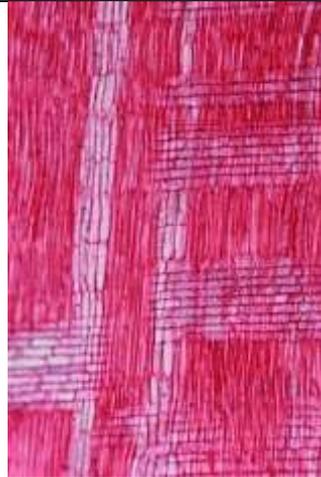
SFR 257 x 40



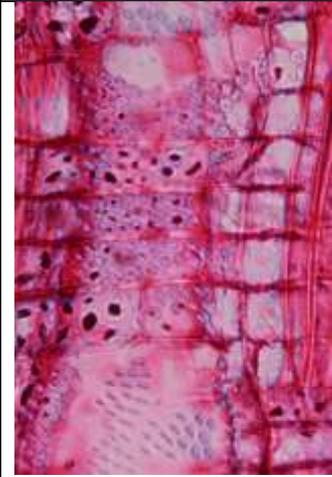
SFR 257 x 200

Radial section

Simple perforation plates. Intervessel pits oval to circular and alternate, 6-6-7 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 115-177-225 μm . Fibres with distinctly bordered pits. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.



SFR 257 x 200



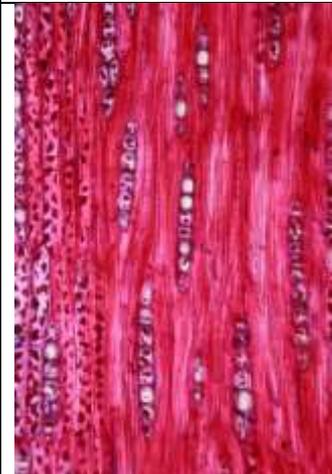
SFR 257 x 1000

Tangential section

Rays uni- and biseriate simultaneously present. Rays predominantly uniseriate. Ray height 90-157-360 μm , with 2-8-12 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied.



SFR 257 x 100

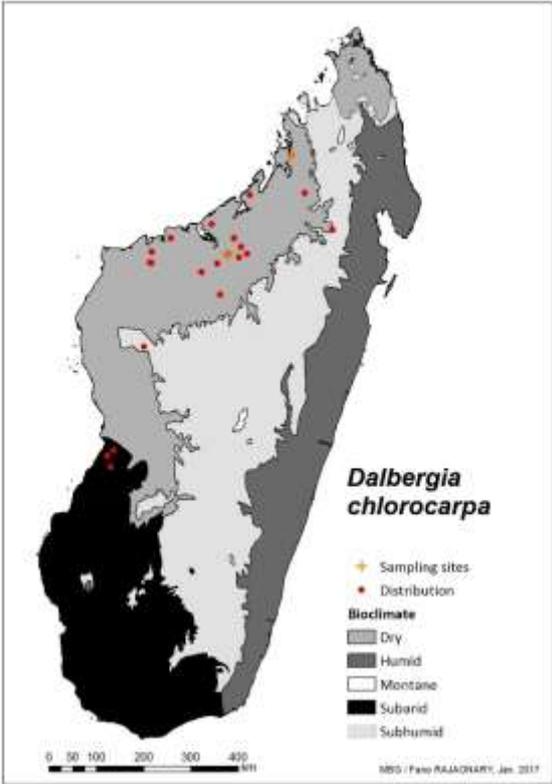
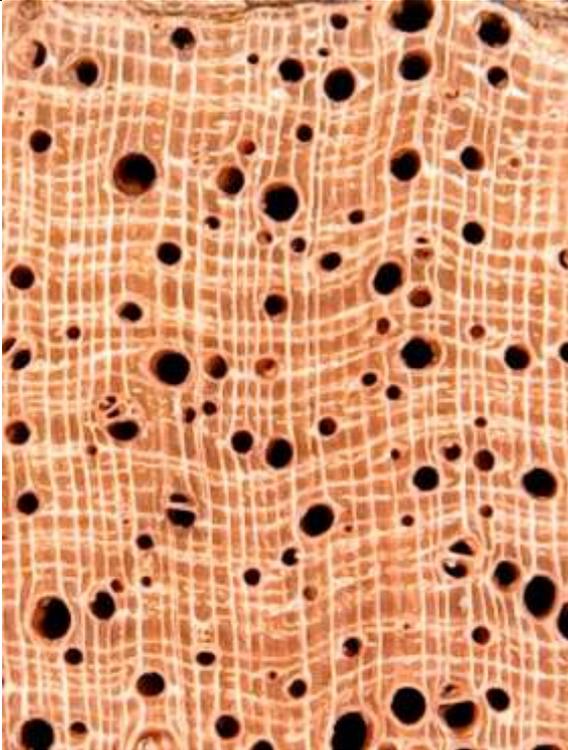


SFR 257 x 400

Dalbergia chapelieri Baill.: RZK 8026, SFR 257, RZK 7712

IAWA feature numbers 2 5 13 22 25 29 30 41 47 52 62 66 69 70 76 77 82 83 89 90 91 97 104 106 115 122 136 142 180 189 190 192 196

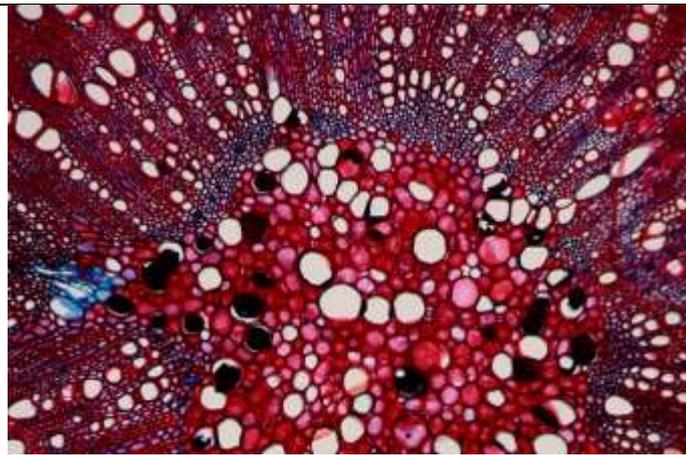
Additional features: 9.1 12.1 96.1 102.2

<i>Dalbergia chlorocarpa</i> R. Vig.	FABACEAE
Synonymy : -	
Specimens : RIR 2903, RIR 2904, RIR 2905	
Local names : Manarimboraka, Manary vimboa, Manary vazanomby, Votomborona, Tsiandalana, Manary boraka, Manarikaoty, Manary mavo	
<p>PLANT DESCRIPTION Tree 6-20 m high 10-30 cm DBH. Endemic to Madagascar. Exploited species</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-999 m a.s.l. <i>Vegetation formation</i>: Forest, Woodland <i>Bioclimate</i>: Dry, Subarid <i>Protected areas</i>: Andranomena, Ankarafantsika, Bemaraha, Kirindy Mitea, Loky Manambato (Daraina), Namoroka, Ankarafantsika <i>New protected ares</i> : -</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 elements. Vessels large¹ and rare². Tyloses present in vessels. Paratracheal axial parenchyma winged-aliform. Apotracheal axial parenchyma in bands. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">RIR 2904</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape pentagonal. Heterogeneous pith. A few scattered thick-walled parenchyma cells present. Cells dimorphic. Dark staining substances present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles distinct. Vessels solitary and in long radial multiples.



RIR 2904 x 200

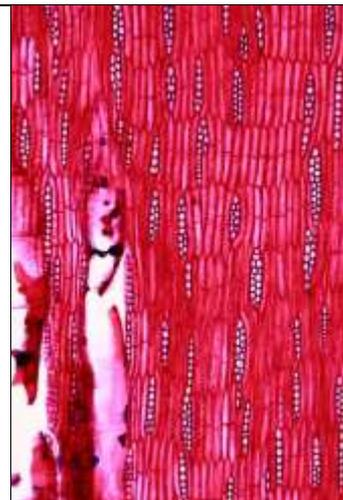
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 70-118-170 μm , 30-42-59 vessels/ mm^2 . Vessel element length 110-146-210 μm . Intervessel pits small, 4-6-8 μm in diameter. Fibres thin-, thick- and very thick-walled. Axial parenchyma diffuse, diffuse-in-aggregates, scanty, vasicentric and in bands of 2-5 cells wide. Heterogeneous rays predominantly biseriate. Ray height 55-119-270 μm . Rays 4-8-16/mm.

Anatomical differences to stem xylem: Growth ring distinct in the stem. Mean tangential diameter of vessel lumina is smaller in the branch (70-118-170 μm / 35-169-275 μm) while vessels number is higher (30-42-59 / 11-15-18 vessels/ mm^2). Heterogeneous rays in the branch. Ray height and ray number are higher in the stem than in the branch (55-119-270 / 80-237-540 μm) (4-8-16/ 11-12-13/mm). Rays, fibres and axial parenchyma irregularly storied.



RIR 2904 x 100

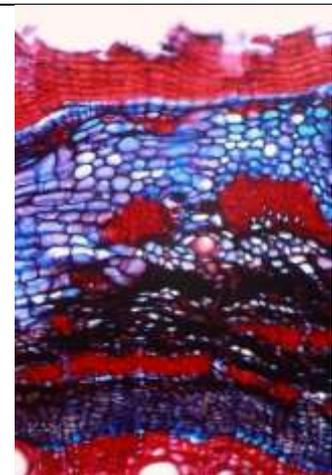


RIR 2904 x 200

BARK ANATOMY

Branch bark: Collapsed sieve tubes alternating with groups of thick-walled fibres. The cortex consists of irregularly rectangular parenchyma cells.

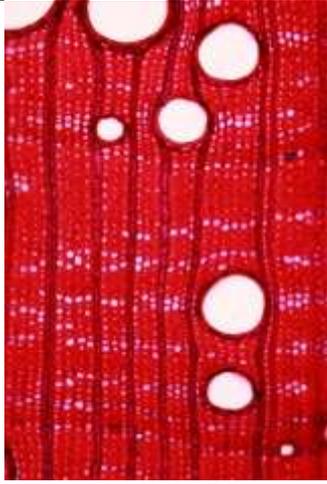
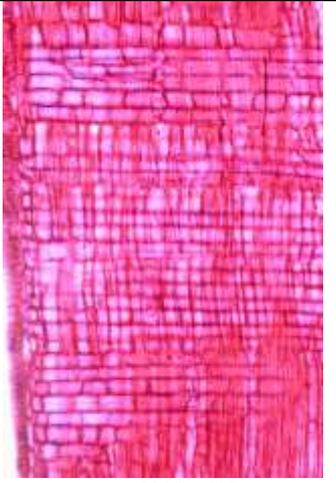
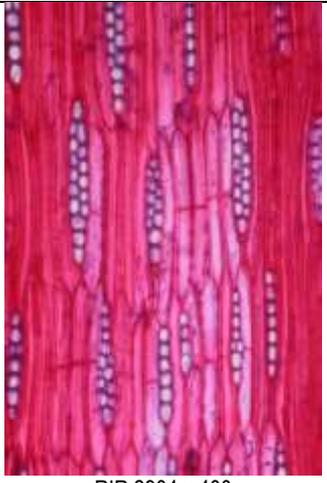
Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non-collapsed sieve tubes. Parenchyma dilatation present. Only some rays become dilated. The phellem is homogeneous and it consists of regularly arranged rectangular cells. Lignified cells in phellem with prismatic crystals, distinct in polarized light.



RIR 2904 x 400



RIR 2904 x 40

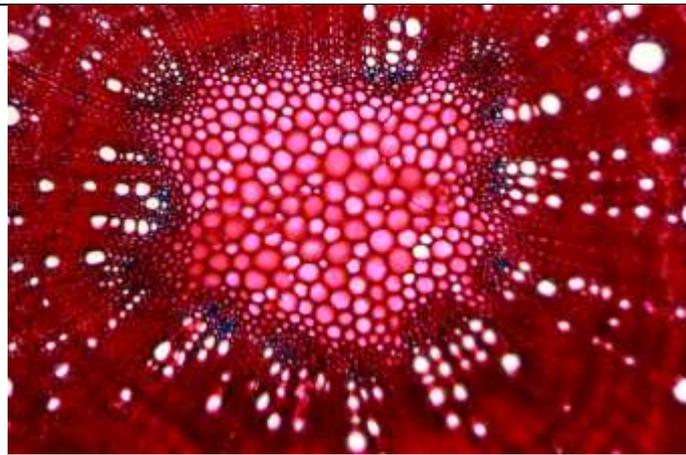
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct marked by marginal parenchyma. Wood semi-porous. Vessels solitary or in radial multiples of 2-3 elements. Tangential diameter of the vessels 35-169-275 μm, 11-15-18 vessels/mm^2. Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse-in-aggregates. Paratracheal parenchyma scanty and in narrow lines up to three cells wide. Rays 11-12-13/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 6-8-9 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 68-150-210 μm. Fibres with simple to minutely bordered pits. All ray cells procumbent. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni-, bi- and triseriate simultaneously present. Rays predominantly biseriate. Ray height 75-163-355 μm, with 4-10-26 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements not storied.</p>		
<p><i>Dalbergia chlorocarpa</i> R. Vig. : RIR 2903, RIR 2904, RBE 2905 IAWA feature numbers 1 5 13 22 26 29 30 42 47 52 61 66 69 70 77 78 86 90 91 97 104 115 136 142 180 189 192 196 Additional features: 9.1 12.1 96.1 102.3</p>		

<i>Dalbergia tricolor</i> Bosser & R. Rabev.	FABACEAE
Synonymy : -	
Specimens : RBE 2447, RBE 2448, RBE 2449	
Local names : Vahitaha, Manary baomba, Manary fotsy, Sangnary, Tsiandalana, Manarivoraka, Manary	
<p>PLANT DESCRIPTION Shrub to tree 6-20 m high 10-30 cm DBH. Endemic to Madagascar. Exploited species</p>	
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-1499 m <i>Vegetation Formation</i>: Forest, Inselberg/Rock Face and Woodland <i>Bioclimate</i>: Dry, Humid, Subhumid <i>Protected areas</i>: Ankarafantsika and Isalo <i>New protected areas</i> : Analavelona (Forêt Sacrée Alandraza Analavelo)</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 3 elements. Apotracheal axial parenchyme in narrow lines. Paratracheal axial parenchyma winged-aliform. Vessels large¹ and rare². Tyloses present in vessels. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">RBE 2448</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape polygonal. Heterogeneous pith. Cells dimorphic. Thick-walled parenchyma cells present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles distinct, vessels solitary and in long radial multiples



RBE 2448 x 200

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 40-57-90 μm , 20-35-63 vessels/ mm^2 . Vessel element length 90-129-150 μm . Intervessel pits small, 4-5-7 μm in diameter. Fibres very thin- and thick-walled. Apotracheal parenchyma diffuse-in-aggregates. Paratracheal parenchyma scanty, winged-aliform, confluent, in lines up to three cells and in bands more than 3 cells wide. Homogeneous and heterogeneous rays predominantly uniseriate. Ray height 70-120-240 μm . Rays 10-12-16/ mm .

Anatomical differences to stem xylem: Growth ring distinct in the stem. Mean tangential diameter of late wood vessel of the stem is larger (50-73-90 / 40-57-90 μm). Vessel density is higher in the branch 20-35-63 / 5-11-20 vessels/ mm^2 . Rays in the branch are shorter (70-120-240 μm / 70-163-420 μm) while ray number is similar (10-12-16 / 8-11-13 rays/ mm).



RBE 2448 x 100

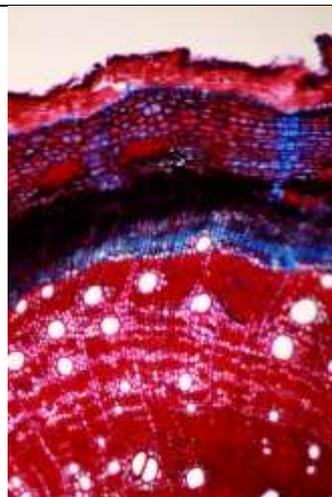


RBE 2448 x 100

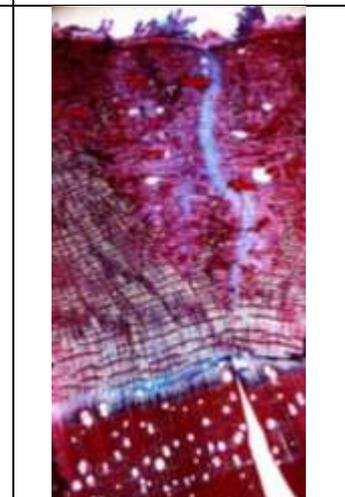
BARK ANATOMY

Branch bark: Sieve tubes, groups of fibre and collapsed sieve tubes present in the phloem. The cortex consists of rectangular parenchyma cells and group of tangentially distributed fibres.

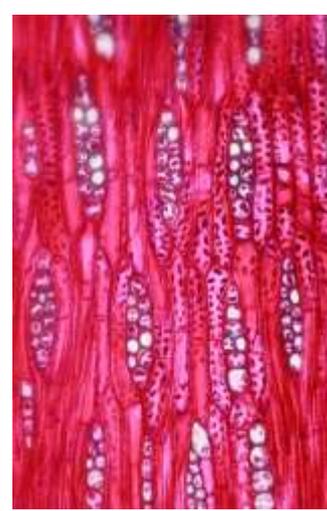
Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non collapsed sieve-tubes. Parenchyma dilatation and crystal sand scattered present in the cortex. The phellem is homogeneous, consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem, distinct in polarized light.



RBE 2448 x 200



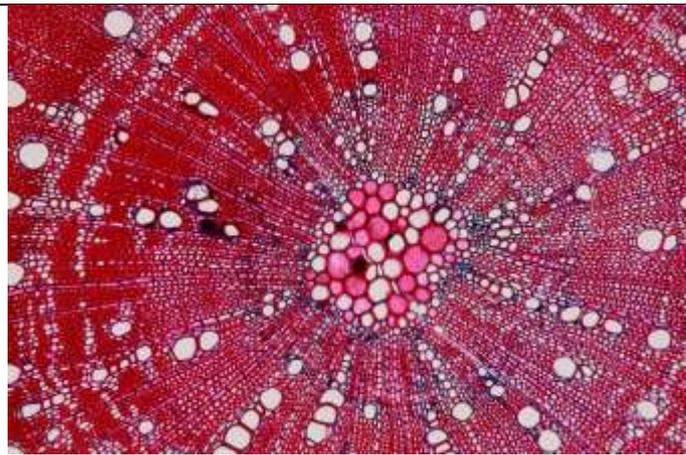
RBE 2448 x 200

<p>STEM XYLEM ANATOMY Transverse section Growth rings boundaries distinct, marked by thick-walled and radially flattened fibres and by differences in vessel diameter between latewood and earlywood. Wood semi-porous. Earlywood vessels mostly solitary, latewood vessels in radial multiples of 2-4 elements. Tangential diameter of earlywood vessels 50-73-90 µm and of latewood vessels 100-154-220 µm, 5-11-20 vessels per mm². Gums and/or other deposits in heartwood vessels. Fibres thick- to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma scanty. Rays 8-11-13/ mm.</p>	 <p>RBE 2448 x 40</p>	 <p>RBE 2448 x 200</p>
<p>Radial section Simple perforation plates. Intervessel pits oval to circular and alternate, 7-11-16 µm in diameter. Vested pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 110-170-260 µm. Fibres with distinctly bordered pits. Heterogeneous rays with body ray cells procumbent and one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>	 <p>RBE 2448 x 200</p>	 <p>RBE 2448 x 1000</p>
<p>Tangential section Rays uni- and biseriate simultaneously present, rarely triseriate. Rays predominantly biseriate. Ray height 70-163-420 µm, with 3-9-18 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand.</p>	 <p>RBE 2448 x 400</p>	 <p>RBE 2448 x 400</p>
<p>Dalbergia tricolor Drake : RBE 2447, RBE 2448, RBE 2449 IAWA feature numbers 1ab 4 13 22 27 29 30 41 42 47 52 62 66 69 70 76 77 78 82 90 91 97 104 106 115 136 142 180 189 190 192 196 Additional features : 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia monticola</i> Bosser & R. Rabev.	FABACEAE
Synonymy : -	
Specimens : SFR 262, T37	
Local names : Voamboana mena, Manariketsana, Voamboana madinidravina, Hazovola, Tsiandalana, Palissandre	
<p>PLANT DESCRIPTION Tree 7-30 m high 20-70 cm DBH Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-2000 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Humid and subhumid <i>Protected areas</i>: Analamazaotra-Périnet, Manongarivo, Ranomafana, Zahamena <i>New protected areas</i>: Ambatovy</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 4 elements. Vessels large¹ and rare². Paratracheal axial parenchyma confluent. Apotracheal axial parenchyma in bands. Rays are distinct with hand lens. ¹Large: Visible to the naked eye ²Rare: 5-20 vessels/mm²</p>	 <p style="text-align: center;">SFR 262</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape square. Heterogeneous pith. Cells dimorphic. Cell contents present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.
Primary xylem: Vascular bundles separate, vessels solitary and in long radial multiples.



SFR 262 x 200

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 60-101-180 μm , 20-43-93 vessels/ mm^2 . Vessel element length 120-153-200 μm . Intervessel pits small, 5-6-7 μm in diameter. Fibres thin- to thick-walled. Apotracheal parenchyma diffuse-in-aggregates. Paratracheal parenchyma confluent and in narrow lines up to three cells wide. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Rays are predominantly uniseriate. Ray height 60-102-160 μm . Rays 11-13-15/mm. Rays and/or axial elements irregularly storied.
Anatomical differences to stem xylem: Mean tangential diameter in the stem is higher (60-101-180 / 90-178-380 μm). Vessel density is rare in the stem (20-43-93 / 2-6-11 vessels/ mm^2). Rays are predominantly uniseriate in the branch while biseriate in the stem. Ray height in the stem is higher (60-102-160 / 70-161-300 μm) while ray number is comparable (11-13-15 / 8-12-15/mm).



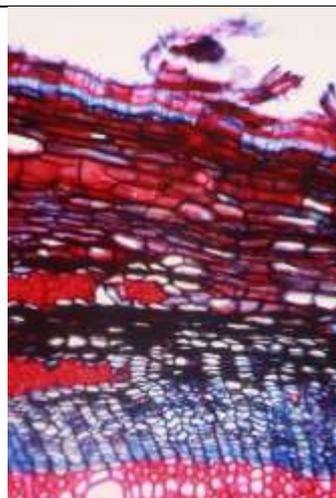
SFR 262 x 100



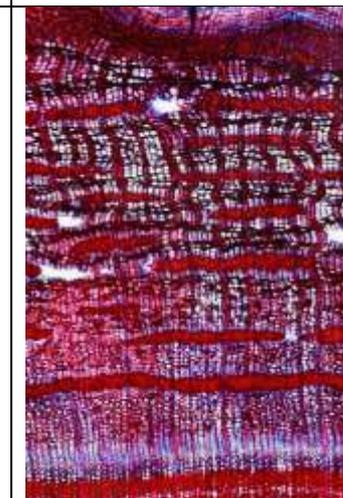
SFR 262 x 100

BARK ANATOMY

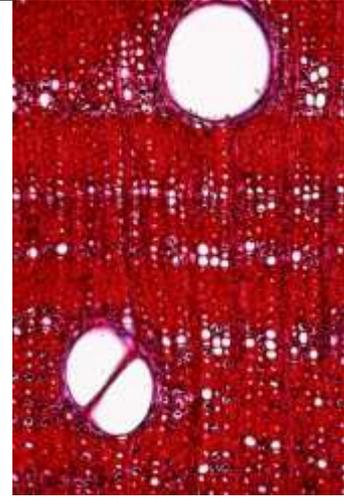
Branch bark: Sieve tubes, group of fibres and collapse sieve tubes present in the phloem. The cortex consists of rectangular parenchyma cells.
Stem bark: Phloem consists of alternating bands of fibre and collapsed and non collapsed sieve-tubes. Prismatic crystals present in the sclereids. The layer phellem is homogeneous, consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem, distinct in polarized light.



SFR 262 x 200



SFR 262 x 100

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-3 elements. Tangential diameter of the vessels 90-178-380 μm, 2-6-11 vessels/mm^2. Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma aliform to confluent and in bands more than 3 cells wide. Rays 8-12-15 /mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits oval to circular and alternate, 4-9-30 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 130-171-230 μm. Fibres with distinctly bordered pits. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- et bi- and triseriate simultaneously present. Rays predominantly biseriate. Ray height 70-161-300 μm, with 2-8-18 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements not storied.</p>		
<p><i>Dalbergia monticola</i> Bosser & R. Rabev.: SFR 262, T37 IAWA feature numbers 2 5 13 22 26 29 30 42 47 52 62 66 69 70 76 77 80 83 86 90 91 97 104 106 115 136 142 180 189 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia abrahamii</i> Bosser & R. Rabev.	FABACEAE
Synonymy : -	
Specimens : RIR 2834, RIR 2835	
Local names : -	
<p>PLANT DESCRIPTION Tree 7-16 m high 10-18 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-499 m a.s.l. <i>Vegetation formation</i>: forest, inselberg/rock face, woodland <i>Bioclimate</i>: dry <i>Protected areas</i>: Ankarana <i>New protected areas</i>: Mt Français</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries distinct marked by differences in vessel diameter between latewood and earlywood of the following ring. Wood semi-ring porous. Solitary vessels and in radial multiples of 2 to 5. Axial parenchyma diffuse-in aggregates and winged-aliform. Large¹ and rare² vessels. Tyloses present in the vessels. The rays are thick³.</p> <p>¹ Large: distinct to the naked eye ² Rare: 5-20 vessels/mm². ³ Thick: distinct to the naked eye</p>	 <p style="text-align: center;">RIR 2834</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape square. Heterogeneous pith. Cells dimorphic. Cell contents present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles separate, vessels solitary and in long radial multiples.



RIR 2834 x 100

Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 40-71-100 μm , 24-53-73 vessels/ mm^2 . Vessel element length 90-154-230 μm . Intervessel pits small, 4-5-8 μm in diameter. Fibres thin- to thick-walled. Paratracheal parenchyma confluent, in narrow lines up to three cells wide and in bands more than three cells wide. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Rays are predominantly uniseriate. Ray height 50-128-240 μm . Rays 11-13-16 /mm. Rays and/or axial elements irregularly storied.

Anatomical differences to stem xylem: Mean tangential diameter in the stem is higher (40-71-100 / 50-104-170 μm). Vessel density is rare in the stem (24-43-73 / 3-7-15 vessels/ mm^2). Ray height in the stem is higher (50-128-240 / 70-164-290 μm) while ray number is similar (11-13-16 / 11-13-14/mm).



RIR 2834 x 100

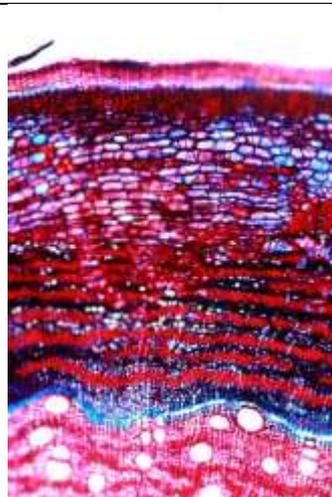


RIR 2834 x 100

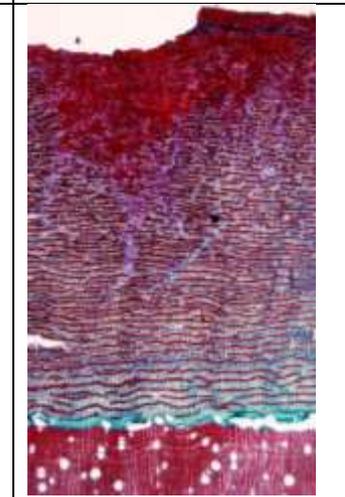
BARK ANATOMY

Branch bark: Sieve tubes, group of fibres and collapse sieve tubes present in the phloem. The cortex consists of rectangular parenchyma cells.

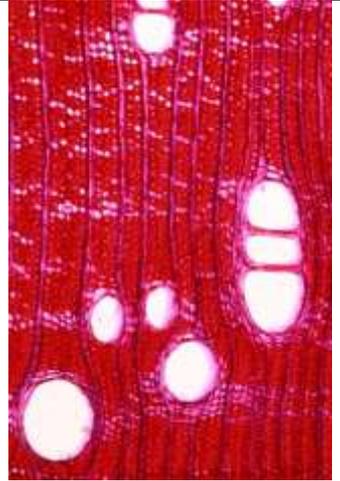
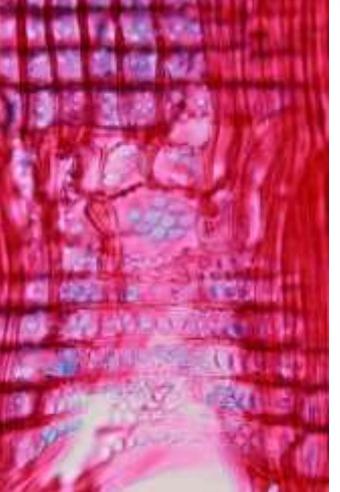
Stem bark: Phloem consists of alternating bands of fibre and collapsed and non collapsed sieve-tubes. Crystal sands irregularly present and prismatic crystals present in the sclereids. The layer phellem is homogeneous, consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem, distinct in polarized light

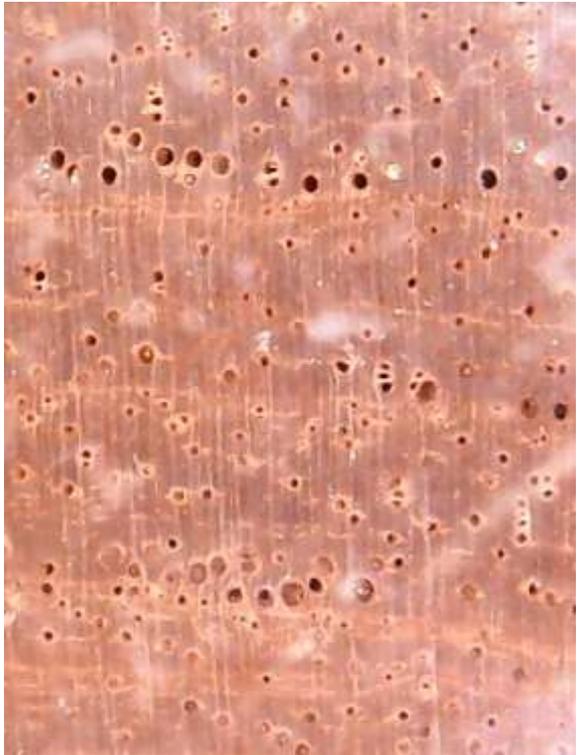


RIR 2834 x 200



RIR 2834 x 20

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct. Wood semi-porous. Vessels solitary and in radial multiples of 2-5 elements. Tangential diameter of earlywood vessels large 50-100-160 μm and of latewood vessels medium 20-44-90 μm, 12-17-25 vessels/mm^2. Fibres thin to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma vasicentric and winged-aliform. Rays 15-17-18/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 4-7 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 140-167-210 μm. Fibres with simple to minutely bordered pits. Homogeneous rays with all cells procumbent. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate simultaneously present. Rays predominantly uniseriate. Ray height 70-106-140 μm, with 4-7-10 cells in height. Axial parenchyma strands composed of 1-2 cells. Fusiform parenchyma cells present. Rays, fibres and axial parenchyma regularly storied. Number of ray tiers par axial mm: 6-7-7.</p>		
<p><i>Dalbergia abrahamii</i> Bosser & R. Rabev.: RIR 2834, RIR 2835 IAWA feature numbers 1b 4 9 13 22 25 29 30 41 47 52 61 66 69 70 76 77 79 82 90 91 97 104 116 118 120 121 136 142 180 189 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

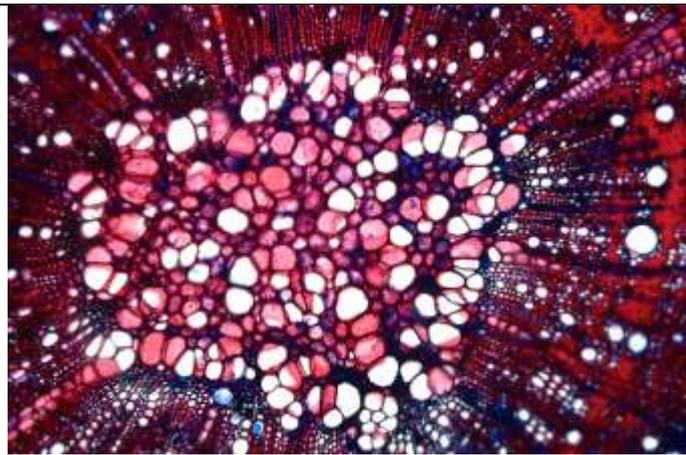
<i>Dalbergia lemurica</i> Bosser & R. Rabev.	FABACEAE
Synonymy : -	
Specimens : RIR 2430, CR 6675	
Local names : Manary ravikily, Manary tsiatondro, Manipika, Manaritoloho, Manary mainty, Manary	
<p>PLANT DESCRIPTION Shrub to tree 6-10 m high 20-100 cm DBH Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-500 m a.s.l. <i>Vegetation formation</i>: Forest and woodland <i>Bioclimate</i>: Dry and sub-arid <i>Protected areas</i>: Bemaraha, Kirindy-Mitea <i>New protected areas</i>: Orangea/Rigny and Sahafary</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries distinct. Ring semi-porous. Vessels solitary and in radial multiples of 2 to 3 elements, rarely in clusters. Apotracheal axial parenchyma diffuse-in-aggregates and in marginal bands. Paratracheal axial parenchyma confluent and winged-aliform. Vessels large¹ and rare². Tylosis present in the vessels. Rays distinct with hand lens.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm²</p>	

CR 6675

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith polygonal. Prismatic crystals rare. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles not distinct. Vessels solitary and in short radial multiples.



RIR 2430 x 100

Description: Growth rings boundaries indistinct. Tangential diameter of vessels 40-68-90 μm , 14-27-38 vessels/ mm^2 . Vessel element length 50-115-180 μm . Intervessel pits small, 5-7-8 μm in diameter. Fibres thin- to thick-walled to very thick-walled. Apotracheal parenchyma diffuse-in-aggregates. Paratracheal parenchyma vasicentric, winged-aliform and in narrow lines up to 3 cells wide. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Ray are predominantly uniseriate. Ray height 60-114-200 μm . Rays 9-11-13 /mm.

Anatomical differences to stem xylem: Growth rings boundaries distinct marked by differences in vessels diameter in the stem. Vessel number is comparable (19-26-33 / 14-27-38 vessels/ mm^2). Ray height in the branch is higher (60-114-200 μm / 60-90-180 μm) while ray number is higher in the stem (9-11-13 / 13-15-17 per mm).



CR 6675 x 100



RIR 2430 x 100

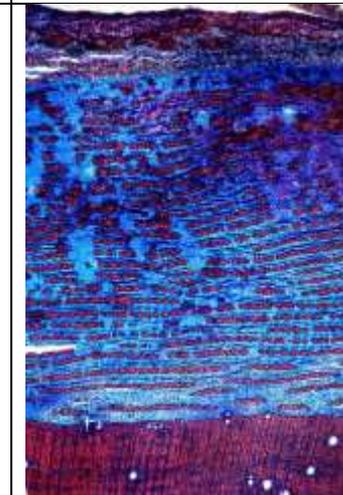
BARK ANATOMY

Branch bark: Sieve tubes, groups of fibre and collapsed sieve tubes present in the phloem. The cortex consists of large blue-stained parenchyma cells and group of tangentially distributed fibres.

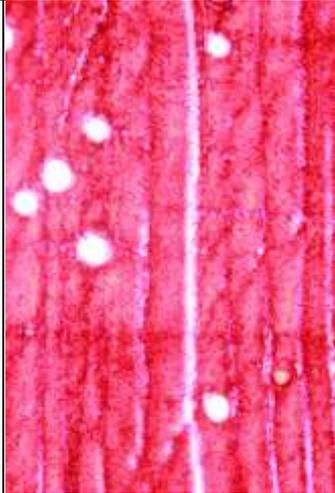
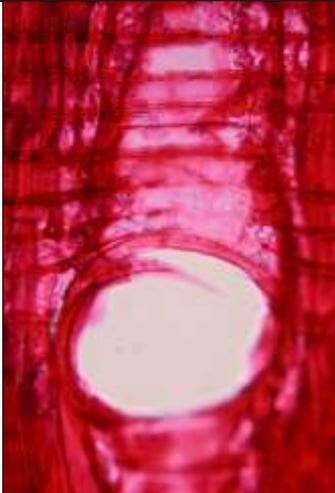
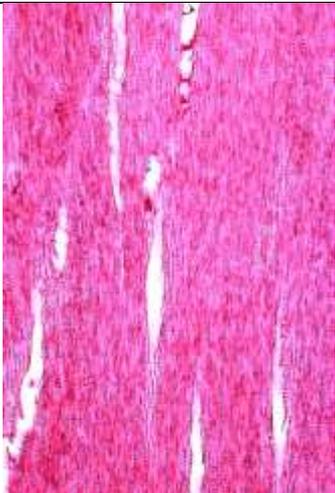
Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non-collapsed sieve tubes. Parenchyma dilatation present. The layered phellem is homogeneous and consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem distinct in polarized light.



RIR 2430 x 200



RIR 2430 x 20

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct, marked by differences in vessel diameter between earlywood and latewood and marginal parenchyma. Wood semi-ring-porous. Vessels solitary or in radial multiples of 2-4 elements. Tangential diameter of earlywood vessels 70-111-150 and latewood vessels 40-58-80 μm, 19-26-33 vessels/mm^2. Tylosis present in the heartwood vessels. Fibres very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma vasicentric, winged-aliform and in bands up to three cells. Rays 13-15-17 per mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 2-4-5 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 75-136-170 μm. Fibres with simple to minutely bordered pits. Homogeneous all ray cells procumbent. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni-, bi- and triseriate simultaneously present. Rays predominantly biseriate. Ray height 70-138-350 μm, with 3-7-18 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied.</p>		
<p>Dalbergia lemurica Bosser & R. Rabev.: RIR 2430, CR 6675 IAWA feature numbers 1bc 4 13 22 25 29 30 41 42 48 52 56 62 66 68 70 76 77 79 82 86 90 91 97 104 116 122 136 142 180 190 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia masoalensis</i> Bosser & R. Rabev.	FABACEAE
Synonymy : -	
Specimens : RBE 2485, RBE 2455	
Local names : Manary ravikily, Manary tsiatondro, Manipika, Manaritoloho, Manary mainty, Manary	
<p>PLANT DESCRIPTION Shrub up to 5 m high Endemic to Madagascar. Non exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-499 m <i>Vegetation Formation</i>: Forest <i>Bioclimate</i>: Humid <i>Protected areas</i> : Masoala New protected areas: -</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 elements. Apotracheal axial parenchyma in bands. Paratracheal axial parenchyma confluent. Vessels large¹ and very rare². Tyloses present in vessels. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²very rare: < 5mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">RBE 2485</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape oval. Heterogeneous pith. Cells dimorphic. Prismatic crystals present. Simple pits in transverse cell walls. Vascular bundles distinct. Pith visible in polarized light.

Primary xylem: Vessels solitary and in long radial multiples.



RBE 2479 x 100

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 30-52-80 μm , 7-18-44 vessels/ mm^2 . Vessel element length 105-130-150 μm . Intervessel pits medium, 5-7-10 μm in diameter. Fibres very thin- and thick-walled. Axial parenchyma diffuse, diffuse-in-aggregates, in lines up to three cells and in bands more than 3 cells wide. Homogeneous and heterogeneous rays predominantly biseriate. Ray height 60-107-160 μm . Rays 11-14-16/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is smaller in the branch (30-52-80 μm / 70-136-240 μm). Vessel density is higher in the branch 10-17-22 / 0-4-8 vessels/ mm^2 . Rays in the branch are shorter (60-107-160 / 80-121-260 μm). Ray number is higher in the branch (11-14-16 / 9-12-15 rays/mm).



RBE 2485 x 100

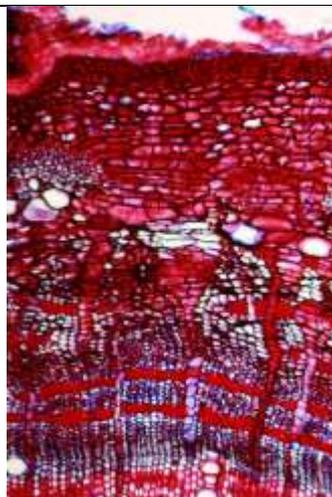


RBE 2485 x 100

BARK ANATOMY

Branch bark: The phloem consists of alternating tangential bands of fibres and collapsed and non-collapsed sieve tubes. The cortex consists of irregularly shaped parenchyma cells with some lignified cells irregularly distributed.

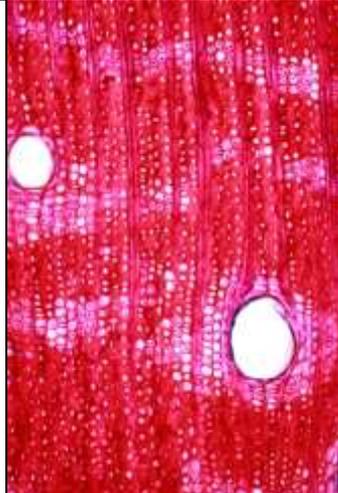
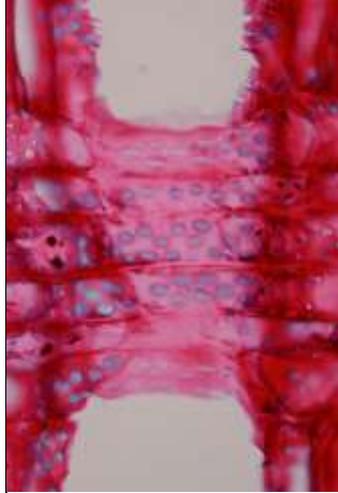
Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non-collapsed sieve tubes. Parenchyma dilatation present. The layered phellem is homogeneous and it consists of regularly arranged rectangular cells. Lignified cells in phellem with prismatic crystals, distinct in polarized light.

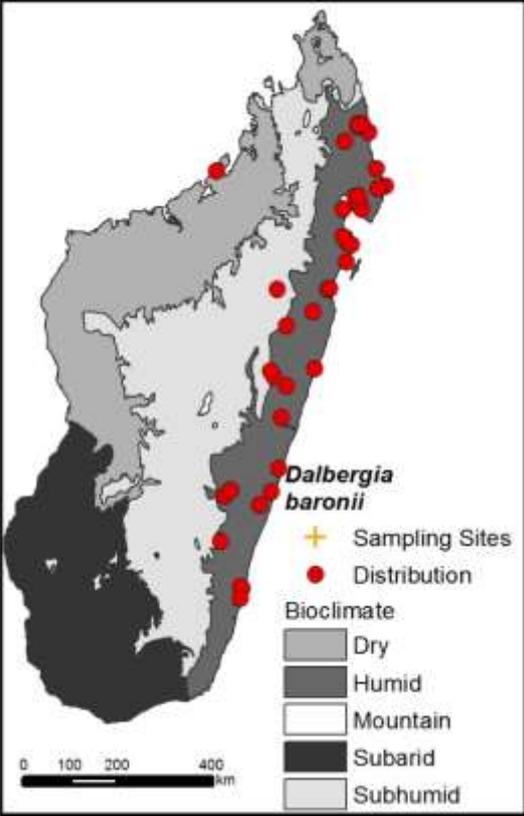


RBE 2455 x 400



RBE 2455 x 40

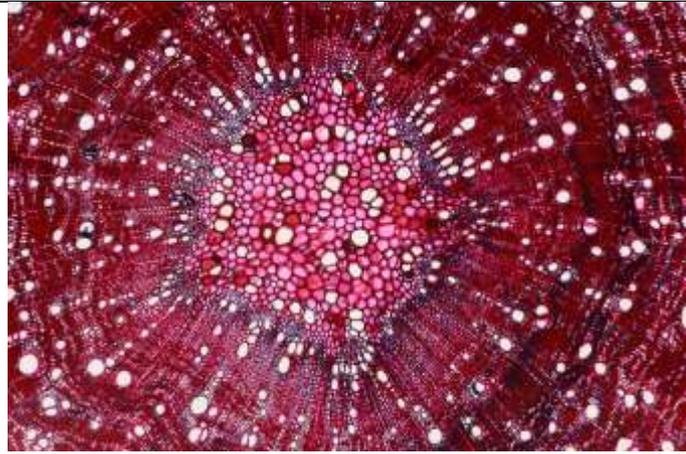
<p>STEM XYLEM ANATOMY <i>Transverse section</i></p> <p>Growth ring boundaries indistinct or absent. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-3 elements. Tangential diameter of the vessels 70-136-240 μm, 1-6-26 vessels/mm^2. Fibres thick- to very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma winged-aliform, confluent and in bands more than three cells wide. Rays 9-12-15/mm.</p>		
<p><i>Radial section</i></p> <p>Simple perforation plates. Intervessel pits oval to circular and alternate, 7-10-12 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 130-176-250 μm. Fibres with simple to minutely bordered pits. Heterogeneous rays with body ray cells procumbent and one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p><i>Tangential section</i></p> <p>Rays uni-, bi- and triseriate simultaneously present. Rays predominantly biseriate. Ray height 80-121-260 μm, with 3-6-12 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied.</p>		
<p><i>Dalbergia masoalensis</i> Bosser & R. Rabev.: RBE 2485, RBE 2455 IAWA feature numbers 2 5 13 22 26 29 30 42 47 52 61 62 66 69 70 76 77 82 83 85 86 90 91 97 106 122 136 142 180 189 190 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia baronii</i> Baker	FABACEAE
Synonymy : -	
Specimens : T12, RBE 2469	
Local names : Voamboana, Volomborona, Sovoka, Hazovola, Volombodimborona, Sovodrano, Lovoka, Voamboana vavy, Palissandre	
<p>PLANT DESCRIPTION Shrub to tree 3-30 m high 8-40 cm DBH Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-2000 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Humid and subhumid <i>Protected areas</i>: Analamazaotra-Périnet, Manongarivo, Ranomafana and Zahamena <i>New protected areas</i>: Ambatovy</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 3 elements. Paratracheal axial parenchyma confluent and vasicentric. Apotracheal axial parenchyma in bands. Vessels large¹ and very rare². Ray distinct with hand lens.</p> <p>¹Large: Distinct to the naked eye ²Very rare: < 5 vessels/mm²</p>	 <p style="text-align: center;">RBE 2469</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape square. Heterogeneous pith. Cells dimorphic. Cell contents present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles separate, vessels solitary and in long radial multiples.

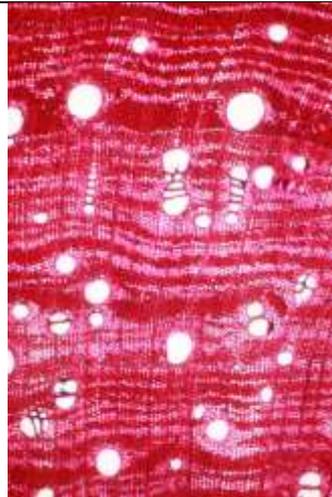


RBE 2469 x 100

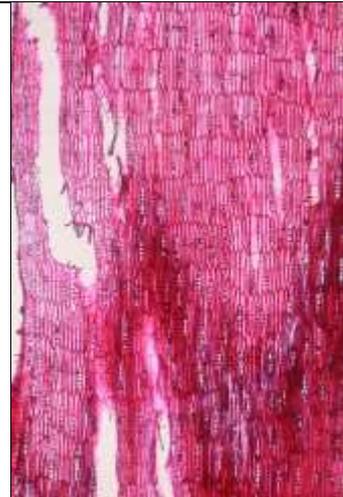
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 40-71-100 μm , 24-53-73 vessels/ mm^2 . Vessel element length 90-154-230 μm . Intervessel pits small, 4-5-8 μm in diameter. Fibres thin- to thick-walled. Paratracheal parenchyma confluent, in narrow lines up to three cells wide and in bands more than three cells wide. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Rays are predominantly uniseriate. Ray height 50-128-240 μm . Rays 11-13-16 /mm. Rays and/or axial elements irregularly storied.

Anatomical differences to stem xylem: Mean tangential diameter in the stem is higher (40-71-100 / 50-104-170 μm). Vessel density is rare in the stem (24-43-73 / 3-7-15 vessels/ mm^2). Ray height in the stem is higher (50-128-240 / 70-164-290 μm) while ray number is similar (11-13-16 / 11-13-14/mm).



RBE 2469 x 100

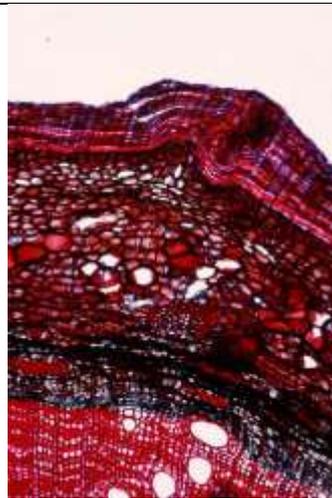


RBE 2469 x 100

BARK ANATOMY

Branch bark: Sieve tubes, group of fibres and collapse sieve tubes present in the phloem. The cortex consists of rectangular parenchyma cells.

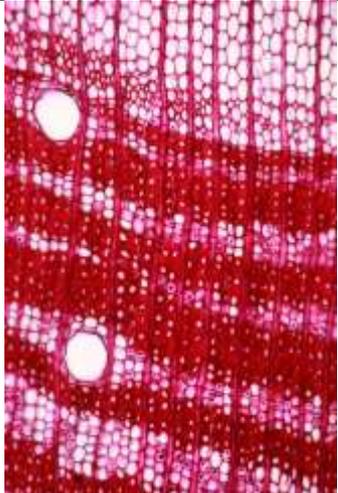
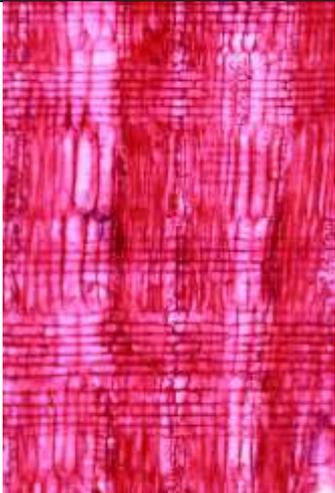
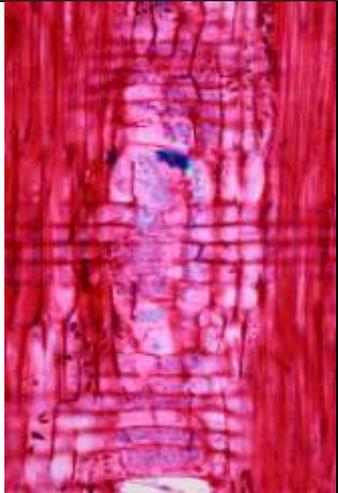
Stem bark: Phloem consists of alternating bands of fibre and collapsed and non collapsed sieve-tubes. Crystal sands irregularly present and prismatic crystals present in the sclereids. The layer phellem is homogeneous, consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem, distinct in polarized light

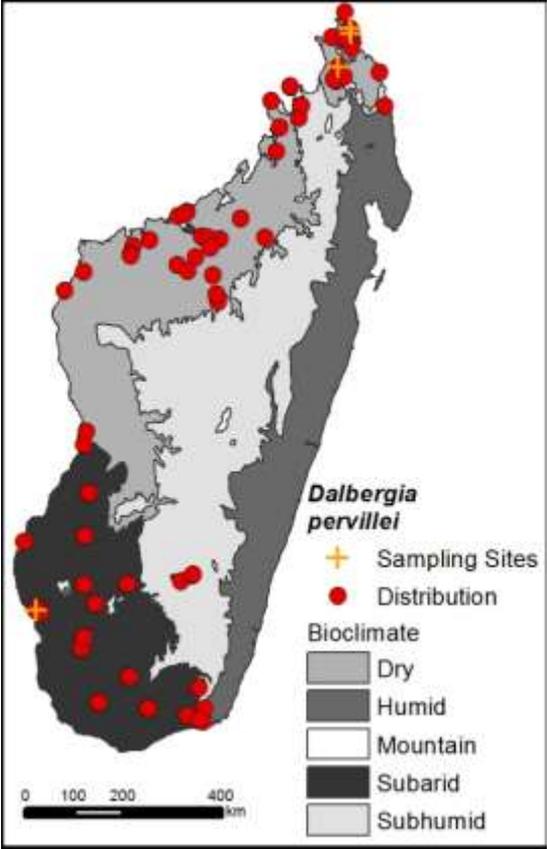
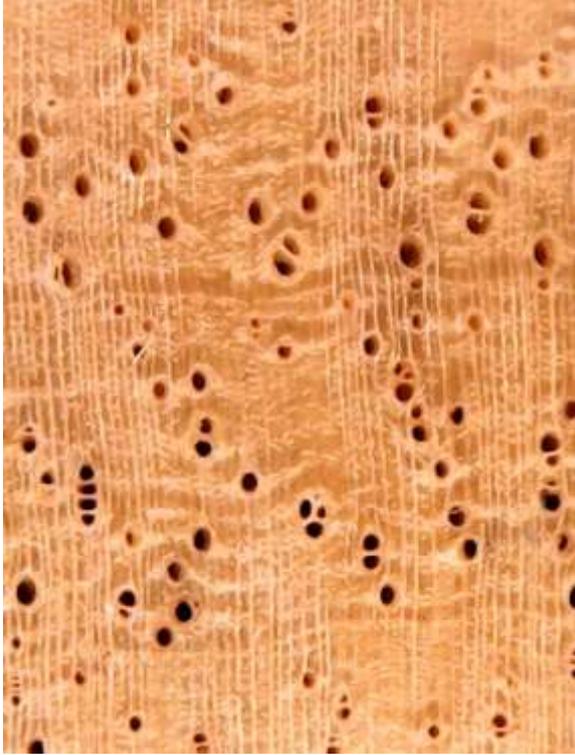


RBE 2469 x 200



RBE 2469 x 400

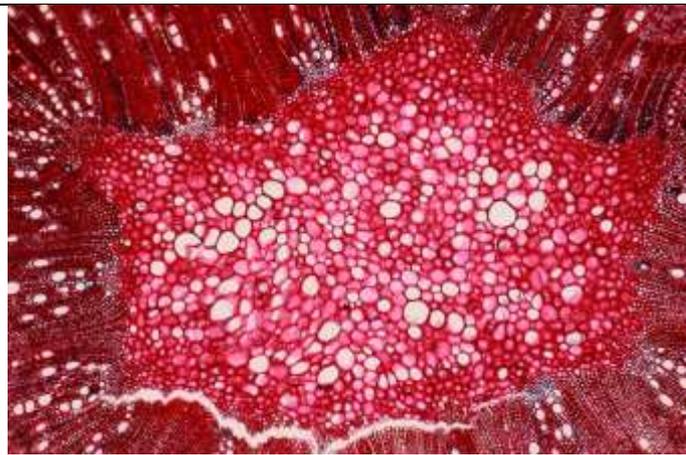
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-4 elements. Tangential diameter of the vessels 50-104-170 μm, 3-7-15 vessels/mm^2. Tyloses common. Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma aliform to confluent and in bands more than 3 cells wide (with 28 cells wide). Rays 11-13-14 /mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits oval to circular, opposite and alternate, 7-10-12 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 90-166-210 μm. Fibres with distinctly bordered pits. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate simultaneously present. Rays predominantly uniseriate. Ray height 70-164-290 μm, with 3-8-14 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied.</p>		
<p><i>Dalbergia baronii</i> Baker: RBE 2469, T12 IAWA feature numbers 2 5 13 22 26 29 30 42 47 52 56 62 66 69 70 69 77 80 83 86 90 91 104 106 116 136 142 180 189 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia pervillei</i> Vatke	FABACEAE
Synonymy : -	
Specimens : T25, RIR 2842	
Local names : Manary, Manary toloho, Manarivola, Vimboa mavo, Hazovola, Manary madinidravina, Hazotana, Kobahitry, Sesetry, Tsiandalana, Manary boraka, Tsiandala, Manary tsianaloka.	
<p>PLANT DESCRIPTION Shrub to tree 3-15 m high 12-40 cm DBH Endemic to Madagascar. Exploited species.</p>	 <p>Dalbergia pervillei</p> <ul style="list-style-type: none"> + Sampling Sites ● Distribution <p>Bioclimate</p> <ul style="list-style-type: none"> ■ Dry ■ Humid ■ Mountain ■ Subarid ■ Subhumid <p>0 100 200 400 km</p>
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-1000 m a.s.l. <i>Vegetation formation</i>: Forest and woodland <i>Bioclimate</i>: Dry, sub-arid and sub-humid <i>Protected areas</i>: Andohahela, Ankarafantsika, Isalo, Manongarivo, Namoroka and Zombitsy-Vohibasia <i>New protected areas</i>: Montagne des Français, Orangea/Rigny and Sahafary</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary, in radial multiples of 2 to 4 elements and rarely in small clusters. Paratracheal axial parenchyma winged-aliform. Apotracheal axial parenchyma in bands. Vessels large¹ and rare². Ray distinct with hand lens.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm²</p>	 <p>RIR 2842</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape pentagonal. Heterogeneous pith. Thick-walled parenchyma cells present. Cells dimorphic. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles separate, vessels solitary and in short radial multiples.



RIR 2842 x 100

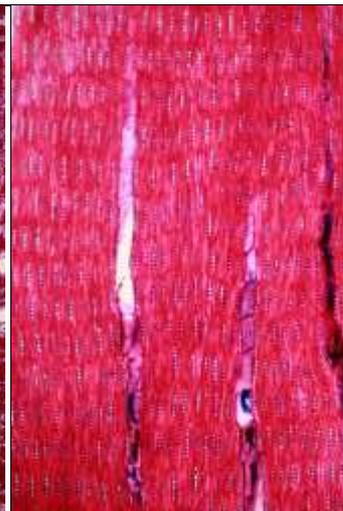
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 44-80-130 μm, 17-25-37 vessels/mm². Vessel element length 125-162-190 μm. Gums and/or other deposits in heartwood vessels. Intervessel pits small, 5-6-8 μm in diameter. Fibres thick to very thick-walled. Paratracheal parenchyma winged-aliform, confluent, in bands up to three and more than three cells wide. Homogeneous rays present. Rays are predominantly uniseriate. Ray height 70-107-130 μm. Rays 13-17-21/mm. Rays, axial parenchyma, fibres are regularly storied. Number of ray tiers par axial mm: 5-6-.

Anatomical differences to stem xylem: Mean tangential diameter in the branch is higher (50-84-110 / 44-80-130 μm). Vessel density is rare in the stem (17-19-21 / 17-25-37 vessels/mm²). Ray height in the stem is higher while ray number is higher in the branch (13-17-21 / 9-11-14 /mm).



RIR 2842 x 100

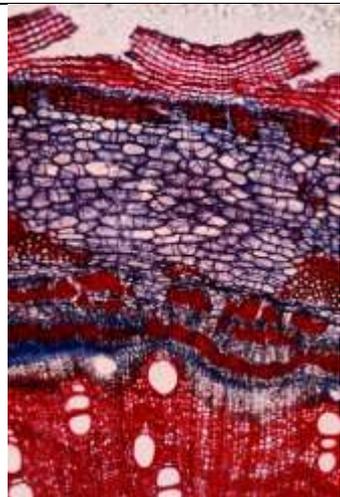


RIR 2842 x 100

BARK ANATOMY

Branch bark: Sieve tubes, groups of fibre and collapsed sieve tubes present in the phloem. The cortex consists of irregular blue-stained parenchyma cells and group of tangentially distributed fibres.

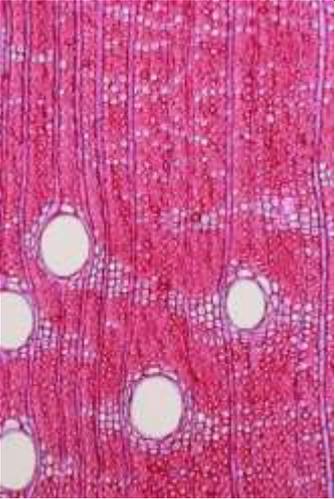
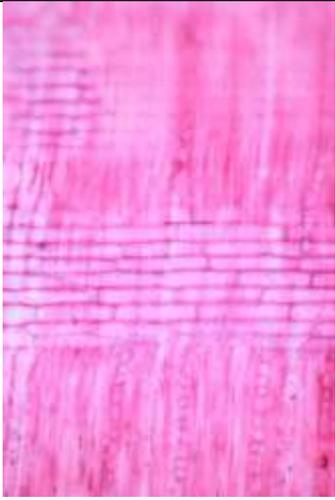
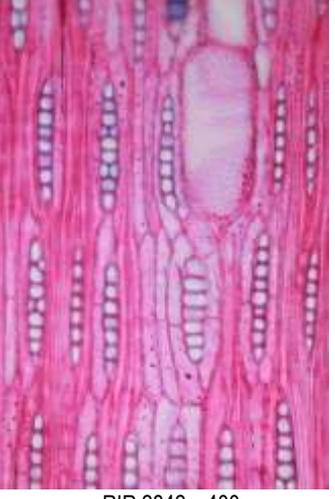
Bark adult: The phloem consists on alternating bands of fibres and collapsed and non collapsed sieve tubes. Crystal sand irregularly dispersed in phloem and phellem. The layered phellem is homogeneous and consists of regularly arranged rectangular parenchyma cells with dark staining substances. Lignified cells in phellem, distinct in polarized light.

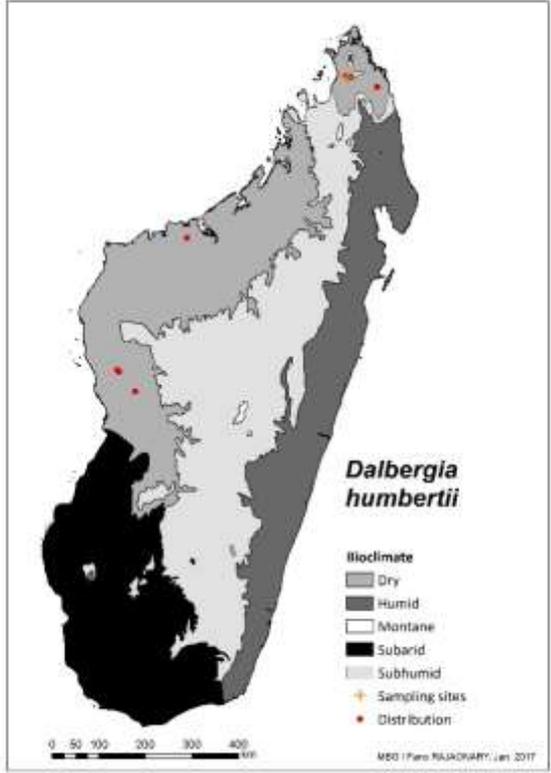
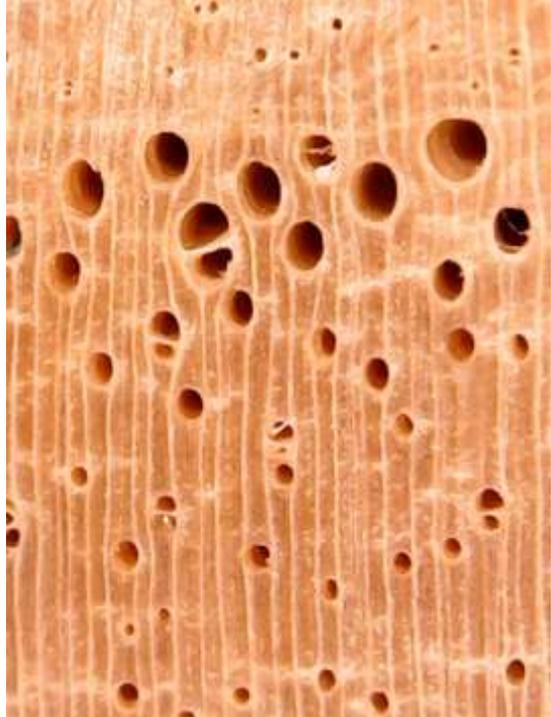


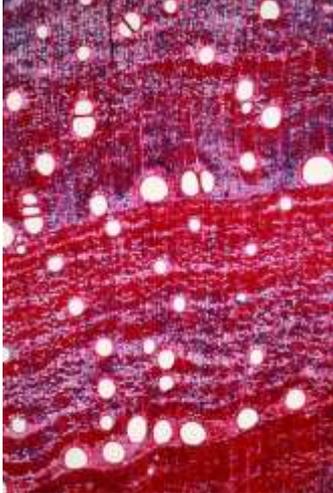
RIR 2842 x 400

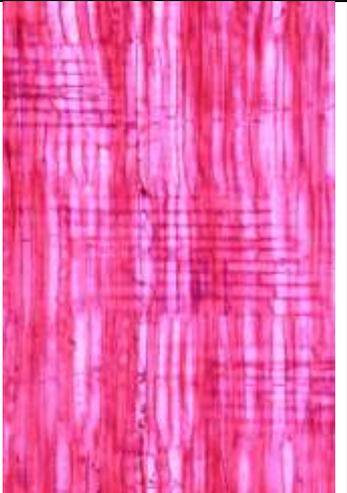


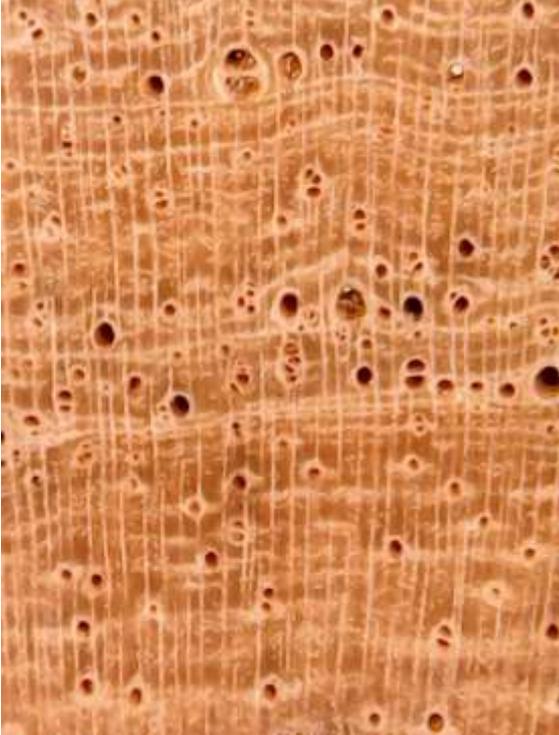
T 25 x 20

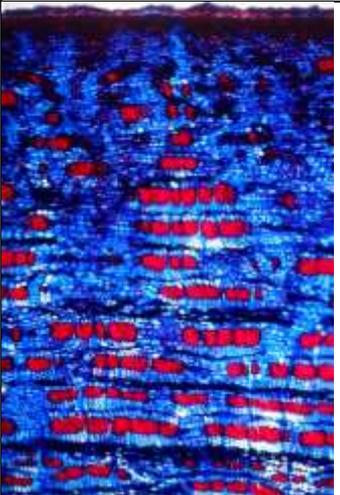
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-4 elements. Tangential diameter of the vessels 44-80-130 μm, 17-19-21 vessels/mm^2. Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma winged-aliform and in narrow lines up to 3 cells. Rays 9-11-14 /mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits oval to circular and alternate, 5-8-10 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 55-190-310 μm. Fibres with distinctly bordered pits. Homogeneous rays, all ray cells are procumbent. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate simultaneously present. Rays predominantly uniseriate. Ray height 100-120-150 μm, with 4-7-9 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays, axial parenchyma, fibres are regularly storied. Number of ray tiers par axial mm: 6-6-7.</p>		
<p><i>Dalbergia pervillei</i> Vatke: T25, RIR 2842 IAWA feature numbers 2 5 13 22 26 29 30 41 47 52 61 66 69 70 76 77 82 86 90 91 97 104 115 118 120 121 136 142 180 189 190 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

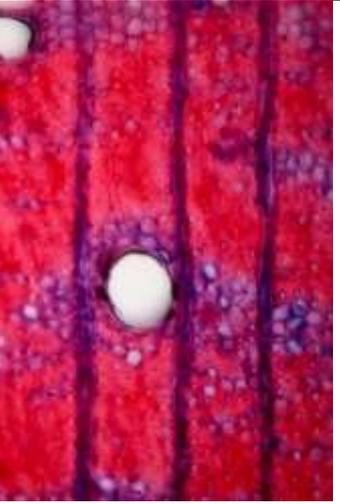
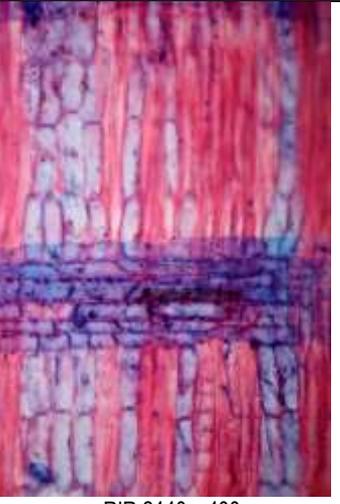
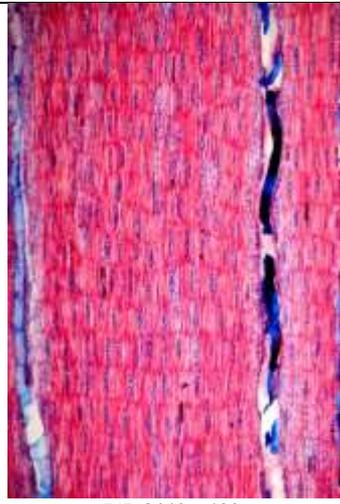
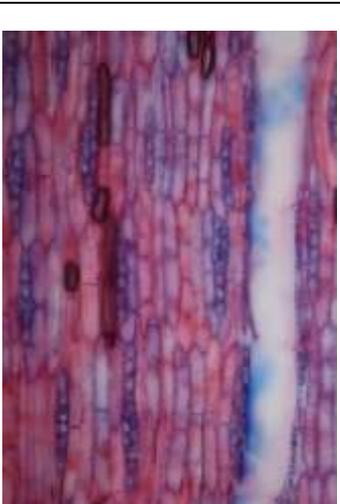
<i>Dalbergia humbertii</i> R. Vig.	FABACEAE
Synonymy : -	
Specimens : RIR 2864	
Local names : Manarifotsy, Manary	
<p>PLANT DESCRIPTION Tree up to 20 high Endemic to Madagascar. Exploited species</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-499 m a.s.l. <i>Vegetation formation</i>: forest, freshwater wetland, woodland <i>Bioclimate</i>: dry <i>Protected areas</i>: Ankarana, Bemaraha, Loky Manambato (Daraina) <i>New protected areas</i>: -</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries distinct marked by differences in vessel diameter between latewood and earlywood. Wood semi-ring-porous. Vessels mostly solitary. Apotracheal axial parenchyma diffuse. Paratracheal axial parenchyma winged-aliform. Vessels large¹ and rare². Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">RIR 2864</p>

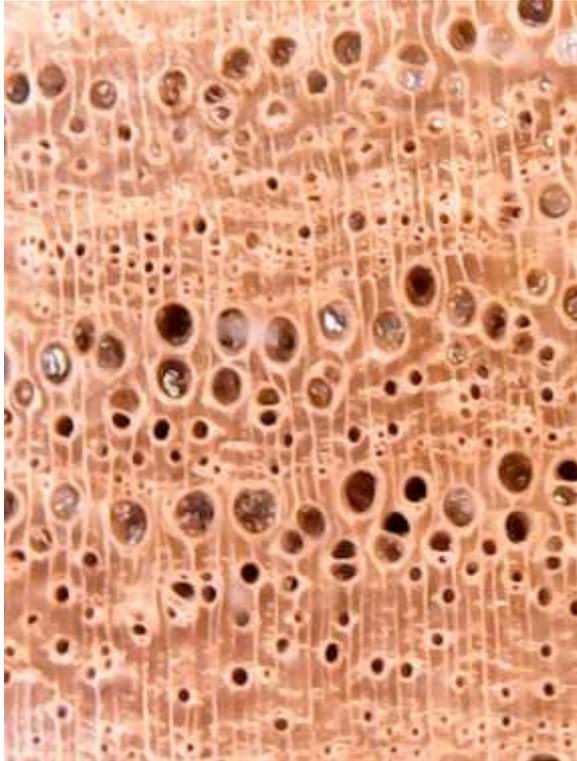
<p>PITH AND PRIMARY XYLEM ANATOMY</p> <p><i>Pith:</i> - <i>Primary xylem:</i> -</p>		
<p>BRANCH XYLEM ANATOMY</p> <p>Description: Growth rings boundaries distinct marked by thick-walled and radially flattened latewood fibres and by differences in vessels diameter. Wood semi-ring-porous. Tangential diameter of earlywood vessels small 39-47-70 μm and latewood vessels small 10-18-25 μm. 27-40-59 vessels/ mm^2. Vessel element length 120-153-210 μm. Intervessel pits small, 5-6-7 μm in diameter. Fibres thin-, thick- and very thick-walled. Apotracheal axial parenchyma diffuse, diffuse-in-aggregates. Paratracheal axial parenchyma scanty, vasicentric, confluent and in narrow bands up to three cells wide and more than three cells wide. Rays predominantly uniseriate. Ray height 70-136-430 μm. Rays 11-12-14/mm.</p> <p>Anatomical differences to stem xylem: Earlywood and latewood are larger in the stem (39-47-70 μm / 170-249-350 μm; 10-18-25 μm / 50-91-150 μm) while vessel number is higher in the the branch (27-40-59 / 5-10-16 vessels/ mm^2). Ray height is higher in the stem (70-136-430 μm/ 85-182-435 μm) while ray number is higher in the branch (14-12-14 / 8-10-11 per mm).</p>	 <p>RIR 2864 x 100</p>	 <p>RIR 2864 x 200</p>
<p>BARK ANATOMY</p> <p>Branch bark: -</p> <p>Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non-collapsed sieve tubes. Parenchyma dilatation present. The phellem is homogeneous, it consists of regularly arranged rectangular cells. Lignified cells in phellem, distinct in polarized light.</p>	 <p>RIR 2864 x 20</p>	

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct marked by thick-walled and radially flattened latewood fibres and by differences in vessels diameter between earlywood and latewood. Wood semi-ring-porous. Earlywood vessels solitary and in radial multiples of 2 elements, latewood vessels solitary or in radial multiples of 2-4 elements. Tangential diameter of earlywood vessels very large 170-249-350 μm and of latewood vessels medium 50-91-150 μm, 5-10-16 vessels per mm^2. Fibres thick- to very thick-walled. Apotracheal parenchyma rarely diffuse-in-aggregates. Paratracheal parenchyma scanty and vasicentric. Rays 8-10-11 per mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 5-6-8 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 115-192-340 μm. Fibres with simple to minutely bordered pits. Homogeneous rays with all cells procumbent. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate simultaneously present but predominantly biseriate. Ray height 85-182-435 μm, with 8-10-11 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements not storied.</p>		
<p>Dalbergia humbertii R. Vig.: RIR 2864 IAWA feature numbers 1ab 4 13 22 25 29 30 41 43 47 52 61 66 69 70 77 78 79 90 91 104 115 136 142 180 189 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia peltieri</i> Bosser & R. Rabev.	FABACEAE
Synonymy : <i>D. microcarpa</i> R. Vig.	
Specimens : RIR 2440	
Local names : Manary, Manary toloho, Manary mavo, Manarifotsy, Manarivazanomby, Adabo, Manary adabo, Manarimboraka, Tainakanga, Mendoravina	
<p>PLANT DESCRIPTION Shrub to tree 5-12 m high 5-60 cm DBH Endemic to Madagascar. Exploited species</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-500 m a.s.l. <i>Vegetation formation</i>: Forest and woodland <i>Bioclimat</i>: Dry and sub-humid <i>Protected areas</i>: Ankarafantsika, Bemaraha and Namoroka <i>New protected areas</i>: Orangea-Rigny</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries distinct marked by differences in vessel diameter between latewood and earlywood. Wood semi-ring-porous. Vessels mostly solitary. Apotracheal axial parenchyme in narrow lines. Paratracheal axial parenchyma winged-aliform. Vessels large¹ and rare². Tyloses present in vessels. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p>RIR 2440</p>

<p>PITH AND PRIMARY XYLEM ANATOMY</p> <p>Pith: Shape of pith round. Thick-walled parenchyma cells present. Cells dimorphic. Dark staining substances present. Prismatic crystals rare. Simple pits in transverse cell walls. Pith not visible in polarized light.</p> <p>Primary xylem: Vascular bundles clearly separated. Vessels solitary and in short radial multiples. Fibres thin- to thickwalled in radial rows.</p>		
<p>BRANCH XYLEM DESCRIPTION</p> <p>Description: Growth ring boundaries indistinct. Tangential diameter of vessels 40-62-120 μm, 17-24-37 vessels/mm^2. Vessel element length 110-140-180 μm. Intervessel pits small, 4-7 μm in diameter. Fibres thick to very thick-walled. Axial parenchyma in bands more than 3 cells. Rays predominantly uniseriate. Ray height 70-139-230 μm, rays 9-11-13/mm.</p> <p>Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is smaller in branch (40-62-120/40-88-150 μm). Vessel density is higher in the branch than in stem (17-24-37/10-16-24 vessels/mm^2). Rays are slightly higher in the branch (70-139-230/50-131-200 μm) while ray density is similar (9-11-13/10-11-14 rays/mm).</p>		
<p>BARK ANATOMY</p> <p>Branch bark: Collapsed and non-collapsed sieve tubes present in the phloem. The cortex consists of irregular rectangular blue-stained parenchyma cells and groups of tangentially distributed fibres.</p> <p>Stem bark: The phloem consists of alternating bands of fibres and collapsed and non-collapsed sieve tubes. Parenchyma dilatations present. Prismatic crystals irregularly dispersed in phloem. The phellem is homogeneous, it consists of regularly arranged rectangular cells. Lignified cells in phellem distinct in polarized light.</p>		
	RIR 2440 x 200	RIR 2440 x 100
	RIR 2440 x 100	RIR 2440 x 100
	RIR 2440 x 400	RIR 2440 x 100

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct, marked by radially flattened latewood fibres and by difference vessel diameter between latewood and earlywood. Wood ring-porous. Vessels solitary and in clusters of 3 to 4 elements. Tangential diameter of earlywood vessels 90-136-190 µm and latewood vessels 40-88-150 µm, 10-16-24 vessels/mm². Gums and/or other deposits in heartwood vessels. Fibres thin- to thick-walled. Apotracheal parenchyma diffuse-in-aggregates. Paratracheal parenchyma vasicentric to winged-aliform. Axial parenchyma bands more than three cells wide. Rays 10-11-14/mm.</p>	 <p>RIR 2440 x 100</p>	 <p>RIR 2440 x 400</p>
<p>Radial section Simple perforation plates. Intervessel pits oval to circular and alternate, 7-10 µm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 100-148-180 µm. Fibres with simple to minutely bordered pits. Homogeneous and heterogeneous rays both present. A few rays with body ray cells procumbent and one row of square or upright cells. Prismatic crystal in chambered axial parenchyma cells.</p>	 <p>RIR 2440 x 400</p>	 <p>RIR 2440 x 1000</p>
<p>Tangential section Rays predominantly biseriate. Ray height 50-131-200 µm. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays, vessels and axial parenchyma irregularly storied. Number of ray tiers par axial mm: 16-17.</p>	 <p>RIR 2440 x 100</p>	 <p>RIR 2440 x 400</p>
<p>Dalbergia peltieri Bosser & R. Rabev. : RIR 2440 IAWA feature numbers 3 9 11 13 22 26 29 30 42 47 52 58 61 66 69 77 79 82 86 90 91 97 102.2 104 115 118 120 136 142 180 189 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia davidii</i> Bosser & R. Rabev	FABACEAE
Synonymy : -	
Specimens : CR 6676	
Local names : -	
<p>PLANT DESCRIPTION Tree 20 - 25 m high Endemic to Madagascar. Exploited species</p>	
<p>DISTRIBUTION Elevation: 0-499 m a.s.l. Vegetation formation: forest Bioclimate: dry Protected areas: Ankarafantsika and Kirindy Antimena New protected areas: -</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries distinct marked by differences in vessel diameter between latewood and earlywood. Wood semi-ring-porous. Vessels mostly solitary. Apotracheal axial parenchyme in narrow lines. Paratracheal axial parenchyma winged-aliform. Vessels large¹ and rare². Tyloses present in vessels. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">CR 6676</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Pith shape round. Thick-walled parenchyma cells present. Cells dimorphic. Cell content present. Prismatic crystals present. Simple pits in transverse cell walls. Pith visible in polarized light.
Primary xylem: Vessels solitary and in long radial multiples.



CR 6676 x 200

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries distinct marked by differences in vessels diameter. Wood semi-ring-porous and marginal parenchyma. Tangential diameter of earlywood vessels medium 40-59-95 μm and latewood vessels small 30-35-70 μm . 42-56-77 vessels/ mm^2 . Vessel element length 55-120-170 μm . Intervessel pits small, 3-6-8 μm in diameter. Fibres thick-walled. Apotracheal parenchyma rarely diffuse-in-aggregates. Paratracheal parenchyma scanty, vasicentric and in narrow lines up to 3 cells wide. Rays predominantly uniseriate. Ray height 60-107-150 μm . Rays 8-11-12/mm.

Anatomical differences to stem xylem: Earlywood and latewood are larger in the stem (40-59-95/ 80-113-170 μm / 30-45-70 / 20-38-60 μm). Vessel number is higher in the stem (43-56-77 / 66-74-118 vessels/ mm^2). Ray height and ray number are higher in the stem (60-107-150/ 30-144-250) (8-11-12 / 10-13-18 per mm).



CR 6676 x 100

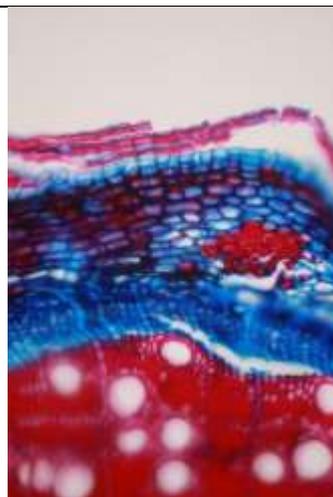


CR 6676 x 100

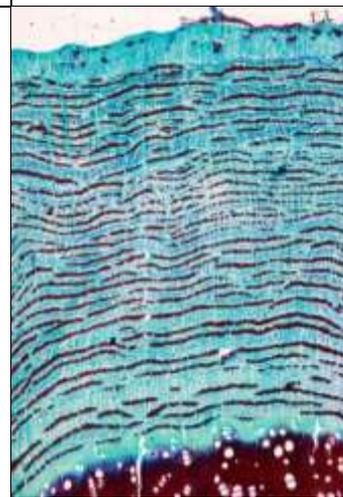
BARK ANATOMY

Branch bark: Collapsed sieve tubes and prismatic crystals present in the phloem. The cortex consists on irregularly blue-stained parenchyma cells and groups of tangentially distributed fibres.

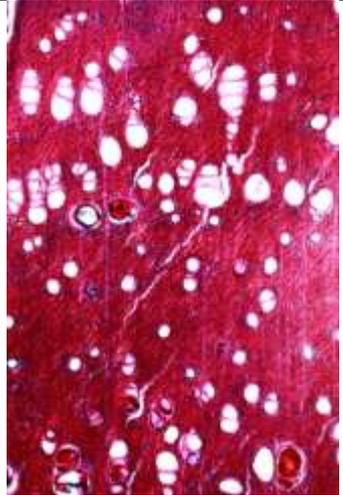
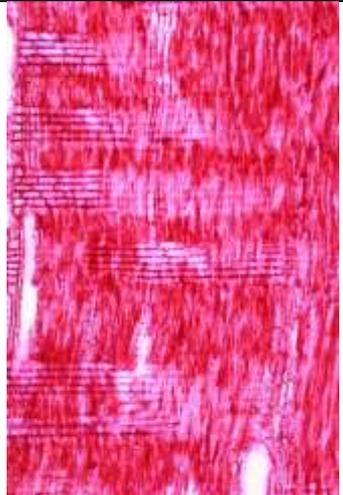
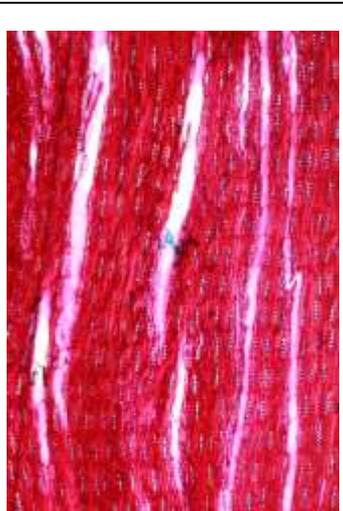
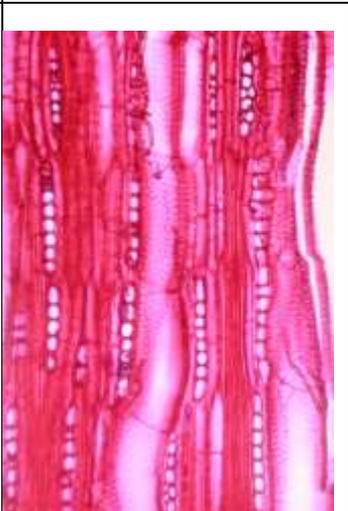
Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non-collapsed sieve tubes. The phellem is homogeneous and it consists of regularly arranged rectangular parenchyma cells. Lignified cells in phellem, distinct in polarized light.

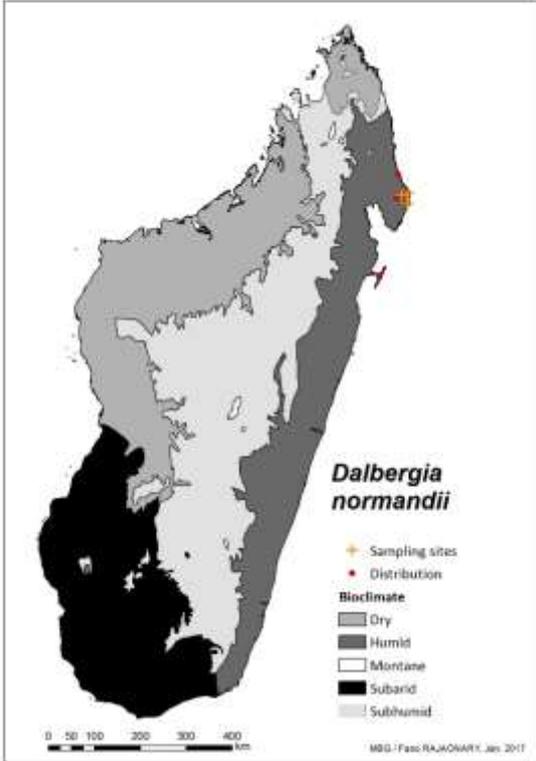


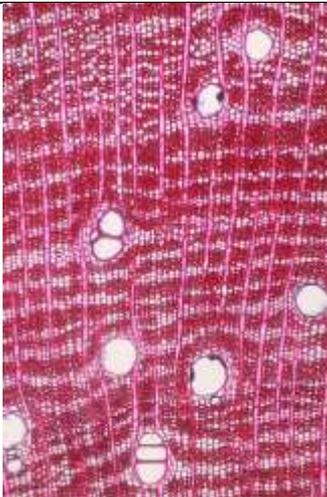
CR 6676 x 400



CR 6676 x 40

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct marked by differences in vessels diameter between earlywood and latewood. Wood ring-porous. Earlywood vessels solitary and in radial multiples of 2 elements, latewood vessels solitary or in radial multiples of 2-4 elements. Tangential diameter of earlywood vessels large 80-130-170 μm and of latewood vessels small 20-38-60 μm, 66-74-118 vessels per mm^2. Fibres very thick-walled. Apotracheal parenchyma rarely diffuse-in-aggregates. Paratracheal parenchyma scanty, vasicentric and in narrow lines up to 3 cells wide. Rays 10-13-18 per mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 2-4-5 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 60-120-150 μm. Fibres with simple to minutely bordered pits. Homogeneous rays with all cells procumbent. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate simultaneously present but predominantly uniseriate. Ray height 30-144-250 μm, with 3-6-13 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied.</p>		
<p><i>Dalbergia davidii</i> Bosser & R. Rabev.: CR 6676 IAWA feature numbers 1b 4 13 22 25 29 30 40 42 49 52 61 66 69 70 76 77 78 79 86 90 91 97 104 116 136 142 180 189 192 196 Additional features: 9.1 12.1 96.1 102.2</p>		

<i>Dalbergia normandii</i> Baill.	FABACEAE
Synonymy : -	
Specimens : RBE 2486	
Local names : Manarifotsy, Manary	
<p>PLANT DESCRIPTION Tree up to 20 high Endemic to Madagascar. Exploited species</p>	
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-499 m a.s.l. <i>Vegetation formation</i>: forest <i>Bioclimate</i>: humid <i>Protected areas</i>: - <i>New protected areas</i>: Ile Ste Marie, Pointe à Larrée, Ambohitralanana Antalaha</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 4 elements. Vessels large¹ and very rare². Tyloses present in vessels. Paratracheal axial parenchyma vasicentric, confluent and winged-aliform. Apotracheal axial parenchyma in bands. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Very rare: <5 vessels/mm² ³Thick: Distinct to the naked eye</p>	
RBE 2486	

<p>PITH AND PRIMARY XYLEM ANATOMY</p> <p><i>Pith:</i> - <i>Primary xylem:</i> -</p>		
<p>BRANCH XYLEM ANATOMY</p> <p>Description: Growth rings boundaries indistinct. Wood diffuse-porous. Tangential diameter of vessels 30-88-170 μm, 3-11-19 vessels/ mm^2. Tyloses present in the vessels. Vessel element length 120-215-260 μm. Intervessel pits small, 5-7-9 μm in diameter. Fibres very thin-walled to thin to thick-walled. Apotracheal parenchyma diffuse-in-aggregates. Paratracheal parenchyma winged-aliform, in bands up to three and more than three cells wide. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Rays are predominantly uniseriate. Ray height 60-160-300 μm. Rays 9-11-12 /mm. Rays and/or axial elements irregularly storied.</p> <p>Anatomical differences to stem xylem: Mean tangential diameter in the stem is higher (30-88-170 / 65-168-220 μm). Vessel density is rare in the stem (3-11-19 / 0-3-6 vessels/mm^2). Ray height in the stem is higher (60-160-300 / 120-209-260 μm) while ray number is similar (9-11-12 / 8-11-14/mm).</p>	 <p>RBE 2486 x 100</p>	 <p>RBE 2486 x 100</p>
<p>BARK ANATOMY</p> <p>Branch bark: -</p> <p>Stem bark: The phloem consists of alternating bands of fibres and collapsed and non-collapsed sieve tubes. Distinct ray and parenchyma dilatations present. Only some rays become dilated. Crystal sand irregularly dispersed in phloem. The phellem is homogeneous, it consists of regularly arranged rectangular cells. Lignified cells in phellem, distinct in polarized light.</p>	 <p>RBE 2486 x 40</p>	

STEM XYLEM ANATOMY**Transverse section**

Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-3 elements. Tangential diameter of the vessels 65-168-220 μm , 0-3-6 vessels/ mm^2 . Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma winged-aliform and in bands up to three cells. Seemingly parenchyma marginal bands present. Rays 8-11-14 /mm.



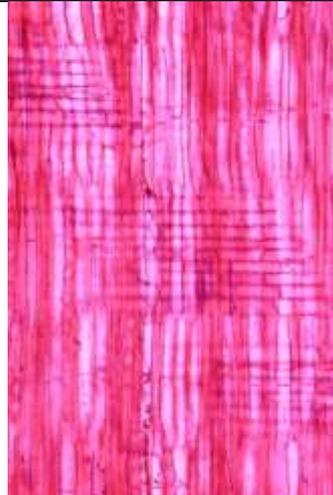
RIR 2486 x 40



RIR 2486 x 200

Radial section

Simple perforation plates. Intervessel pits oval to circular, opposite and alternate, 5-8-10 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 130-166-350 μm . Fibres with distinctly bordered pits. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.



RIR 2486 x 200



RIR 2486 x 1000

Tangential section

Rays uni- and biseriate simultaneously present. Rays predominantly uniseriate. Ray height 120-209-260 μm , with 3-8-11 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied. Number of ray tiers per axial mm: 9.



RIR 2486 x 100

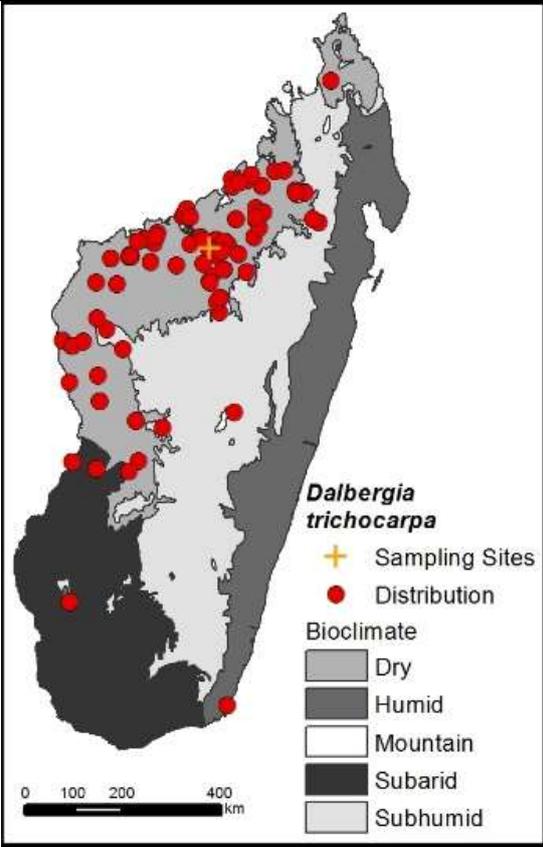


RIR 2486 x 400

Dalbergia normandii Baill.: RBE 2486

IAWA feature numbers 2 5 13 22 26 29 30 42 46 52 62 66 69 70 76 77 82 86 90 91 97 104 106 115 118 120 121 122 136 142 180 189 190 192 196

Additional features: 9.1 12.1 96.1 102.3

<i>Dalbergia trichocarpa</i> Baker.	FABACEAE
Synonymy : <i>D. boinensis</i> Jum., <i>D. perrieri</i> Drake	
Specimens : RIR 2470	
Local names : Manariboty, Sovoka, Manary, Manary kamboty, Manary toloho, Magnary, Manipika, Amaninomny, Manarimena, Manarivatany, Manary boraka, Manary kitratra.	
<p>PLANT DESCRIPTION Tree 4-25 m high 15-40 cm DBH Endemic to Madagascar. Non exploited species.</p>	 <p><i>Dalbergia trichocarpa</i></p> <ul style="list-style-type: none"> + Sampling Sites ● Distribution <p>Bioclimate</p> <ul style="list-style-type: none"> ■ Dry ■ Humid ■ Mountain ■ Subarid ■ Subhumid <p>0 100 200 400 km</p>
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-1000 m a.s.l. <i>Vegetation formation</i>: Forest, grassland and woodland <i>Bioclimate</i>: Dry and sub-arid <i>Protected areas</i>: Ankarafantsika, Bemaraha and Namoroka <i>New protected areas</i>: -</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary, in radial multiples of 2 to 3 elements and rarely in clusters. Vessels large¹ and very rare². Tyloses present in vessels. Paratracheal axial parenchyma vasentric. Apotracheal axial parenchyma in bands. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Very rare: <5 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p>RIR 2470</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith round. Layer of blue-stained cells surround the pith. Thick-walled parenchyma cells present. Cells dimorphic. Dark staining substances abundant. Simple pits in transverse cell walls. Pith not visible in polarized light.

Primary xylem: Vascular bundles not distinct. Vessels solitary and in short radial multiples.



RIR 2470 x 200

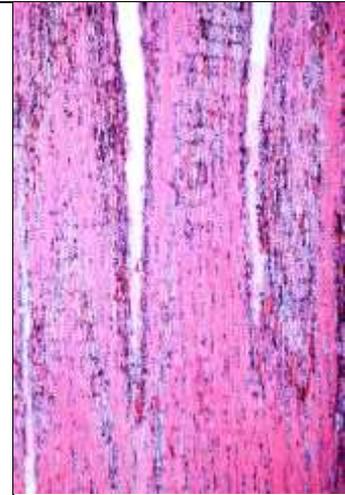
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 60-103-150 μm , 24-31-50 vessels/ mm^2 . Vessel elements length 130-144-160 μm . Intervessel pits small, 4-7 μm in diameter. Fibres thin- to thick-walled. Axial parenchyma in bands 2 to 5 cells wide. Rays predominantly uniseriate. Ray height 60-96-120 μm . Rays 10-14-18/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is slightly smaller in branch (60-103-150/120-174-260 μm). Vessel density is higher in the branch (24-31-50/5-9-22 vessels/ mm^2). Rays are shorter in the branch (60-96-120/130-144-160 μm) while ray number is similar (10-14-18/11-14-17 rays/mm).



RIR 2470 x 100

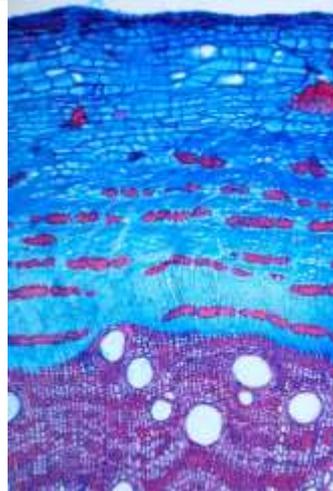


RIR 2470 x 100

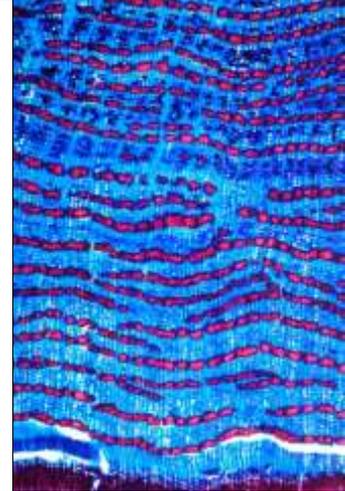
BARK ANATOMY

Branch bark: The phloem consists of alternating bands of fibres and collapsed and non-collapsed sieve tubes. Prismatic crystals present. The cortex consists of irregular rectangular blue-stained parenchyma cells and tangential groups of fibres.

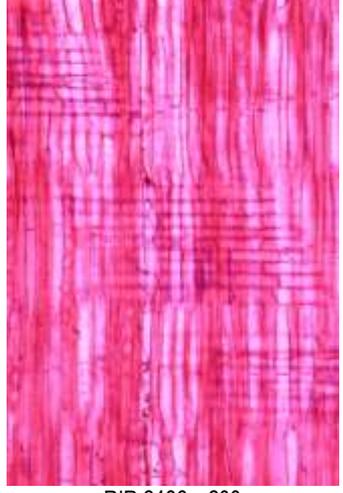
Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non-collapsed sieve tubes. Parenchyma dilatation present and crystal sand scattered or irregularly dispersed in the phloem. The phellem is homogeneous, consists of regularly arranged rectangular parenchyma cells with rarely dark staining substances. Lignified cells in phellem, distinct in polarized light.



RIR 2470 x 200



RIR 2470 x 100

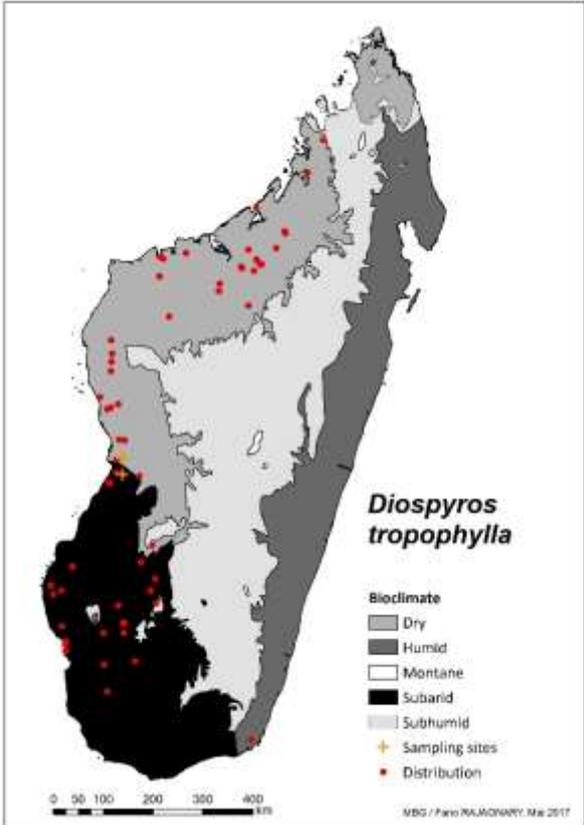
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries indistinct. Wood diffuse-porous. Vessels solitary or in radial multiples of 2-3 elements. Tangential diameter of the vessels 65-168-220 μm, 0-3-6 vessels/mm^2. Fibres thick to very thick-walled. Apotracheal axial parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma winged-aliform and in bands up to three cells. Seemingly parenchyma marginal bands present. Rays 8-11-14 /mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits oval to circular, opposite and alternate, 5-8-10 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 130-166-350 μm. Fibres with distinctly bordered pits. Homogeneous and heterogeneous rays both present. In some rays body ray cells procumbent with one row of square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate simultaneously present. Rays predominantly uniseriate. Ray height 120-209-260 μm, with 3-8-11 cells in height. Fusiform parenchyma cells present. Two cells per parenchyma strand. Rays and/or axial elements irregularly storied. Number of ray tiers per axial mm: 9.</p>		
<p>Dalbergia trichocarpa Baill.: RBE 2486 IAWA feature numbers 2 5 13 22 26 29 30 42 46 52 62 66 69 70 76 77 82 86 90 91 97 104 106 115 118 120 121 122 136 142 180 189 190 192 196 Additional features: 9.1 12.1 96.1 102.3</p>		

Diospyros



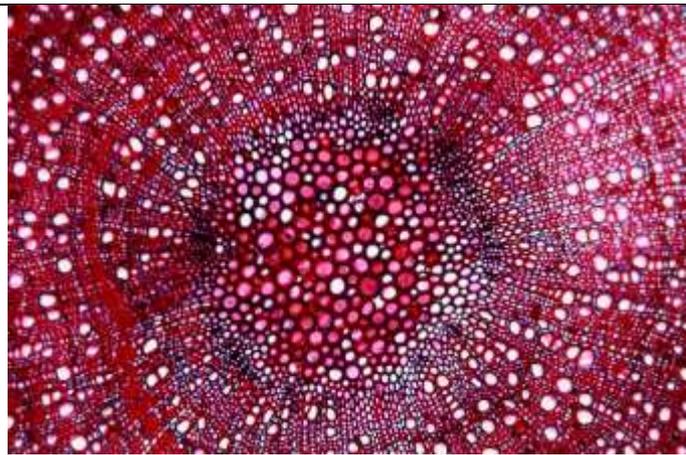
The taxonomy of Diospyros is currently being revised. A total of 84 described species are currently recognized, and at least 130 additional species remain to be named and described.

Here we describe the stem anatomy of Diospyros species with specimens duplicates.

<p><i>Diospyros tropophylla</i> (H. Perrier) G.E. Schatz & Lowry</p>	<p>EBENACEAE</p>
<p>Synonymy : <i>Maba tropophylla</i> H. Perrier</p>	
<p>Specimens : CR 6666, CR 6687, CR 6689</p>	
<p>Local names : Remeloky, Firaraza, Maintifotra, Firaraza, Hazomafana</p>	
<p>PLANT DESCRIPTION Shrub to tree up to 20 high Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-500 m a.s.l. <i>Vegetation formation</i>: Forest, thicket and woodland <i>Bioclimate</i>: Dry, humid and subarid <i>Protected areas</i>.: Ankarafantsika, Baie de Baly, Mahavavy Kinkony Complex, Isalo, Kirindy Mitea, Manongarivo, Kirindy Antimena, Mikea, Mikea, Namoroka and Zombitse Vohibasia. <i>New protected areas</i>: Amoron'i Onilahy, Beanka, Ranobe PK 32. Tsimembo Manambolomaty, Tsimongambarika and Corridor Forestier Bongolava</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 -4 elements. Vessel small¹. Apotracheal parenchyma in short lines. Rays are thin². ¹Small : indistinct to the naked eye ²Thin : indistinct to the naked eye</p>	 <p style="text-align: center;">CR 6666</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith round. Thick-walled parenchyma cells present. Cells dimorphic. Prismatic crystal present. Pits in transverse cell walls. Pith not visible in polarized light.
Primary xylem: Vascular bundles indistinct. Vessels solitary and in long radial multiples of 2 to 5 elements.



CR 6666 x 200

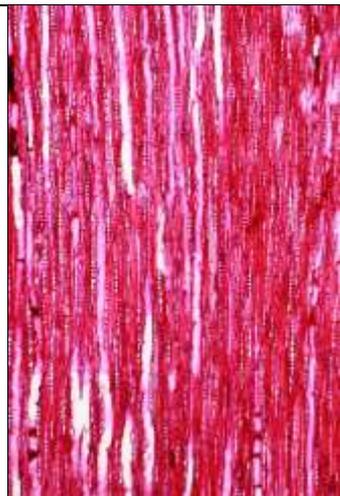
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 15-27-40, 50-83-145 vessels/ mm². Vessel element length 70-201-330 μm. Intervessel pits minute, 2-3-5 μm in diameter. Fibers thin to thick- to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates, paratracheal parenchyma scanty. Rays uni- and biseriate, predominantly uniseriate. Three to 4 cells per parenchyma strand. Ray height 155-271-510 μm, with 4-8-11 cells in height. Rays 15-18-24/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina and vessel density are higher in the stem (15-27-40 /30-40-50 μm) (50-83-145/84-113-167 vessels/ mm²). Rays are higher in the stem (70-201-330 / 180-306-430 μm) while ray number is higher in the branch (15-18-24 / 14-15-16 rays/mm).



CR 6666 x 100



CR 6666 x 100

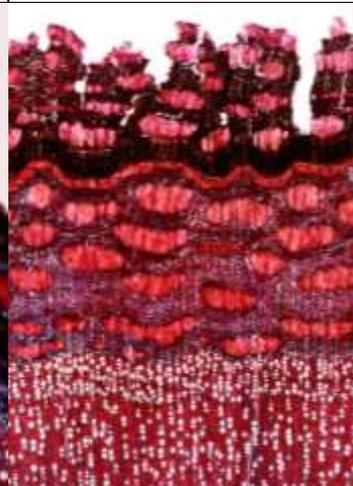
BARK ANATOMY

Branch bark: Collapsed and non-collapsed sieve tubes present in the phloem. The cortex is characterized by a band of sclereids and regularly arranged rectangular parenchyma cells.

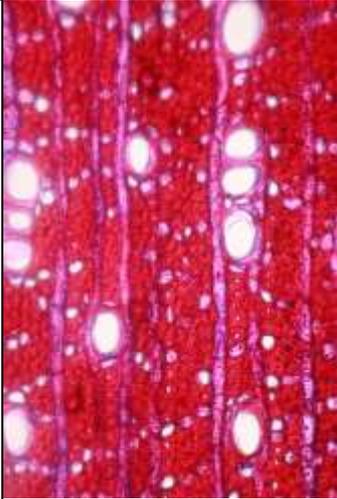
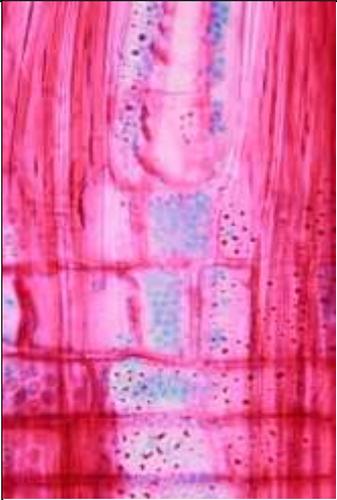
Stem bark: The phloem consists of collapsed and non-collapsed sieve tubes, and irregularly distributed groups of sclereids, sclereids arranged in a tangential bands. Prismatic crystals present in the sclereids. Ray and axial parenchyma dilatation present. The cortex is characterized by a band of sclereids. The phellem cells are homogeneous and it consists of arranged rectangular cells, indistinct in polarized light.

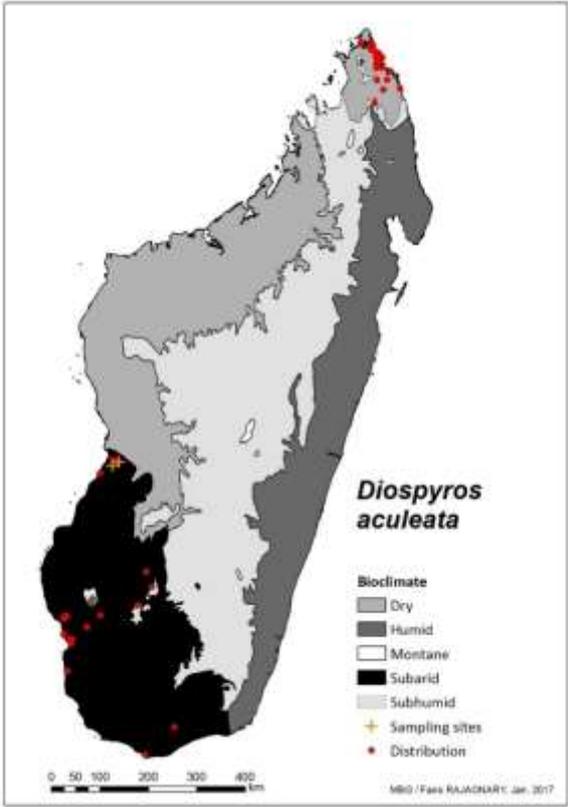


CR 6666 x 200



CR 6666 x 40

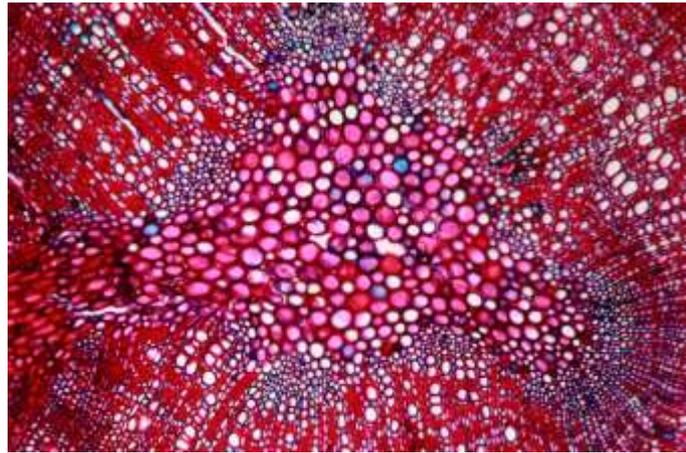
<p>STEM XYLEM ANATOMY Transverse section Growth rings boundaries indistinct or absent. Wood diffuse-porous. Vessels solitary and in long radial multiples of 2 to 10 elements. Tangential diameter of vessels small 30-40-50 μm, 84-113-167 vessels/mm^2. Tylosis, gums and other deposits in heartwood vessels. Fibers thin to thick-walled to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma scanty. Rays 14-15-16/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits circular and alternate, 5-5-6 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 180-306-430 μm. Fibres with simple to minutely bordered pits (libriform fibres). Heterogeneous rays, body ray procumbent with 1 – 4 row upright or square cells. Prismatic crystals in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate, predominantly uniseriate. Ray height 80-353-1130 μm, with 5-14-35 cells in height. Three to 4 and 5 – 8 cells per parenchyma strand.</p>		
<p><i>Diospyros tropophylla</i> H. Perrier) G.E. Schatz & Lowry.: CR 6666, CR 6687, CR 6689 IAWA feature numbers 2 5 9 13 22 25 30 40 50 52 56 58 61 66 69 70 76 77 78 92 93 97 106 107 116 136 142 180 189 190 192 196 Additional features: 9.1 96.1 102.3</p>		

<i>Diospyros aculeata</i> H. Perrier	EBENACEAE
Synonymy : <i>D. aculeata</i> subsp. <i>aculeata</i> H. Perrier, <i>D. aculeata</i> subsp. <i>meridionalis</i> H. Perrier	
Specimens : T33, CR 6673	
Local names : Hazo mafana, Hazomafana masiaka, Relefo, Hazomafany, Voandoboka, Siloravy, Lopingo, Jaobiampototra, Remeloka	
<p>PLANT DESCRIPTION Shrub to tree 3-8 m 20-30 cm DBH Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-500 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Dry and sub-arid <i>Protected areas</i>: Analamerana, Kirindy, Menabe, Cap Ste Marie and Isalo</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary, in radial multiples of 2 to 5 elements and rarely in clusters. Vessels small¹ and numerous². Rays are thin³.</p> <p>¹Small : Indistinct to the naked eye ²numerous: > 100 vessels/mm² ³Thin: Indistinct to the naked eye</p>	 <p style="text-align: center;">CR 6673</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith triangular. Thick-walled parenchyma cells present. Cells dimorphic. Prismatic crystal present. Pits in transverse cell walls. Pith not visible in polarized light.

Primary xylem: Vascular bundles distinct. Vessels solitary and in long radial multiples of 2 to 5 elements.



CR 6673 x 200

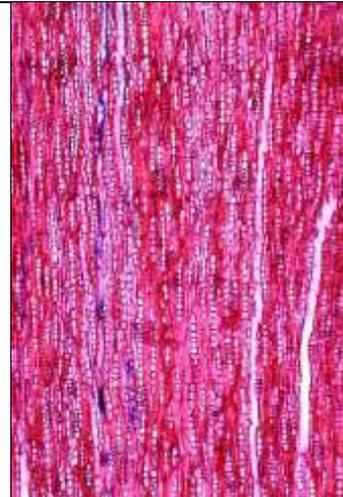
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 20-38-55 μm, 70-99-117 vessels/ mm². Vessel element length 110-207-340 μm. Intervessel pits minute, 2-2-3 μm in diameter. Fibers thin to thick- to very thick-walled. Apotracheal parenchyma diffuse-in-aggregates, paratracheal parenchyma scanty to vasicentric and in narrow bands up to 3 cells. Rays uni- and biseriate, predominantly uniseriate. Three to 4 and 5 to 8 cells per parenchyma strand. Ray height 80-229-410 μm, with 2-10-16 cells in height. Rays 15-18-22/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina and vessel density are higher in the stem (20-38-55 /20-44-60 μm) (70-99-117/111-141-177 vessels/ mm²). Rays are higher in the stem (90-229-410/20-316-1020 μm) while ray number is higher in the branch (15-18-22 / 8-11-15 rays/mm).



CR 6673 x 100



CR 6673 x 100

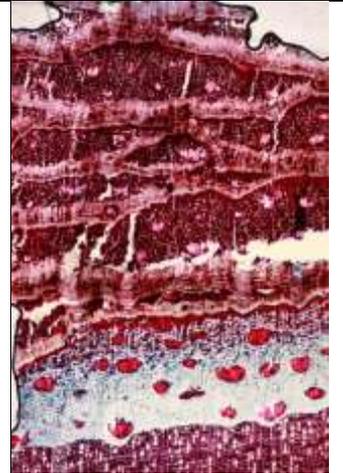
BARK ANATOMY

Branch bark: Collapsed and non-collapsed sieve tubes present in the phloem. The cortex is characterized by a band of sclereids and regularly arranged rectangular parenchyma cells.

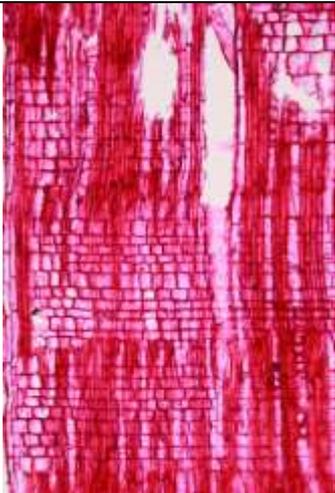
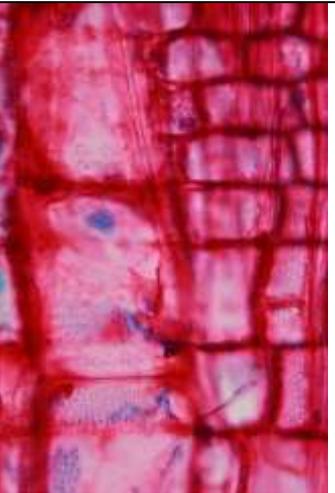
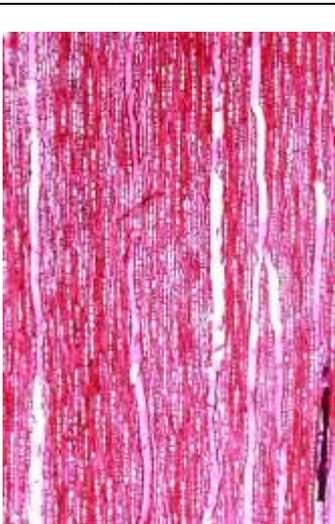
Stem bark: The phloem consists of collapsed and non-collapsed sieve tubes, and irregularly distributed groups of sclereids. The cortex is defined by a band of sclereids. Layer phellem. The phellem is homogeneous with dark stained substances and it consists of regularly arranged rectangular cells, indistinct in polarized light.

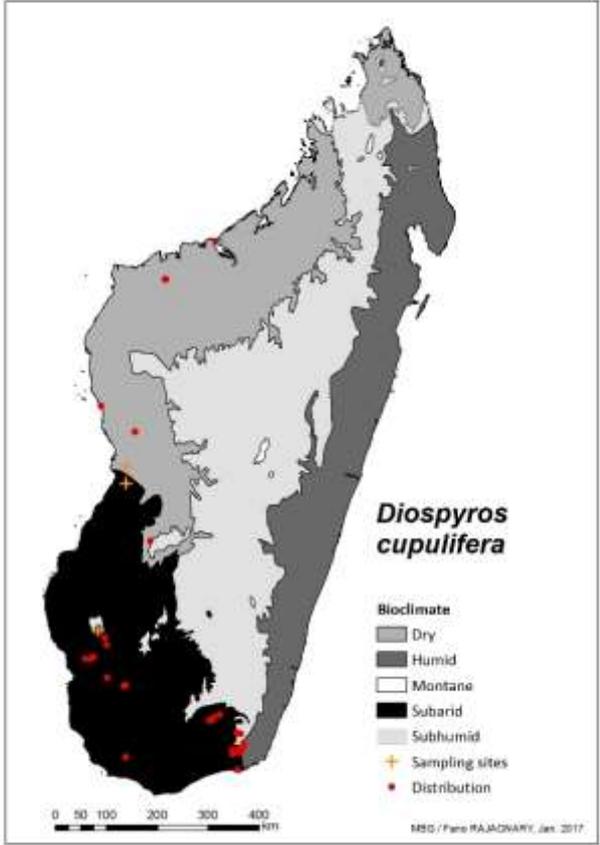
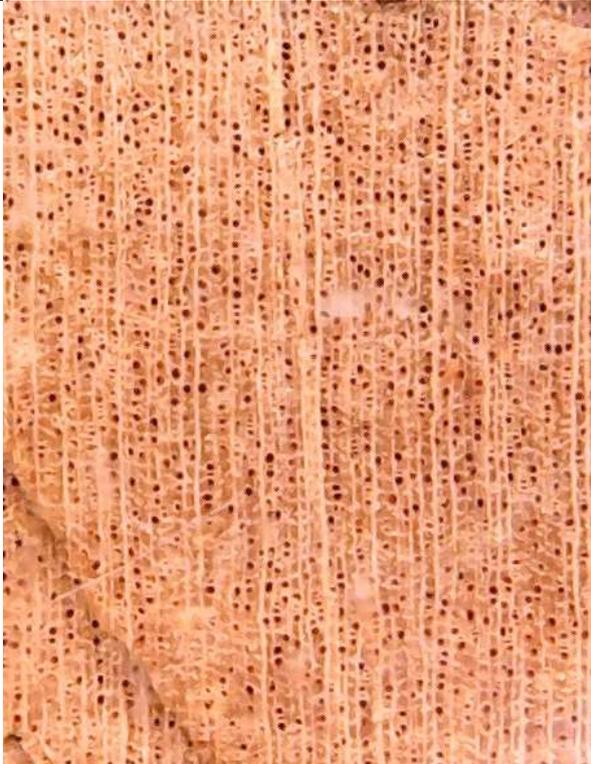


CR 6673 x 200



CR 6673 x 40

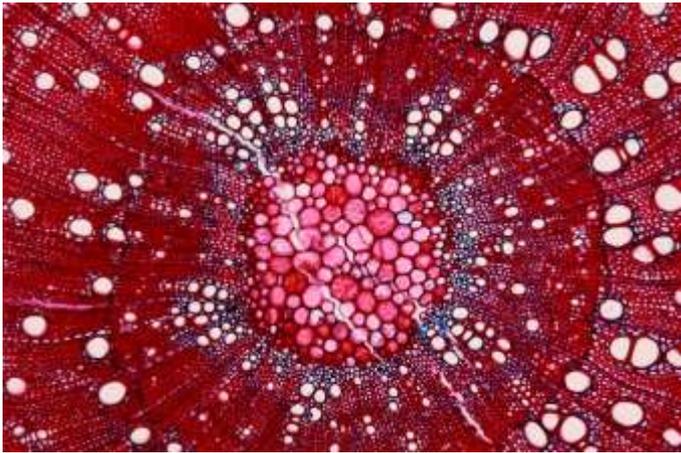
<p>STEM XYLEM ANATOMY Transverse section Growth rings boundaries indistinct or absent. Wood diffuse-porous. Vessels solitary and in short radial multiples of 2 to 5 elements. Tangential diameter of vessels small 20-44-60 μm, 111-144-177 vessels/mm^2. Tylosis in heartwood vessels. Fibers thin to thick-walled to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma scanty and in narrow lines up to 3 cells. Rays 8-11-15/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits circular and alternate, 1-3-8 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 20-235-420 μm. Fibres with simple to minutely bordered pits (libriform fibers). Heterogeneous rays, rays with procumbent, square and upright cells mixed. Prismatic crystals in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate, predominantly uniseriate. Ray height 20-316-1020 μm, with 2-11-30 cells in height. Three to 4 cells per parenchyma strand.</p>		
<p><i>Diospyros aculeata</i> H. Perrier.:T33, CR 6673 IAWA feature numbers 2 5 9 13 22 24 30 40 50 52 56 61 66 69 70 76 77 78 86 92 97 109 115 136 142 180 189 190 192 196 Additional features: 9.1 96.1 102.3</p>		

<i>Diospyros cupulifera</i> H. Perrier.	EBENACEAE
Synonymy : -	
Specimens : CR 6674	
Local names : Takehely, Vatraha, Takehily, Korofoky, Porofoky, Revaky, Maintipototra	
<p>PLANT DESCRIPTION Tree 6 – 15 m high Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-1500 m a.s.l. <i>Vegetation formation</i>: Bushland and forest <i>Bioclimate</i>: Dry, subarid and subhumid <i>Protected areas</i>: Andohahela, Bemaraha, Bezà Mahafaly, Menabe Antimena, Namoroka <i>New protected areas</i>: Amoron'i Onilahy, Analavelona (Forêt Sacrée Alandraza Analavelo), Ranobe PK 32.</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 -4 elements. Vessel small¹. Apotracheal parenchyma in short lines. Rays are thin².</p> <p>¹Small : indistinct to the naked eye ²Thin : indistinct to the naked eye</p>	 <p style="text-align: center;">CR 6674</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith oval. Thick-walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls. Pith not visible in polarized light.

Primary xylem: Vascular bundles distinct. Vessels solitary and in short radial multiples of 2 to 3 elements.



CR 6674 x 200

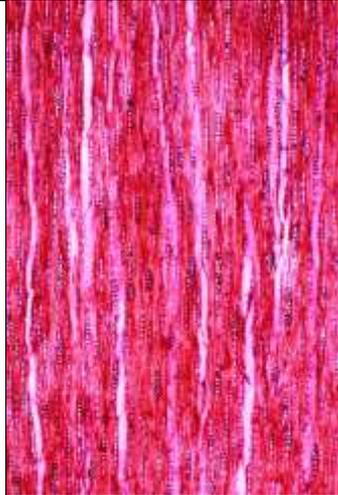
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 35-62-90, 5-48-69 vessels/ mm². Vessel element length 150-347-700 μm. Intervessel pits minute, 1-2-2 μm in diameter. Fibers thin to thick- to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates, paratracheal parenchyma in narrow lines up to 3 cells wide. Rays uni- and biseriate, predominantly uniseriate. Three to 4 cells per parenchyma strand. Ray height 100-276-680 μm, with 3-8-14 cells in height. Rays 14-16-19/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is higher in the stem (35-62-90 / 55-77-110 μm) while vessel density is higher in the branch (5-48-69 / 11-21-34 vessels/ mm²). Rays are higher in the stem (100-276-680 / 100-320-610 μm) while ray number is higher in the branch (14-16-19 / 6-10-14 rays/mm).



CR 6674 x 100

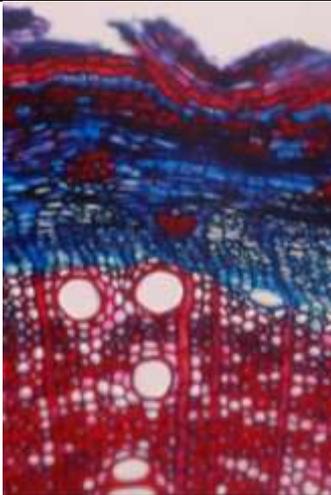


CR 6674 x 100

BARK ANATOMY

Branch bark: Sieve tubes in tangential rows. Some rays get dilated. Small groups of thick-walled fibers in the cortex. The cortex is characterized by tangentially elongated fibre and irregularly shaped blue stained parenchyma cells.

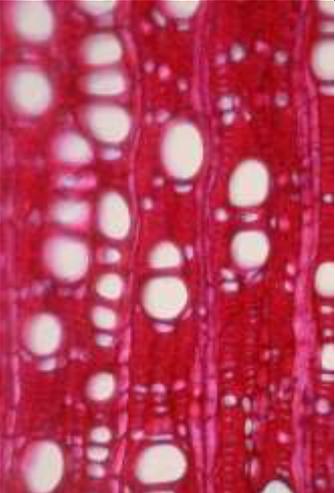
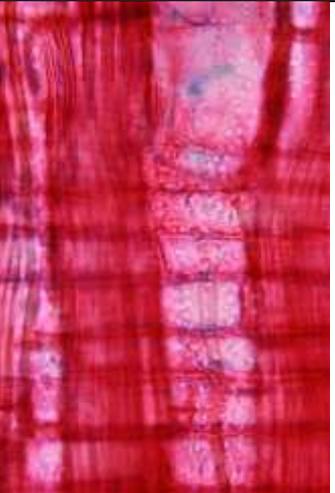
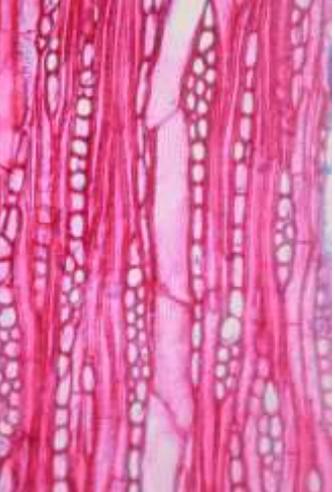
Stem bark: The phloem is characterized by sieve tubes and groups of sclereids irregularly distributed. Prismatic crystals present within sclereid groups. The phellem is homogeneous and it consists of regularly arranged rectangular cells, indistinct in polarized light. Dark staining substances in phellem cells.

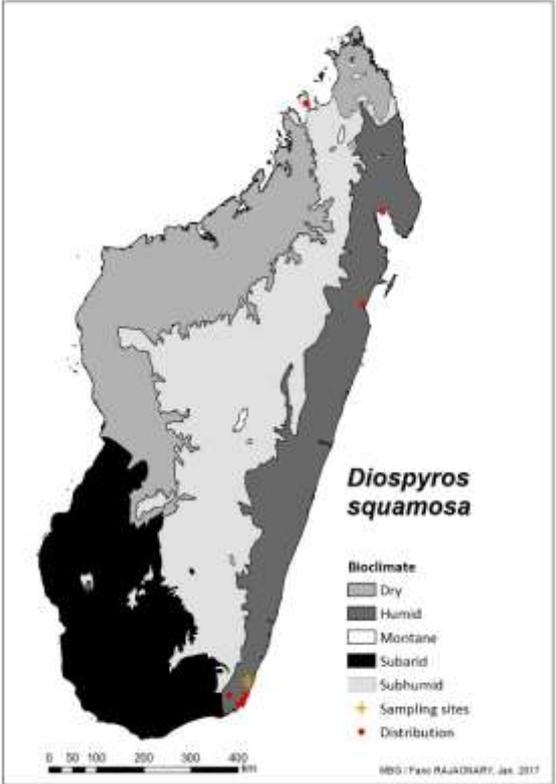


CR 6674 x 400



CR 6674 x 40

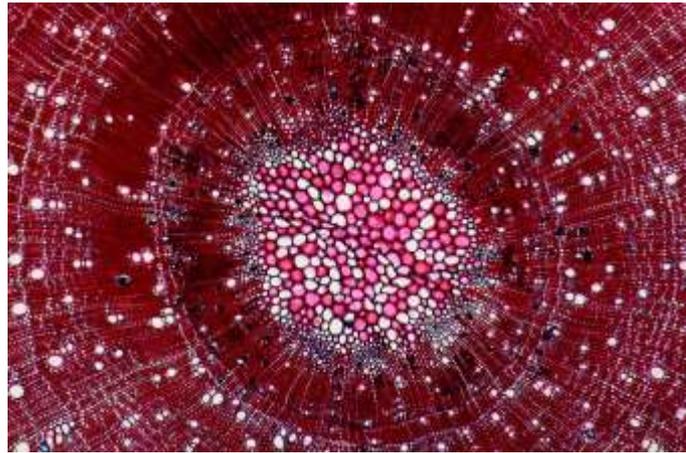
<p>STEM XYLEM ANATOMY Transverse section Growth rings boundaries indistinct or absent. Wood diffuse-porous. Vessels solitary and in long radial multiples of 2 to 6 elements. Tangential diameter of vessels medium 70-110-150 μm, 13-23-34 vessels/mm^2. Tyloses are common in heartwood vessels. Fibers thin to thick-walled to very thick-walled. Apotracheal parenchyma diffuse, diffuse-in-aggregates, reticulate and in narrow lines up to 3 cells wide. Paratracheal parenchyma scanty. Rays 13-14-17/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits circular and alternate, 3-4-6 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 120-235-400. Fibres with simple to minutely bordered pits (libriform fibers). Heterogeneous rays, body ray procumbent with 2 – 4 and over 4 rows upright and square cells. Prismatic crystals in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni-, bi- and triseriate, predominantly biseriate. Ray height 80-255-550 μm, with 4-10-28 cells in height. Three to 4 cells per parenchyma strand.</p>		
<p>Diospyros cupulifera Bojer ex A. DC.: CR 6674 IAWA feature numbers 2 5 9 13 22 25 30 42 48 52 56 61 66 69 70 76 77 78 86 87 92 97 107 108 116 136 142 180 189 192 196 Additional features: 9.1 102.3</p>		

<i>Diospyros squamosa</i> Bojer ex A. DC.	EBENACEAE
Synonymy : <i>D. bernieri</i> Hiern; <i>D. conifera</i> H. Perrier	
Specimens : RZK 7713, SFR 259	
Local names : Maintifotra, Hazomity, Hazomainty, Hazomafana, Forofoke, Hazomafana, Beravina, Mapingo Hazomintina, Hazomainty	
<p>PLANT DESCRIPTION Shrub to tree 2-12 m high 15-25 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-500 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Humid, sibirid, subhumid <i>Protected areas</i>: Andohahela, Zahamena, and Nosy Mangabe Marojejy, Mananara-Nord, Manongarivo, Masoala, <i>New protected areas</i>: Ampasindava, corridor Fandriana Marolambo, Anjanaharibe-sud, Lokobe, Makira, Makirovana, Mandena, Manombo, Tampolo, Tsitongabarika</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 -3 elements. Vessel small¹. Rays are thin².</p> <p>¹Small : indistinct to the naked eye ²Thin : indistinct to the naked eye</p>	 <p style="text-align: center;">SFR 259</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith oval. Thick-walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls. Pith not visible in polarized light.

Primary xylem: Vascular bundles distinct. Vessels solitary and in short radial multiples of 2 to 3 elements.



SFR 259 x 100

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 35-62-90, 5-48-69 vessels/ mm². Vessel element length 150-347-700 μm. Intervessel pits minute, 1-2-2 μm in diameter. Fibers thin to thick- to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates, paratracheal parenchyma in narrow lines up to 3 cells wide. Rays uni- and biseriate, predominantly uniseriate. Three to 4 cells per parenchyma strand. Ray height 100-276-680 μm, with 3-8-14 cells in height. Rays 14-16-19/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is higher in the stem (35-62-90 / 55-77-110 μm) while vessel density is higher in the branch (5-48-69 / 11-21-34 vessels/ mm²). Rays are higher in the stem (100-276-680 / 100-320-610 μm) while ray number is higher in the branch (14-16-19 / 6-10-14 rays/mm).



SFR 259 x 100

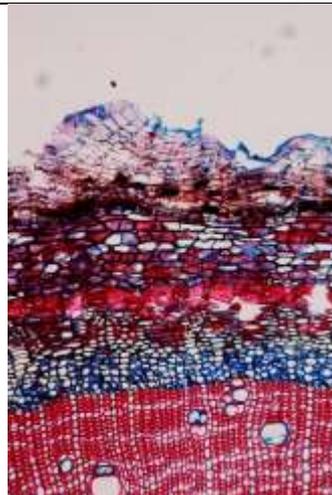


SFR 259 x 100

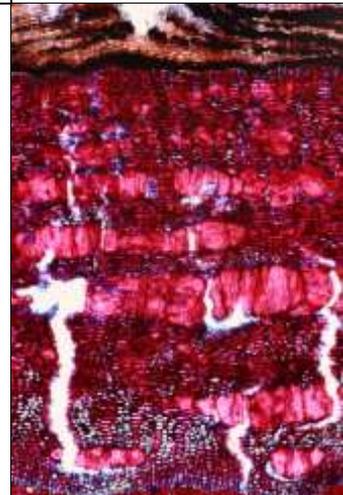
BARK ANATOMY

Branch bark: Collapsed and non-collapsed sieve tubes present in the phloem. The cortex is characterized by a band of sclereids and irregularly parenchyma cells. Dark staining substances in phellem cell lumina.

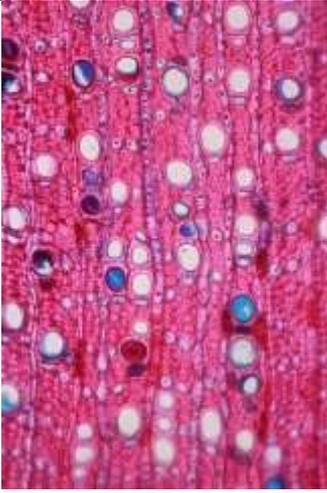
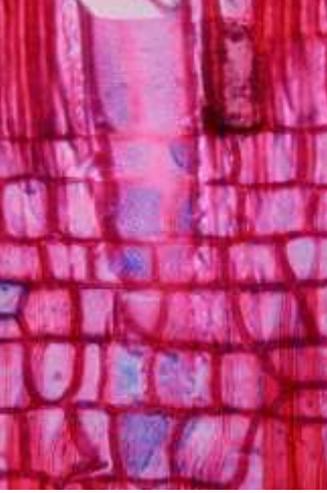
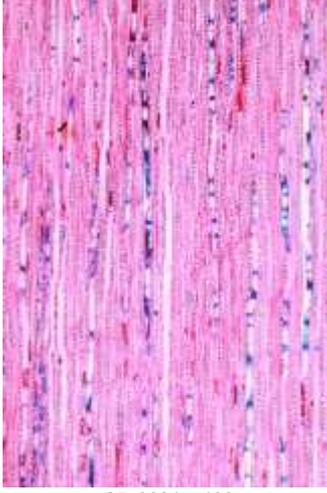
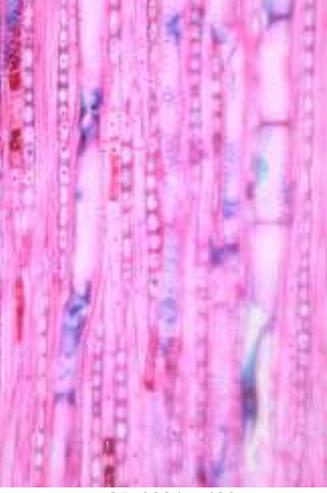
Stem bark: Sieve tubes in tangential row. Collapsed sieve tubes present. Many groups of tangentially elongated sclereid groups. Prismatic crystals present in the sclereids. Prismatic crystals present within sclereid groups. The phellem is homogeneous and it consists of regularly arranged rectangular cells, indistinct in polarized light. Dark staining substances in phellem cells.

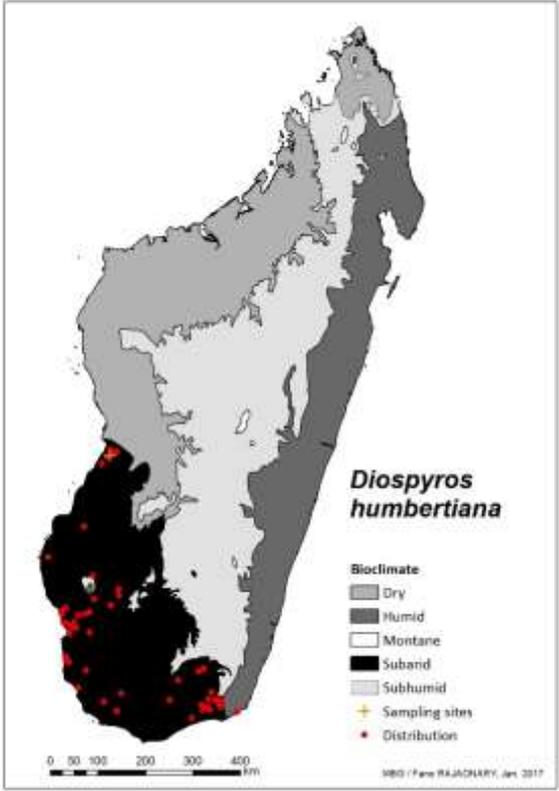


SFR 259 x 200



SFR 259 x 100

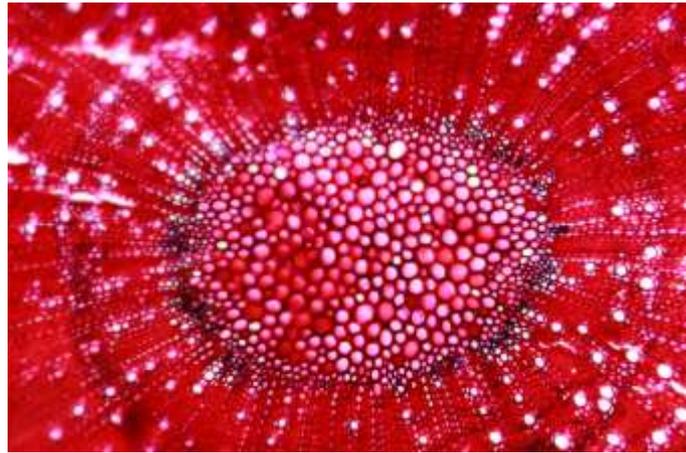
<p>STEM XYLEM ANATOMY Transverse section Growth rings boundaries indistinct or absent. Wood diffuse-porous. Vessels solitary and in long radial multiples of 2 to 6 elements. Tangential diameter of vessels small 20-25-30 μm, 156-184-216 vessels/mm^2. Tylosis and gums and/or other deposits in heartwood vessels. Fibers thin to thick-walled to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma scanty and in narrow lines up to 3 cells. Rays 17-21-23/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits circular and alternate, 3-4-5 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 40-218-400 μm. Fibres with distinctly bordered pits (libriform fibers). Heterogeneous rays, body rays procumbent with 1-4 rows of upright and square marginal cells. Prismatic crystals in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate, predominantly uniseriate. Ray height 50-415-1000 μm, with 2-15-39 cells in height. Three to 4 and 5 to 8 cells per parenchyma strand.</p>		
<p>Diospyros squamosa Bojer ex A. DC.: CR 6681 IAWA feature numbers 2 5 9 13 22 24 30 40 50 52 56 58 61 66 69 70 76 77 78 86 92 93 97 107 116 136 142 180 189 190 192 196 Additional features: 9.1 96.1 102.3</p>		

<i>Diospyros humbertiana</i> H. Perrier	EBENACEAE
Synonymy : -	
Specimens : CR 6516, CR 6681	
Local names : Maintifo, Malainara, Mandravarotra, Hazondrano	
<p>PLANT DESCRIPTION Shrub to tree 2-12 m high 15-25 cm DBH. Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-1000 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Humid <i>Protected areas</i>: Andohahela, Beza Mahafaly, Kirindy Antimena <i>New protected areas</i>: Analavelona, La Table/St Augustin, Mikea</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 -3 elements. Vessel small¹ and numerous². Rays are thin³.</p> <p>¹Small : indistinct to the naked eye ²Numerous: > 100 vessels/mm ³Thin : indistinct to the naked eye</p>	 <p style="text-align: center;">CR 6681</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith oval. Thick-walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls. Pith not visible in polarized light.

Primary xylem: Vascular bundles distinct. Vessels solitary and in short radial multiples of 2 to 3 elements.



CR 6681 x 200

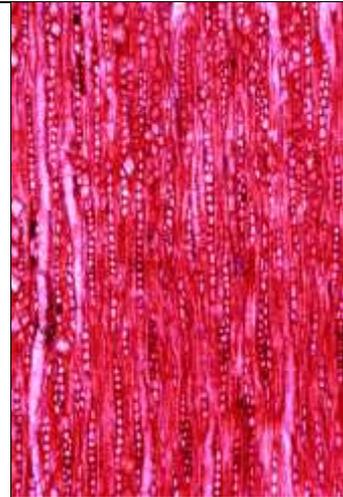
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 20-26-30 μm , 95-112-133 vessels/ mm^2 . Vessel element length 60-198-330 μm . Intervessel pits minute, 3-4-5 μm in diameter. Fibers thin to thick- to very thick-walled. Apotracheal parenchyma diffuse-in-aggregates, paratracheal parenchyma scanty. Rays uni- and biseriate, predominantly uniseriate. Ray height 70-310-840 μm , with 4-10-21 cells in height. Rays 14-16-19/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is comparable (20-26-30 / 20-25-30 μm) while vessel density is higher in the stem (95-112-133 / 156-184-216 vessels/ mm^2). Rays height and number are higher in the stem (70-310-840 / 50-415-1000 μm) (14-16-19 / 17-21-23 rays/mm).



CR 6681 x 100

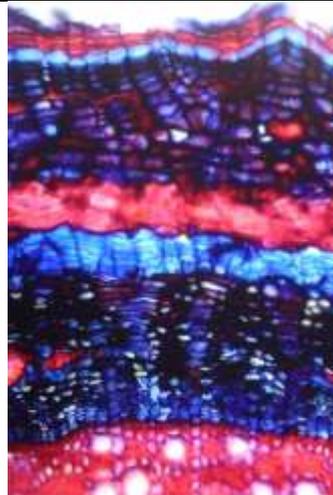


CR 6681 x 100

BARK ANATOMY

Branch bark: Collapsed and non-collapsed sieve tubes present in the phloem. Irregularly distributed solitary and group of sclereids present. Some rays become dilated. The cortex is characterized by a band of sclereids and irregularly blue stained parenchyma cells.

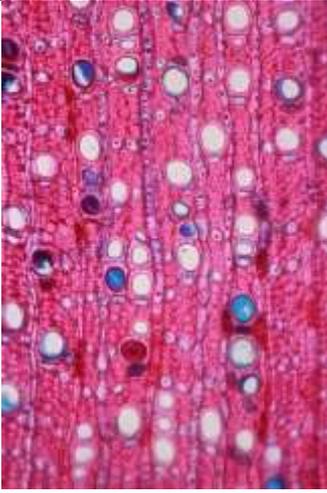
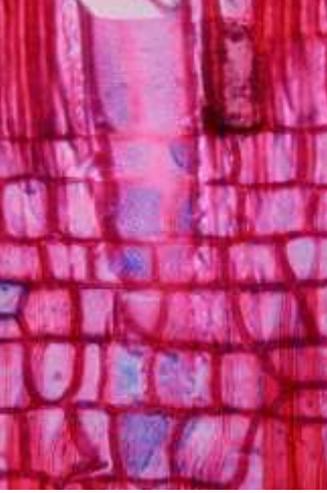
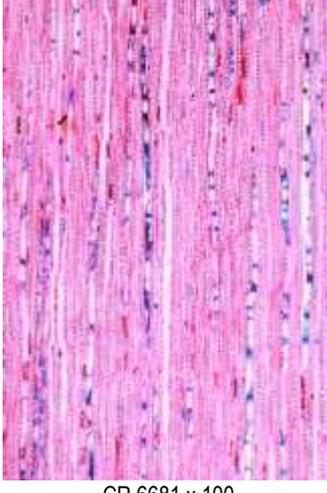
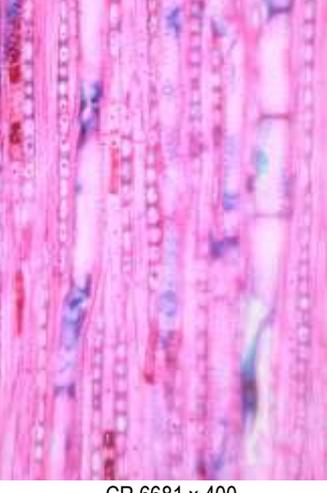
Stem bark: The phloem consists of alternating irregular groups of sclereids, and collapsed and non-collapsed sieve tubes. Prismatic crystals present in the sclereids. The phellem is homogeneous and it consists of regularly arranged rectangular cells, indistinct in polarized light.

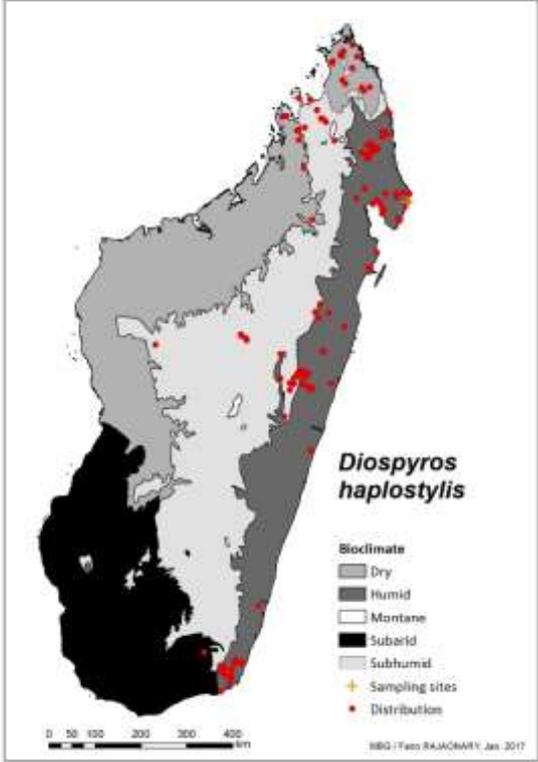


CR 6681 x 400



CR 6681 x 200

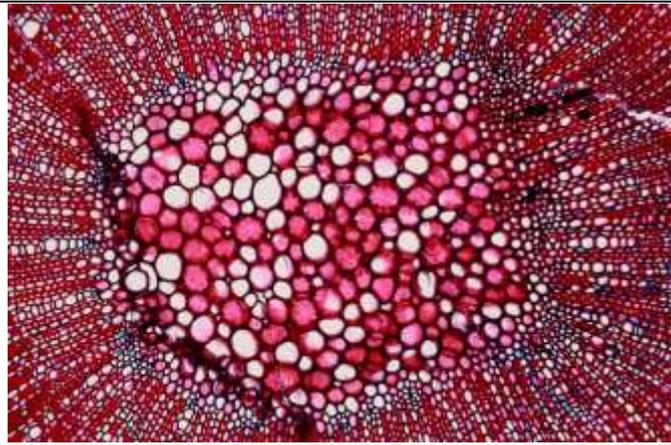
<p>STEM XYLEM ANATOMY Transverse section Growth rings boundaries indistinct or absent. Wood diffuse-porous. Vessels solitary and in short radial multiples of 2 to 3 elements. Tangential diameter of vessels small 20-25-30 μm, 156-184-216 vessels/mm^2. Tylosis and gums and/or other deposits in heartwood vessels. Fibers thin to thick-walled to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Paratracheal parenchyma scanty and in narrow lines up to 3 cells. Rays 17-21-23/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits circular and alternate, 3-4-5 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 40-218-400 μm. Fibres with distinctly bordered pits (libriform fibers). Heterogeneous rays, body rays procumbent with 1-4 rows of upright and square marginal cells. Prismatic crystals in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate, predominantly uniseriate. Ray height 50-415-1000 μm, with 2-15-39 cells in height. Three to 4 and 5 to 8 cells per parenchyma strand.</p>		
<p>Diospyros humbertiana H. Perrier.: CR 6681 IAWA feature numbers 2 5 9 13 22 24 30 40 50 52 56 58 61 66 69 70 76 77 78 86 92 93 97 107 116 136 142 180 189 190 192 196 Additional features: 9.1 96.1 102.3</p>		

<i>Diospyros haplostylis</i> Boivin ex Hiern	EBENACEAE
Synonymy : <i>Diospyros haplostylis</i> var. <i>haplostylis</i> ; <i>D. haplostylis</i> var. <i>orientalis</i> H. Perrier; <i>D. onivensis</i> H. Perrier; <i>D. rubrolanata</i> H. Perrier; <i>D. viguieriana</i> H. Perrier.	
Specimens : RBE 2471	
Local names : Maintimpototra, Hazo mainty, Jobiampototra, Hazojôby, Hazomintina, Forofoke Hazomety, Maintimpototra, Mapingo, Vomipototra	
PLANT DESCRIPTION Shrub to tree 10-12 m high Endemic to Madagascar. Exploited species.	
DISTRIBUTION <i>Elevation</i> : 0-1500 m a.s.l. <i>Vegetation formation</i> : Forest <i>Bioclimate</i> : Dry, humid and subhumid <i>Protected areas</i> : Ambohijanahary, Analamerana, Andohahela, Ankarana, Betampona, Lokobe, Mananara Nord, Manongarivo, Marojejy, Masoala, Montagne d'Ambre, Nosy Mangabe, Tsaratanana, Zahamena. <i>New protected areas</i> : Loky Manambato (Daraina), Makira, Montagne des Français	
STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 5 elements. Vessels large ¹ and very rare ² . Parenchyma reticulate. Ray thick ³ . ¹ Large: Visible to the naked eye ² Rare: 5-20 vessels/mm ² ³ Thick: Visible to the naked eye	

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith pentagonal. Thick-walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles indistinct. Vessels solitary and in short radial multiples of 2 to 3 elements.



RBE 2471 x 200

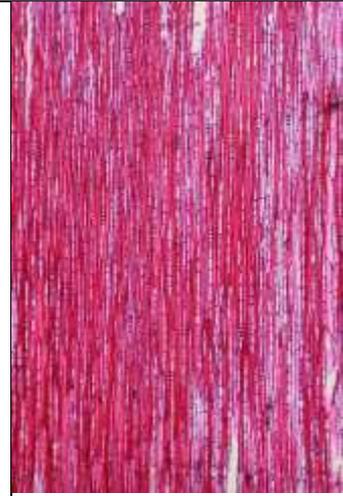
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 20-32-40, 42-69-112 vessels/ mm². Vessel element length 120-203-340 μm. Intervessel pits minute, 1-2-3 μm in diameter. Fibers thin to thick- to very thick-walled. Apotracheal parenchyma diffuse, paratracheal parenchyma reticulate and in narrow lines up to 3 cells wide. Rays uni- and biseriata, predominantly uniseriate. Three to 4, 5 to 8 cells per parenchyma strand. Ray height 100-430-1120 μm, with 3-11-22 cells in height. Rays 14-16-19/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is higher in the stem (20-32-40 / 30-54-90 μm) while vessel density is higher in the branch (42-69-112 / 120-203-340 vessels/ mm²). Rays are higher in the branch (100-430-1120 / 190-420-1300 μm) while ray number is comparable (14-16-19 / 14-17-21 rays/mm).



RBE 2471 x 100



RBE 2471 x 100

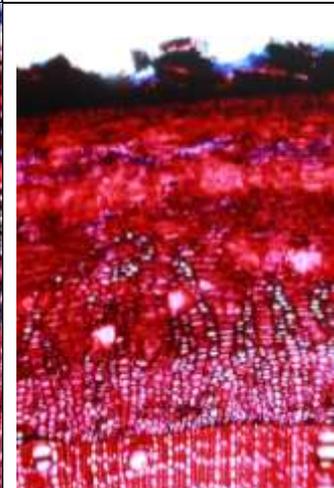
BARK ANATOMY

Branch bark: The phloem is characterized by collapsed and non-collapsed sieve tubes and tangentially distributed solitary and groups of sclereids. In the cortex sclereids arranged in a tangential bands and irregular parenchyma cells present.

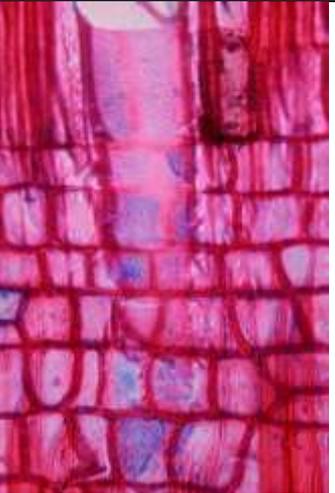
Stem bark: Tangentially distributed solitary and groups of sclereids, and collapsed and non collapsed sieve tubes present in the phloem. Ray and axial parenchyma dilatation present. Prismatic crystals present in the sclereids. Band of sclereids present in the cortex. The phellem is homogeneous with dark stained substances and it consists of regularly arranged rectangular cells.

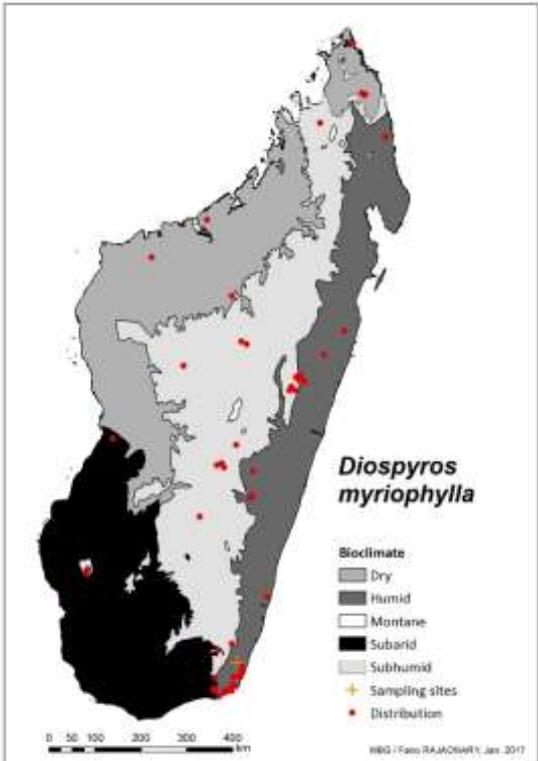


RBE 2471 x 200



RBE 2471 x 200

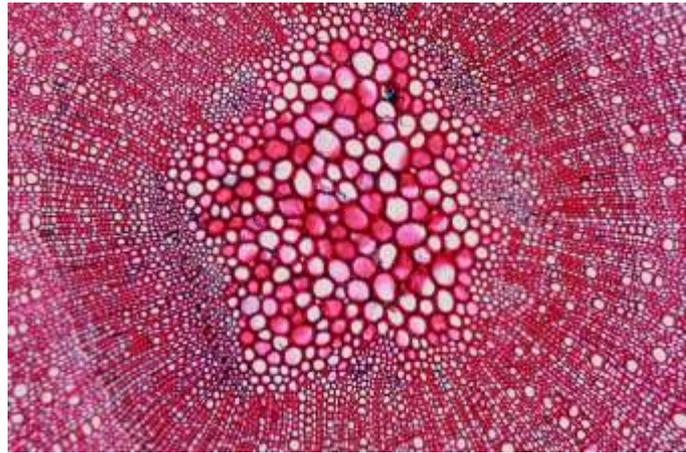
<p>STEM XYLEM ANATOMY Transverse section Growth rings boundaries indistinct or absent. Wood diffuse-porous. Vessels solitary and in long radial multiples of 2 to 7 elements. Tangential diameter of vessels medium 30-54-90 μm, 13-27-42 vessels/mm^2. Fibers thin to thick-walled to very thick-walled. Apotracheal parenchyma diffuse and in narrow lines up to 3 cells wide. Paratracheal parenchyma scanty. Rays 14-17-21/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits circular and alternate, 1-2-3 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 50-106-250 μm. Fibres with simple to minutely bordered pits (libriform fibres). Heterogeneous rays, body ray procumbent with 1 to 4 rows upright and square cells. Prismatic crystals in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate, predominantly uniseriate. Ray height 190-420-1300 μm, with 4-12-19 cells in height. Three to 4 and 5 – 8 cells per parenchyma strand.</p>		
<p>Diospyros haplostylis Boivin ex Hiern : RBE 2471 IAWA feature numbers 2 5 9 13 22 24 30 41 48 52 61 66 69 70 77 78 86 92 93 97 107 108 116 136 142 180 189 190 192 196 Additional features: 9.1 96.1 102.3</p>		

<p><i>Diospyros myriophylla</i> (H. Perrier) G.E. Schatz & Lowry</p>	<p>EBENACEAE</p>
<p>Synonymy : <i>Maba myriophylla</i> H. Perrier</p>	
<p>Specimens : RZK 8027</p>	
<p>Local names : Maba, Maintiampototra, Arivoravina, Forofoke, Korofoka, Jombiampototra, Jobiampototra madinidravina, Lopingo keliravy, Lorofoka, Forofoky, Havohanala, Taly, Taimboalavo.</p>	
<p>PLANT DESCRIPTION Shrub to tree 3-6 m high Endemic to Madagascar. Exploited species.</p>	
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-2000 m a.s.l. <i>Vegetation formation</i>: Forest, inselberg/rock face, woodland <i>Bioclimate</i>: Humid and subarid and subhumid <i>Protected areas</i>: Ambohitately, Analamazaotra, Andohahela, Ranomafana, Tsaratanana. <i>New protected areas</i>: Ambatovy, Analavelona, Itremo-Ambatofinandrahana</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 -5 elements. Vessel small¹. Apotracheal parenchyma in short lines. Rays are thin².</p> <p>¹Small : indistinct to the naked eye ²Thin : indistinct to the naked eye</p>	 <p>RZK 8027</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith star. Thick-walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles distinct. Vessels solitary and in short radial multiples of 2 to 6 elements.



RZK 8027 x 200

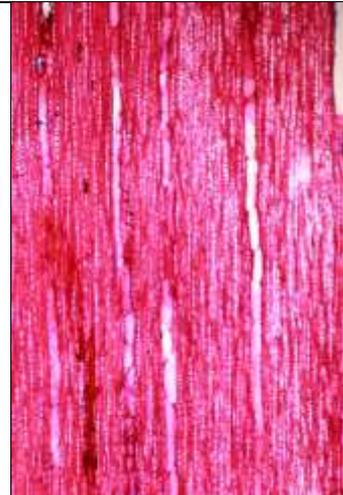
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 30-47-70, 95-112-129 vessels/ mm². Vessel element length 105-151-190 μm. Intervessel pits minute, 2-3-3 μm in diameter. Fibers thin to thick- to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates. Rays uni- and biseriate, predominantly biseriate. Three to 4 cells per parenchyma strand. Ray height 150-361-680 μm, with 5-11-23 cells in height. Rays 11-18-22 /mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is comparable (30-47-70 / 35-49-75 μm) while vessel density is higher in the branch (95-112-129 / 12-47-69 vessels/ mm²). Rays are higher in the stem (150-361-680 / 230-374-820 μm) while ray number is comparable (11-18-22 / 13-19-25 rays/mm).



RZK 8027 x 100



RZK 8027 x 100

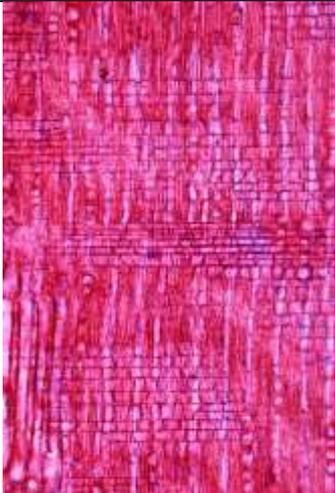
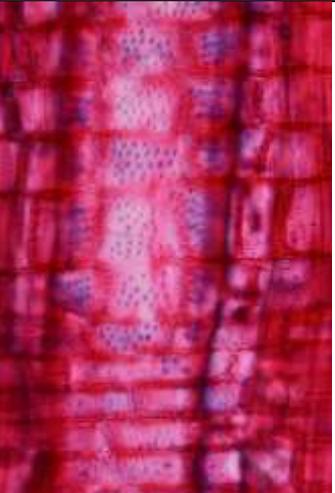
BARK ANATOMY

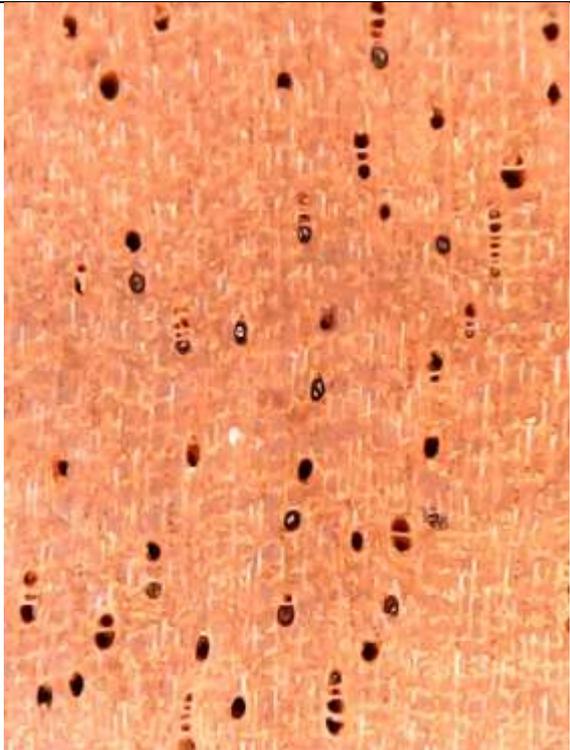
Branch bark: -

Stem bark: Tangentially distributed solitary and groups of sclereids, and collapsed and non collapsed sieve tubes present in the phloem. Ray and axial parenchyma dilatation present. Band of sclereids present in the cortex. Prismatic crystals present in the sclereids. The phellem is homogeneous and it consists of regularly arranged rectangular cells.



RZK 8027 x 100

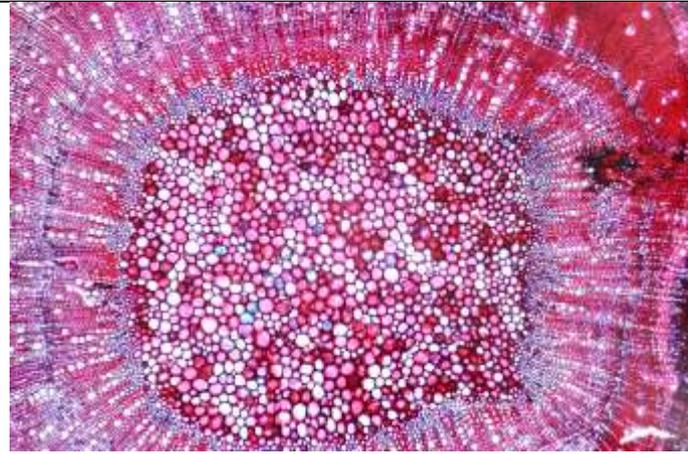
<p>STEM XYLEM ANATOMY Transverse section Growth rings boundaries indistinct or absent. Wood diffuse-porous. Vessels solitary and in long radial multiples of 2 to 10 elements. Tangential diameter of vessels medium 35-49-75 μm, 12-47-69 vessels/mm^2. Fibers very thick-walled. Apotracheal parenchyma diffuse, diffuse-in-aggregates and in narrow lines up to 3 cells wide. Paratracheal parenchyma scanty. Rays 13-19-25/mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits circular and alternate, 1-3-4 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 90-242-420 μm. Fibres with simple to minutely bordered pits (libriform fibres). Heterogeneous rays, body ray procumbent with 2 to 4 and over 4 rows upright and square cells. Prismatic crystals in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni-, bi- and triseriate, predominantly biseriate. Ray height 230-374-820 μm, with 3-12-29 cells in height. Three to 4 and 5 – 8 cells per parenchyma strand.</p>		
<p><i>Diospyros myriophylla</i> (H. Perrier) G.E. Schatz & Lowry : RZK 8027 IAWA feature numbers 2 5 9 13 22 24 30 41 48 52 61 66 70 76 77 78 86 92 93 97 107 108 116 136 142 180 189 190 192 196 Additional features: 9.1 102.3</p>		

<i>Diospyros toxicaria</i> Hiern	EBENACEAE
Synonymy : <i>Diospyros cauceana</i> A. Chev	
Specimens : RBE 2480	
Local names : Maba, Maintiampototra, Arivoravina, Forofoke, Korofoka, Jombiampototro, Jobiampototra madinidravina, Lopingo keliravy, Lorofoka, Forofoky, Havohanala, Taly, Taimboalavo.	
<p>PLANT DESCRIPTION Tree up to 20 high Endemic to Madagascar. Exploited species.</p>	-
<p>DISTRIBUTION</p> <p><i>Elevation</i>: 0-500 m a.s.l. <i>Vegetation formation</i>: Forest and mangrove <i>Bioclimate</i>: humid <i>Protected areas</i>: Betampona, Mananara Nord, Manombo, Masoala <i>New protected areas</i>: Analalava, Ankarabolava (Vohipaho North), Ile Ste Marie, Makirovana-Tsihomanaomby, Tampolo, Tsitongambarika.</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 5 elements. Vessels large¹ and very rare². Parenchyma reticulate. Ray distinct with hand lens.</p> <p>¹Large: indistinct to the naked eye ²Very rare: < 5 vessels/mm²</p>	 <p style="text-align: center;">RBE 2480</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith square. Thick-walled parenchyma cells present. Cells dimorphic. Cell contents present. Prismatic crystal present. Pits in transverse cell walls. Pith not visible in polarized light.

Primary xylem: Vascular bundles indistinct. Vessels solitary and in short radial multiples of 2 to 4 elements.



RBE 2480 x 100

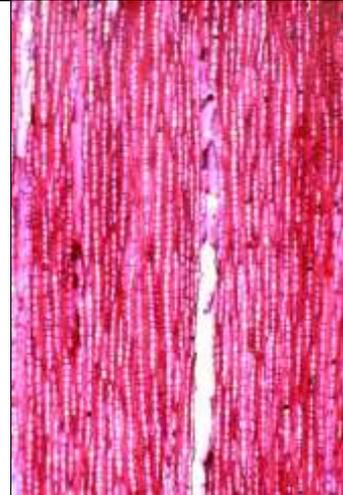
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries indistinct or absent. Tangential diameter of vessels 40-50-70, 25-47-70 vessels/ mm². Vessel element length 160-244-420 μm. Intervessel pits minute, 1-2-3 μm in diameter. Fibers thin to thick- to very thick-walled. Apotracheal parenchyma diffuse and diffuse-in-aggregates, paratracheal parenchyma scanty and in narrow lines up to 3 cell wide. Rays uni- and biseriate, predominantly uniseriate. Three to 4 cells per parenchyma strand. Ray height 175-493-1350 μm, with 4-16-54 cells in height. Rays 19-21-23/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel lumina is higher in the stem (40-50-70 / 50-88-105 μm) while vessel density is higher in the branch (25-47-70 / 6-13-26 vessels/ mm²). Rays are higher in the stem (175-493-1350 / 190-608-1300 μm) while ray number is higher in the branch (19-21-23 / 14-16-19 rays/mm).



RBE 2480 x 100

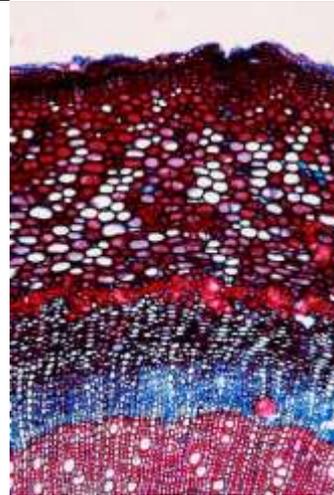


RBE 2480 x 100

BARK ANATOMY

Branch bark: Collapsed and non-collapsed sieve tubes present in the phloem. The cortex is characterized by a band of sclerenchyma and irregular blue-stained parenchyma cells.

Stem bark: The phloem is characterized by sieve tubes and parenchyma cells filled with dark staining substances. Sclereids in irregularly distributed groups. Prismatic crystals present within sclereids groups. The phellem cells are homogeneous and it consists of regularly arranged rectangular cells, indistinct in polarized light. Dark staining substances in phellem cells.



RBE 2480 x 200

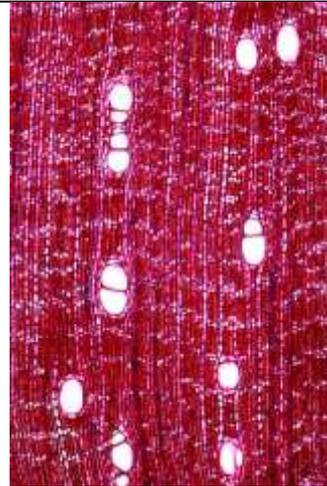


RBE 2480 x 40

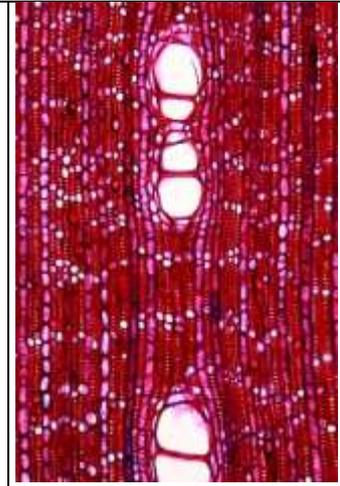
STEM XYLEM ANATOMY

Transverse section

Growth rings boundaries indistinct or absent. Wood diffuse-porous. Vessels solitary and in long radial multiples of 2 to 7 elements. Tangential diameter of vessels medium 50-88-105 μm , 6-13-26 vessels/ mm^2 . Tylosis, gums and other deposits in heartwood vessels. Fibers thin to thick-walled to very thick-walled. Parenchyma diffuse-in-aggregates, reticulate and in narrow lines up to 3 cells wide. Rays 14-16-19/ mm .



RBE 2480 x 100



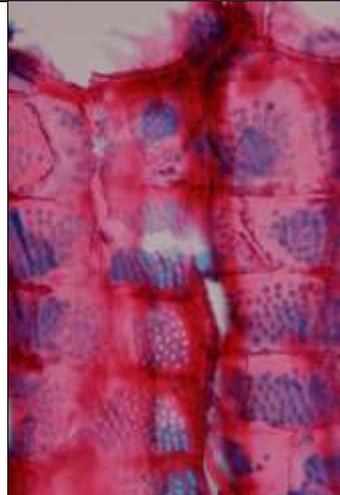
RBE 2480 x 200

Radial section

Simple perforation plates. Intervessel pits circular and alternate, 2-3-4 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 100-322-590 μm . Fibres with simple to minutely bordered pits (libriform fibres). Heterogeneous rays, body ray procumbent with over 4 rows upright or square cells, rays with procumbent, upright and square cells mixed. Prismatic crystals in chambered axial parenchyma cells.



RBE 2480 x 100



RBE 2480 x 1000

Tangential section

Rays uni- and biseriate, predominantly uniseriate. Ray height 190-608-1300 μm , with 4-13-24 cells in height. Three to 4 and 5 – 8 cells per parenchyma strand.



RBE 2480 x 100



RBE 2480 x 200

Diospyros myriophylla (H. Perrier) G.E. Schatz & Lowry : RBE 2480

IAWA feature numbers 2 5 9 13 22 24 30 41 47 52 56 58 61 66 69 70 77 86 87 92 97 108 109 116 136 142 180 189 192 196

Additional features: 9.1 96.1 102.3

Look-alike species



Dupuya madagascariensis

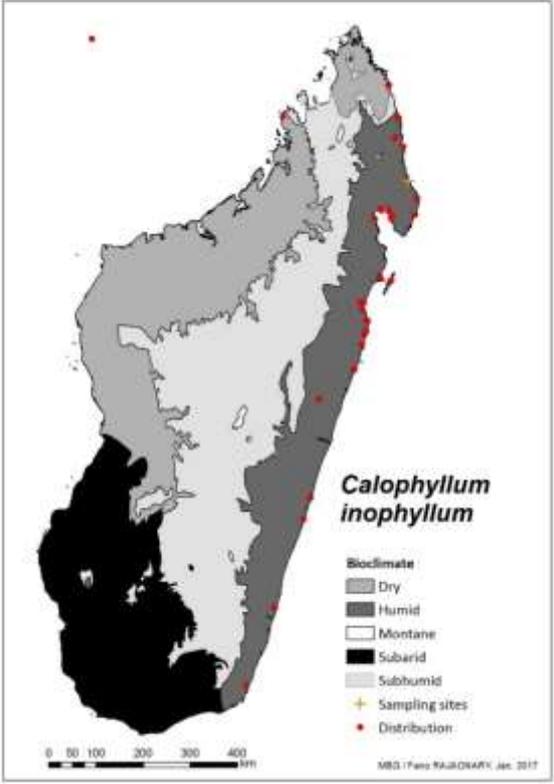
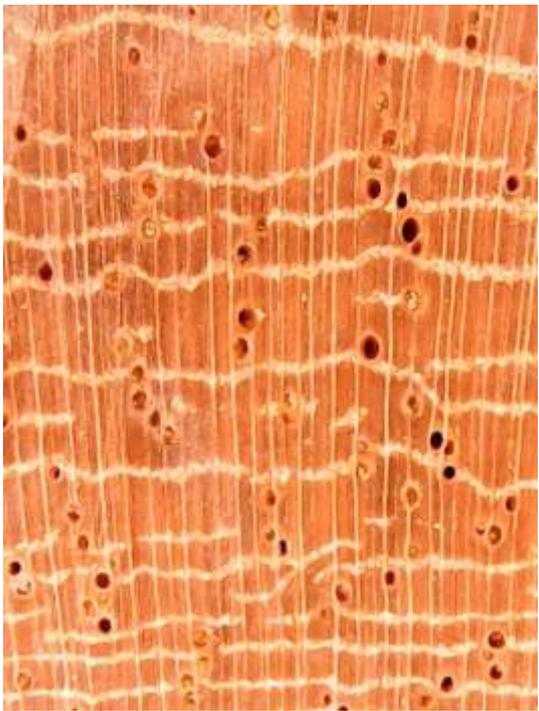


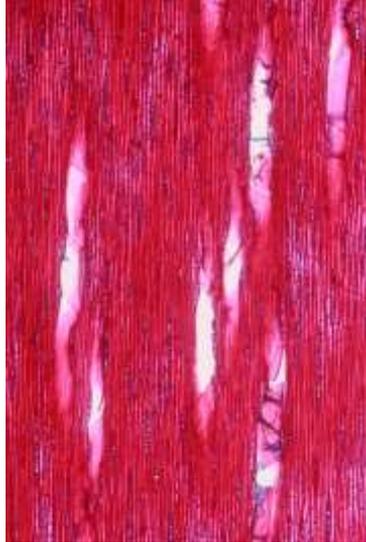
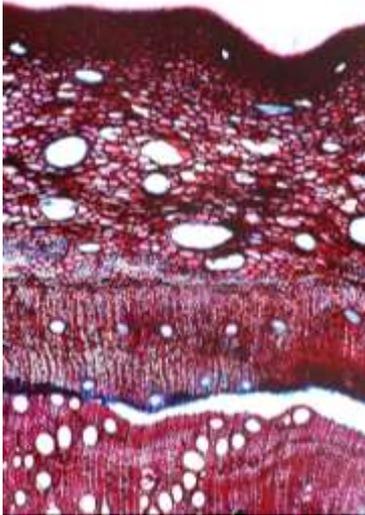
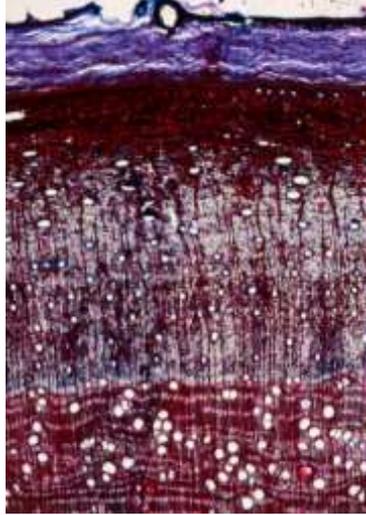
Dupuya madagascariensis

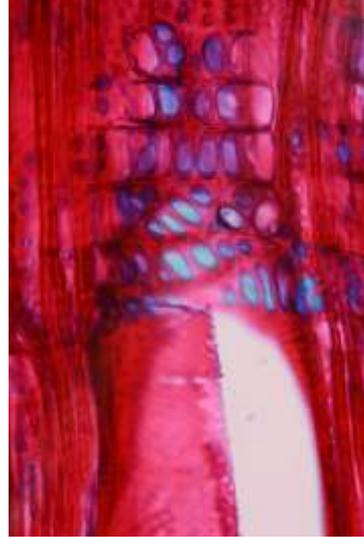
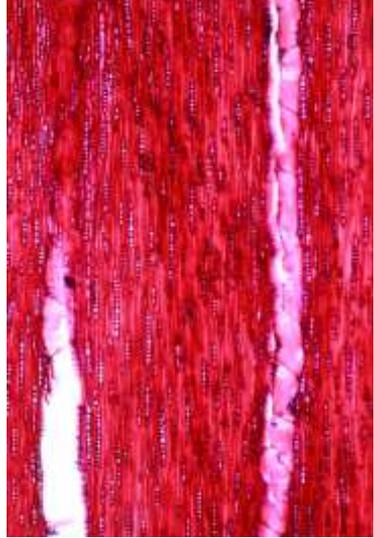


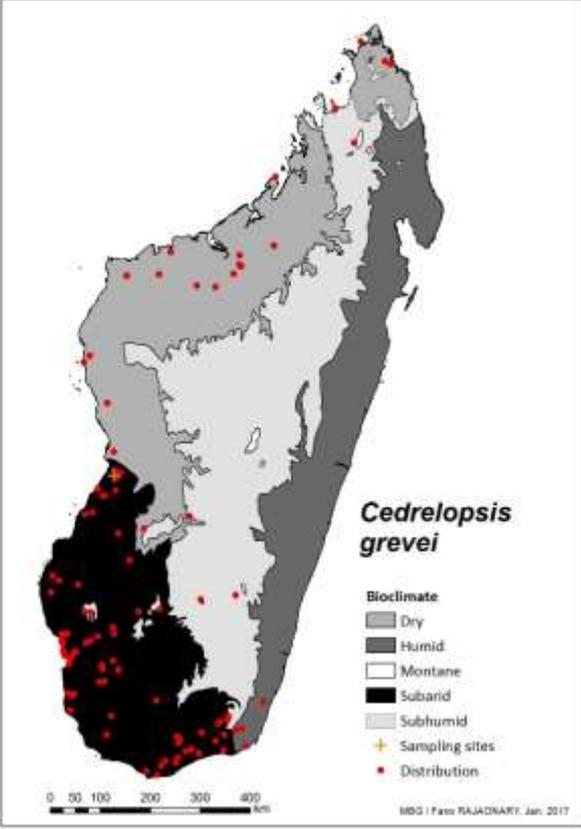
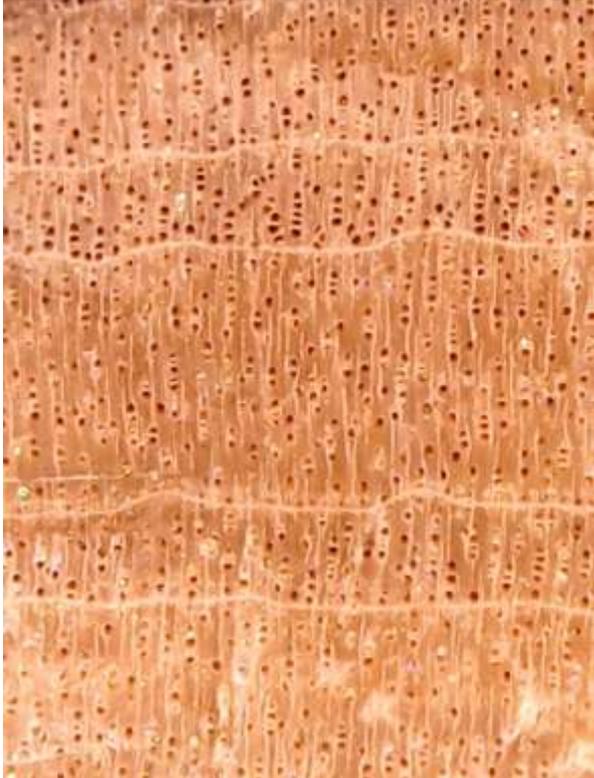
Tamarindus indica

A total of 12 look-alike species are described.

<i>Calophyllum inophyllum</i> L.	CALOPHYLLACEAE
Synonymy: -	
Specimens : RBE 2487	
Local names: Vitano, Vintanona, Resojo, Vitamo, Foraha, Samborano, Lintanina, Ranomena, Vintanondriaka, Kimba madinidravina, Vitanona jjiy madinidravina, Roetra, Tomenja, Forara, Nanto boka.	
<p>PLANT DESCRIPTION</p> <p>Tree up to 15 m high </p>	
<p>DISTRIBUTION</p> <p>Elevation: 0-499 m Vegetation Formation: Forest Bioclimate: Dry, Humid, Subhumid Protected areas and other important sites: Agnalazaha (Mahabo), Ampasindava, Loky Manambato (Daraina), Masoala, Nosy Mangabe, Pointe à Larrée.</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 elements. Vessels large¹ and rare². Tyloses present in vessels. Apotracheal parenchyma in bands. Paratracheal axial parenchyma confluent. Rays are thin³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">RBE 2487</p>

<p>PITH AND PRIMARY XYLEM ANATOMY</p> <p><i>Pith:</i> -</p> <p><i>Primary xylem:</i> -</p>		
<p>BRANCH XYLEM ANATOMY</p> <p>Description: Growth rings boundaries absent. Wood diffuse-porous. Tangential diameter of vessels 50-87-130 μm, 10-19-33 vessels/ mm^2. Vessel element length 140-236-350 μm. Intervessel pits small 3-4-5 in diameter. Fibres thin to thick-walled. Axial paratracheal in bands up to 3 cells wide. Heterogeneous rays, body ray procumbent with one, 2-4 rows upright or square marginal cell. Rays exclusively uniseriate. Ray height 70-242-460 μm. Rays 9-11-14 /mm.</p> <p>Anatomical differences to stem xylem: Tangential diameter of vessel is larger in the branch (50-87-130 / 35-80-120 μm) while vessel density is comparable 10-19-33 / 7-20-39 vessels/mm^2. Ray height is higher in the branch (70-242-460 / 100-216-490 μm) while ray number is higher in the stem (9-11-14 / 12-13-17 rays/mm).</p>	 <p>RBE 2487 x 100</p>	 <p>RBE 2487 x 100</p>
<p>BARK ANATOMY</p> <p>Branch bark: The phloem composed with sieve tubes, parenchyma cells and small intercellular canals. Collapsed and non collapsed sieve tubes and large intercellular canals present in the cortex.</p> <p>Stem bark: The phloem is characterized by collapsed and non collapsed sieve tubes and intercellular canals. Lignified parenchyma cells are present in the cortex. The phellem is homogeneous and consists of regularly arranged rectangular parenchyma cells, indistinct in polarized light.</p>	 <p>RBE 2487 x 100</p>	 <p>RBE 2487 x 40</p>

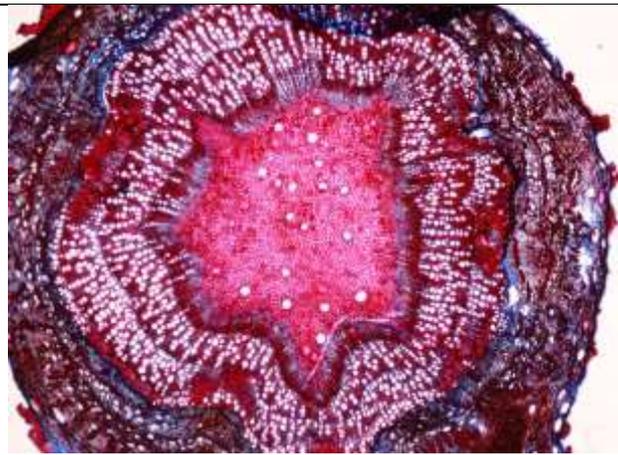
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries absent. Wood diffuse-porous. Vessels mostly solitary. Vessel in diagonal and/or radial pattern. Tylosis common. Tangential diameter of vessels 35-80-120 μm, 7-20-39 vessels/mm^2. Fibres thin to thick-walled. Axial paratracheal in bands up to 3 and more than 3 cells wide. Rays 12-13-17 per mm.</p>	 <p>RBE 2487 x 100</p>	 <p>RBE 2487 x 200</p>
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 5-6-9 μm in diameter. Vessel-ray pits with much reduced borders to apparently simple: pits rounded or angular. Vessel element length 30-219-480 μm. Fibres with simple to minutely bordered pits. Heterogeneous rays, body ray cells procumbent with one, 2-4 rows of upright and/or square marginal cells. Prismatic crystal in upright and or square ray cell and in chambered axial parenchyma cells.</p>	 <p>RBE 2487 x 200</p>	 <p>RBE 2487 x 1000</p>
<p>Tangential section Rays exclusively uniseriate. Ray height 100-216-490 μm, with 3-11-21 cells in height. Three to 4 and 5-8 cells per parenchyma strand.</p>	 <p>RBE 2487 x 100</p>	 <p>RBE 2487 x 400</p>
<p><i>Calophyllum inophyllum</i> L.: RBE 2487 IAWA feature numbers 2 5 7 9 13 25 31 41 47 52 56 61 66 69 85 86 96 106 107 116 136 142 178 180 189 196</p>		

<p><i>Cedrelopsis grevei</i> Baill.</p>	<p>RUTACEAE</p>
<p>Synonymy : <i>Katafa crassisepalum</i> Constantin & Poisson, Henri Louis</p>	
<p>Specimens : CR 6684, CR 6685</p>	
<p>Local names: Hazondita, Katrafay</p>	
<p>PLANT DESCRIPTION Shrub to tree up to 20 m high Endemic to Madagascar Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-999 m a.s.l. <i>Vegetation formation</i>: Forest, Thicket <i>Bioclimate</i>: Dry, subarid, subhumid <i>Protected areas</i> and other important sites : Andohahela, Ankarafantsika, Bezà-Mahafaly, Cap Sainte Marie, Kirindy Mitea, Mikea, Tsimanampetsotse, Tsinjoriake (La Table/St Augustin), Zombitse – Vohibasia</p>	
<p>STEM XYLEM DESCRIPTION Growth ring boundaries distinct marked by marginal parenchyma. Vessels solitary and in radial multiples of 2 to 5 elements. Vessels large¹ and numerous². Rays distinct with hand lens. ¹Large: Distinct to the naked eye ²Numerous: 20-40 vessels/mm²</p>	 <p style="text-align: center;">CR 6684</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith polygonal. Thick-walled parenchyma cells present. Cells dimorphic. Prismatic crystal present. Laticifers and or intercellular canals present. Pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles indistinct. Vessels solitary and in long radial multiples of 2 to 6 elements.



CR 6685 x 100

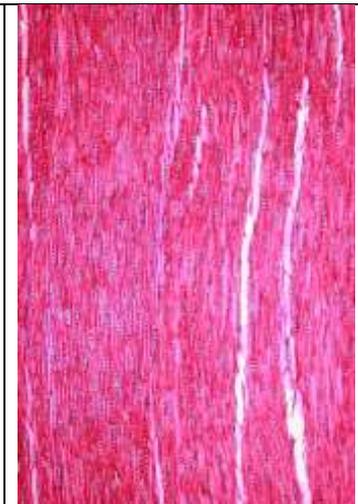
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries distinct. Wood diffuse-porous. Tangential diameter of vessels 30-39-50 μm , 92-109-126 vessels/ mm^2 . Gums and other deposits in vessels. Vessel element length 100-192-322 μm . Intervessel pits medium 3-4-6 μm in diameter. Fibres thin to thick-walled. Axial paratracheal absent or extremely, in marginal or in seemingly marginal bands. Homogeneous rays, all body ray cells procumbent. Rays exclusively uniseriate. Ray height 60-110-170 μm . Rays 9-10-15 /mm.

Anatomical differences to stem xylem: Tangential diameter of vessel is larger and vessel density higher in the stem (30-39-50 / 40-61-90 μm) (92-109-126 / 86-111-143 vessels/ mm^2). Ray number is higher in the branch (9-10-15 / 12-16-19 rays/ mm) and ray height is comparable (60-110-170 / 70-112-180 μm).



CR 6685 x 100

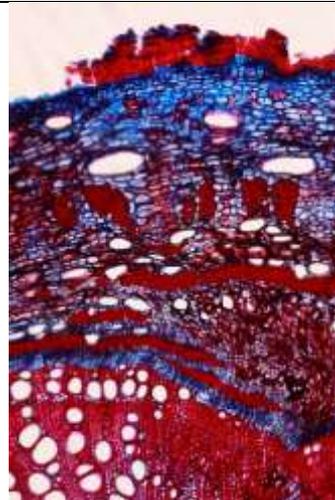


CR 6685 x 100

BARK ANATOMY

Branch bark: Collapsed, non-collapsed sieve tubes and tangentially fibres present in the phloem. The cortex is characterized by laticifers or intercellular canals, irregular blue stained parenchyma cells and groups of fibre.

Stem bark: The phloem consists of alternating tangential bands of fibres and collapsed and non-collapsed sieve tubes and laticifer or intercellular canals. Parenchyma dilatation present. The layer phellem is homogeneous and it consists of regularly arranged rectangular parenchyma cells with dark staining substances. Lignified cells in phellem, distinct in polarized light. .



CR 6685 x 200

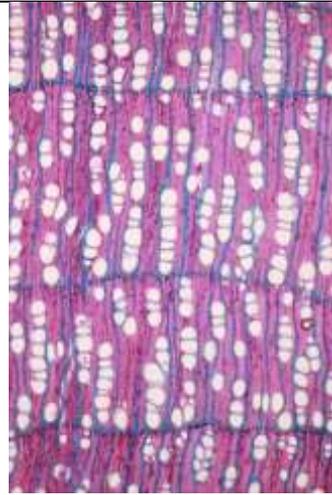


CR 6685 x 20

STEM XYLEM ANATOMY

Transverse section

Growth ring boundaries absent. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 8 elements. Tangential diameter of vessels 640-61-90 μm , 86-111-143 vessels/ mm^2 . Fibres thin to thick-walled. Axial paratracheal absent or extremely, in marginal or in seemingly marginal bands. Rays 12-16-19 per mm.



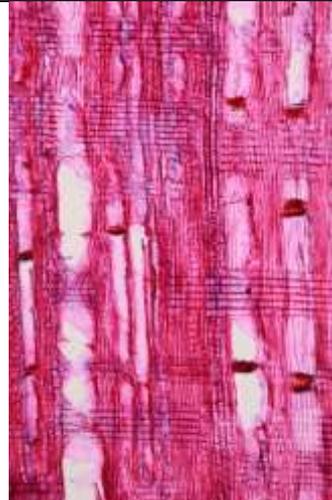
CR 6685 x 100



CR 6685 x 400

Radial section

Simple perforation plates. Intervessel pits small oval to circular and alternate, 7-11-15 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 120-223-340 μm . Fibres with simple to minutely bordered pits. Homogeneous rays, all ray cells procumbent. Prismatic crystal in upright and or square ray cell and in chambered axial parenchyma cells.



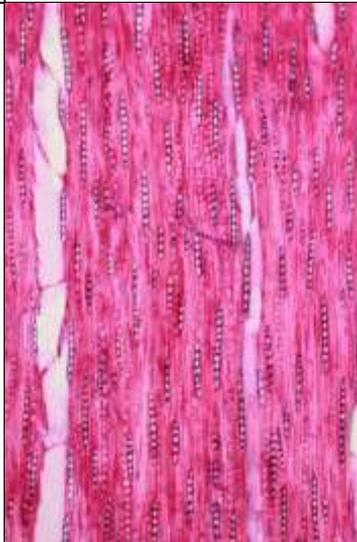
CR 6685 x 200



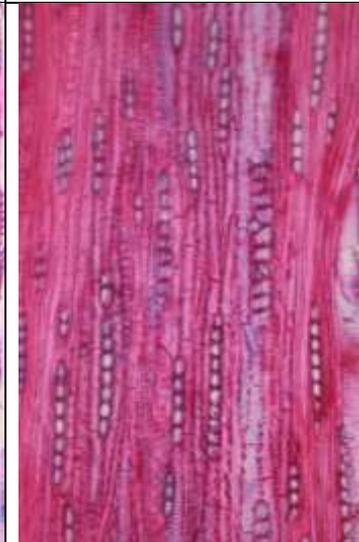
CR 6685 x 1000

Tangential section

Ray width 1 to 3 cells. Ray height 70-112-180 μm , with 2-7-12 cells in height. Three to 4, 5 to 8 cells per parenchyma strand.



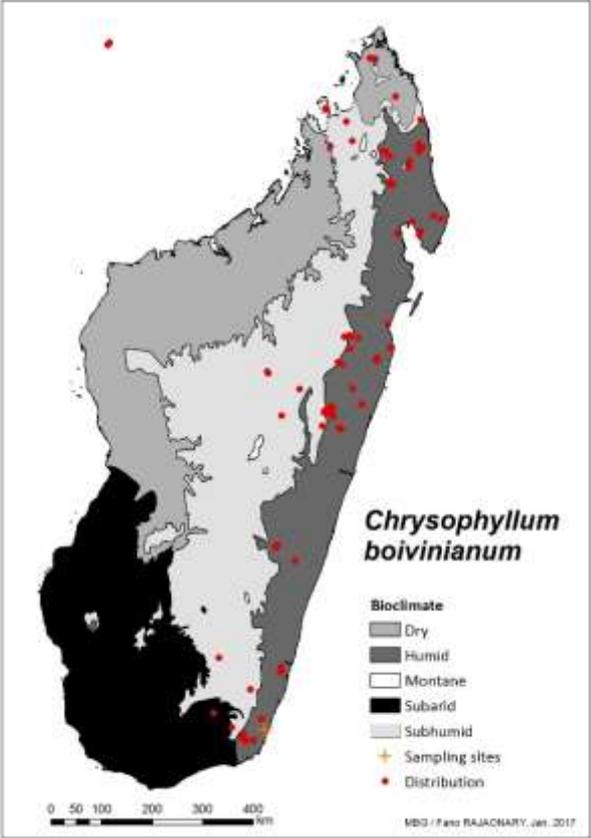
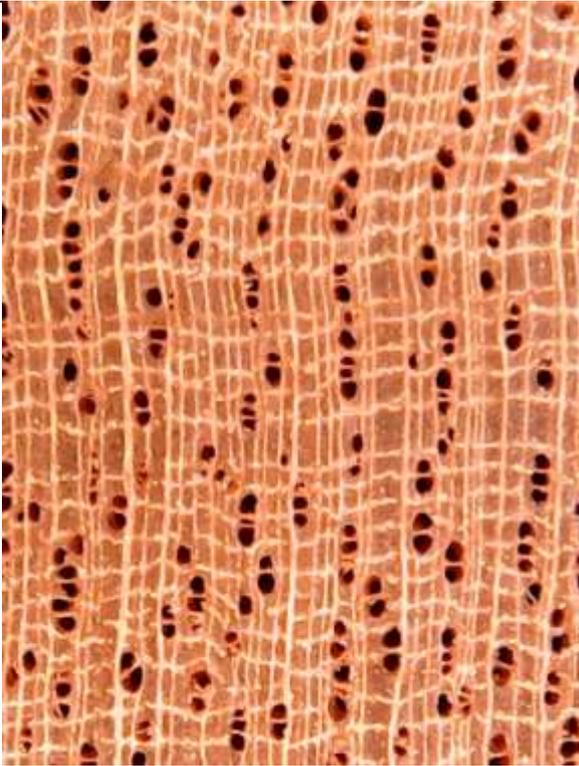
CR 6685 x 200



CR 6685 x 400

Cedrelopsis grevei Baill.: CR 6684, CR 6685

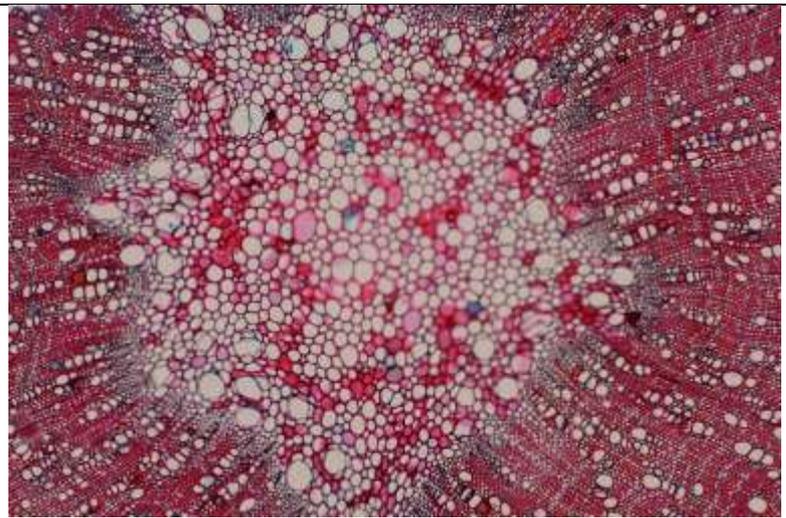
IAWA feature numbers 2 5 13 22 27 30 41 50 52 61 66 69 75 89 92 93 97 106 116 136 142 178 179 180 189 190 192 196

<i>Chrysophyllum boivinianum</i> (Pierre) Baehni	SAPOTACEAE
Synonymy : <i>Diospyros minutiloba</i> H. Perrier, <i>Gambeya boiviniana</i> var <i>lavanchiana</i> Aubrév., <i>Gambeya madagascariensis</i> Lecompte	
Specimens : SFR 261	
Local names : Famelona, Rehiaka, Rehika, Tamenampoza, Hazomiteraka, Famelandriaka, Famelondahy, Nato, Mangidivita, Afotrakalalao, Harongampanihy, Hazomahôgo, Voanangoala, Hazomasay, Mahogo, Hazomahogo	
<p>PLANT DESCRIPTION Tree up to 24 m high Native species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-1999 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Humid, Montane, subhumid <i>Protected areas</i> and other important sites : Andringitra, Galoko Kalobinono, Kalambatritra, Loky Manambato (Daraina), Manongarivo, Marojejy, Masoala, Montagne d’Ambre, Tsaratanana, Zahamena.</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 5 elements. Vessels large¹ and rare². Axial parenchyma reticulate. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">SFR 261</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith pentagonal. Heterogeneous pith. Cells dimorphic. Pits in transverse cell walls. Pith not visible in polarized light.

Primary xylem: Vascular bundles distinct. Vessels solitary and in long radial multiples of 2 to 7 elements.



SFR 261 x 100

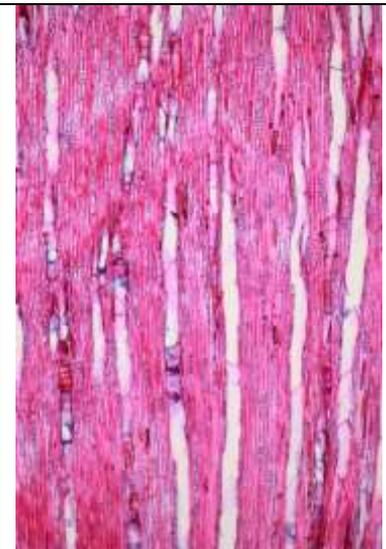
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries absent. Wood diffuse-porous. Tangential diameter of vessels 25-51-70 μm, 85-115-139 vessels/mm². Vessel element length 190-381-600 μm. Intervessel pits small 1-3-6 μm in diameter. Fibres thin to thick-walled. Axial paratracheal in bands up to 3 cells wide. Homogeneous and heterogeneous rays, body ray procumbent with one, 2-4 rows upright or square marginal cell. Ray with 1 to 3 cells. Ray height 100-356-890 μm. Rays 5-15-33 /mm.

Anatomical differences to stem xylem: Tangential diameter of vessel is larger in the stem (25-51-70 / 80-107-150 μm). Vessel density is higher in the branch 85-115-139 / 24-38-52 vessels/mm². Rays are shorter in the branch (100-356-890 / 200-472-760 μm) while ray number is comparable (9-12-15 / 7-11-15 rays/mm).



SFR 261 x 100

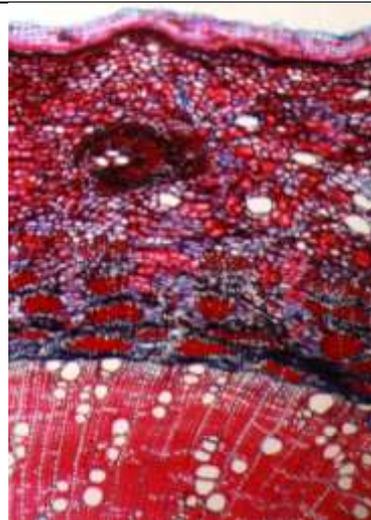


SFR 261 x 100

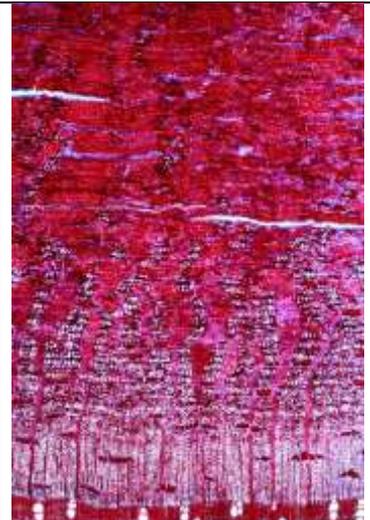
BARK ANATOMY

Branch bark: Collapsed, non-collapsed sieve tubes and tangential dispersed fibres present in the phloem. Ray dilatation present. The cortex is characterized by laticifers or intercellular canals.

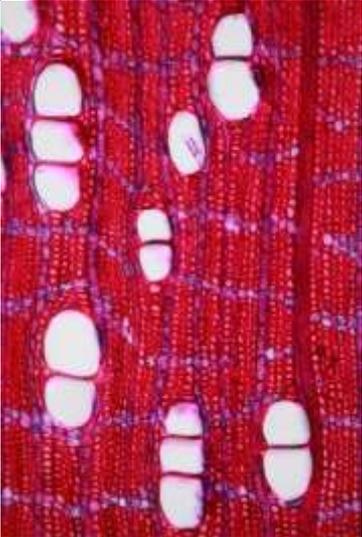
Stem bark: Phloem consists of alternating collapsed and noncollapsed sieve tubes, and tangentially distributed groups of fibres. Only some rays become dilated. The cortex is characterized by groups of sclereids irregularly distributed.

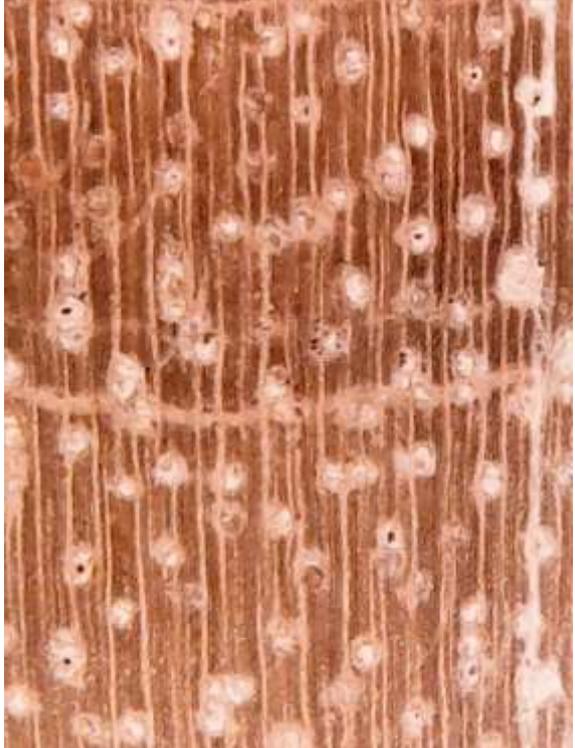


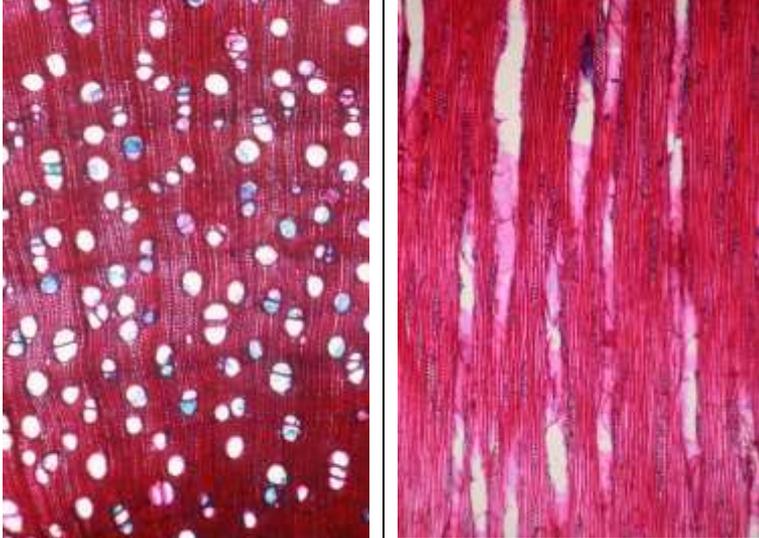
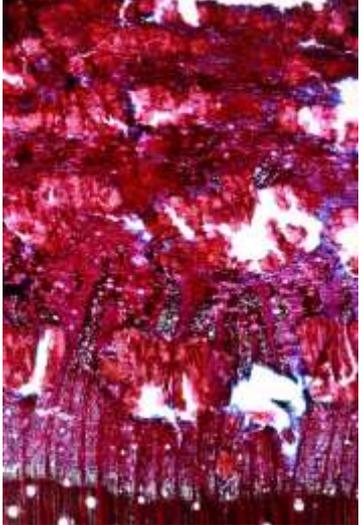
SFR 261 x 100



SFR 261 x 40

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries absent. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 5 elements. Tangential diameter of vessels 80-107-150 μm, 24-38-52 vessels/mm^2. Fibres thin to thick-walled. Axial paratracheal reticulate. Rays 7-11-15 per mm.</p>	 <p>SFR 261 x 40</p>	 <p>SFR 261 x 200</p>
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 4-6-7 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 230-424-610 μm. Fibres with simple to minutely bordered pits. Heterogeneous rays, body ray cells procumbent with 2-4, over 4 rows of upright and/or square marginal cells. Prismatic crystal in upright and or square ray cell and in chambered axial parenchyma cells.</p>	 <p>SFR 261 x 400</p>	 <p>SFR 261 x 1000</p>
<p>Tangential section Ray width 1 to 3 cells. Ray height 200-472-760 μm, with 5-16-28 cells in height. Three to 4 and 5 to 8 cells per parenchyma strand.</p>	 <p>SFR 261 x 100</p>	 <p>SFR 261 x 200</p>
<p><i>Chrysophyllum bovinianum</i> (Pierre) Baehni.: SFR 261 IAWA feature numbers 2 5 13 22 25 30 42 48 53 61 66 69 87 92 93 97 107 108 115 136 178 180 189</p>		

<i>Cryptocarya ovalifolia</i> (Danguy) van der Werff	LAURACEAE
Synonymy: <i>Ravensara ovalifolia</i> Danguy	
Specimens : RZK 8030	
Local names: Tavolomanitra, Tavolomena, Ravintsara	
<p>PLANT DESCRIPTION</p> <p>Tree up to 15 m high 20 cm DBH Endemic to Madagascar</p>	
<p>DISTRIBUTION</p> <p><i>Elevation:</i> 0-999 m a.s.l. <i>Vegetation formation:</i> Forest <i>Bioclimate:</i> humid, subhumid <i>Protected areas and other important sites:</i> Analamazaotra, Zahamena, Didy, Bevoay Fort Dauphin.</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels mostly solitary. Vessels large¹ and rare². Paratracheal axial parenchyma vasicentric. Rays are thin³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thin: Indistinct to the naked eye</p>	 <p style="text-align: center;">RZK 8030</p>

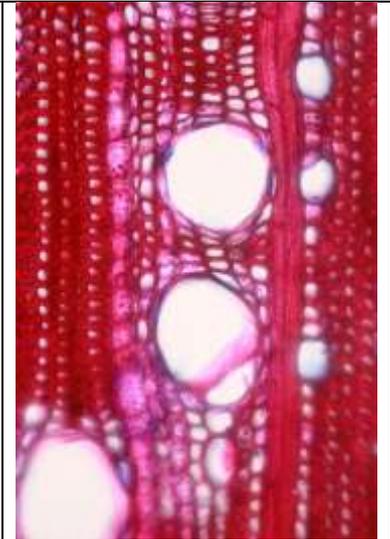
<p>PITH AND PRIMARY XYLEM ANATOMY</p> <p>Pith: Shape of pith pentagonal. Cells dimorphic. Pits in transverse cell walls. Pith not visible in polarized light.</p> <p>Primary xylem: Vascular bundles separate. Vessels solitary and in short radial multiples of 2 to 4 elements.</p>	 <p>RZK 8030 x 40</p>
<p>BRANCH XYLEM ANATOMY</p> <p>Description: Growth rings boundaries absent. Wood diffuse-porous. Tangential diameter of vessels 40-61-100 μm, 71-79-90 vessels/ mm^2. Vessel element length 140-240-294 μm. Intervessel pits large 9-11-13 μm in diameter. Fibres thin to thick-walled. Axial paratracheal vasicentric and in marginal or in seemingly marginal bands. Heterogeneous rays, body ray procumbent with one, 2-4 rows upright or square marginal cell. Ray with 1 to 3 cells. Ray height 110-291-550 μm. Rays 5-8-11 /mm.</p> <p>Anatomical differences to stem xylem: Tangential diameter of vessel is larger in the stem (50-84-110 / 60-120-150 μm). Vessel density is higher in the branch 71-79-90 / 10-17-26 vessels/mm^2. Rays are higher in the stem (110-291-550 / 230-374-820 μm) while ray number is comparable (5-8-11 / 7-9-12 rays/mm).</p>	 <p>RZK 8030 x 100</p> <p>RZK 8030 x 100</p>
<p>BARK ANATOMY</p> <p>Branch bark: -</p> <p>Stem bark: The phloem is composed by collapsed and non collapsed sieve tubes, and tangentially distributed groups of sclereids. Only some rays become dilated. The cortex is characterized by groups of sclereids irregularly distributed.</p>	 <p>RZK 8030 x 20</p>

STEM XYLEM ANATOMY**Transverse section**

Growth ring boundaries absent. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 5 elements. Tangential diameter of vessels 60-120-150, 10-17-26 vessels/mm². Fibres thin to thick-walled. Axial paratracheal vasicentric and scanty. Rays 5-8-11 per mm.



RZK 8030 x 100



RZK 8030 x 400

Radial section

Simple perforation plates. Intervessel pits small oval to circular and alternate, 10-15-20 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 210-357-500 μm. Fibres with simple to minutely bordered pits. Heterogeneous rays, body ray cells procumbent with one, 2-4 rows of upright and/or square marginal cells.



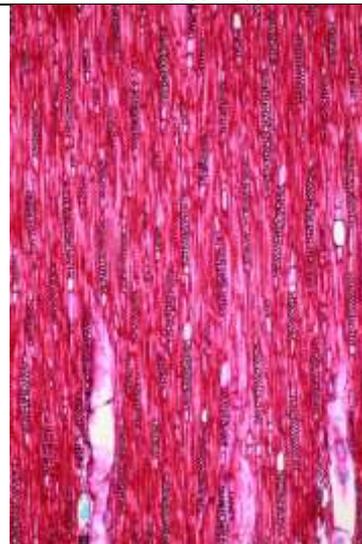
RZK 8030 x 200



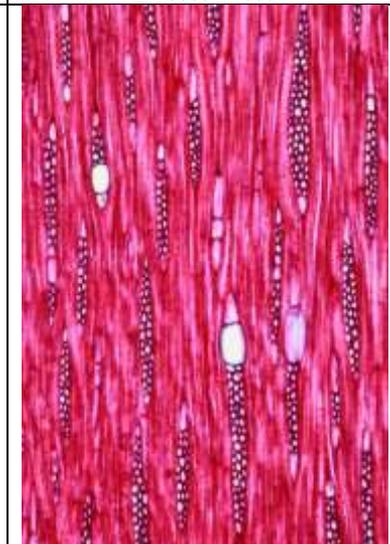
RZK 8030 x 1000

Tangential section

Ray width 1 to 3 cells. Ray height 100-378-980 μm, with 6-12-19 cells in height. Two and 3-4 cells per parenchyma strand. Oil and/or mucilage cells associated with ray parenchyma and axial parenchyma.



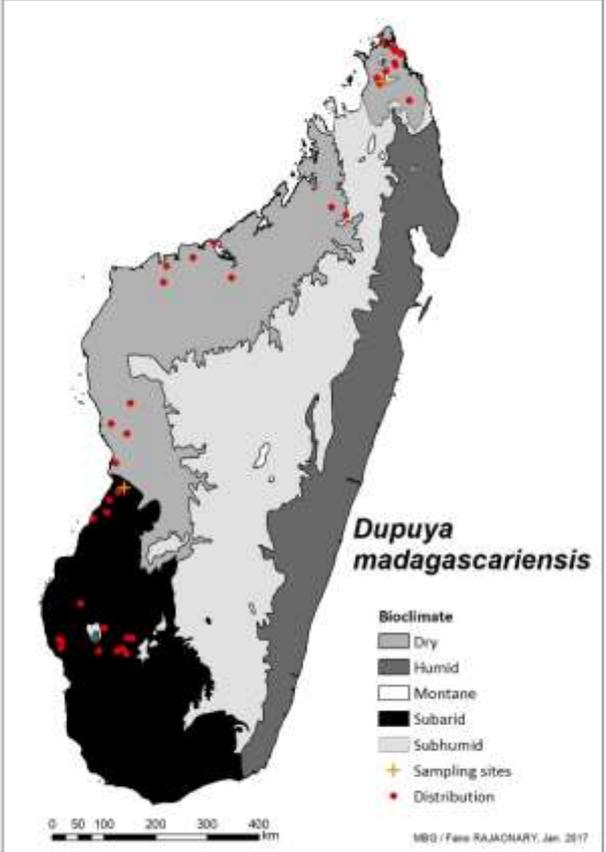
RZK 8030 x 100



RZK 8030 x 400

Cryptocarya ovalifolia (Danguy) van der Werff.: RZK 8030

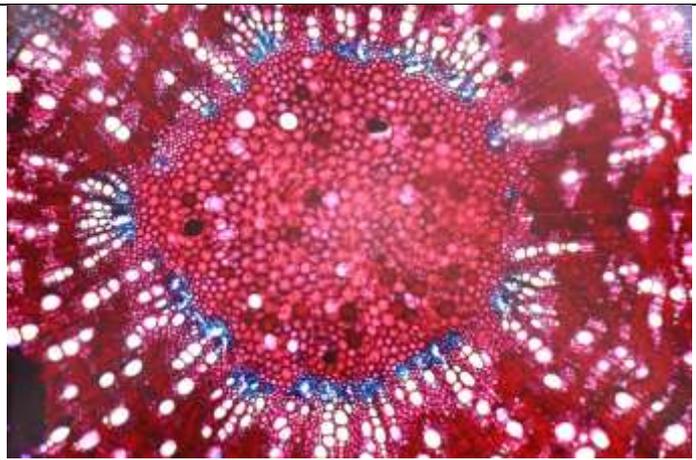
IAWA feature numbers 2 5 13 27 42 47 53 61 66 69 78 79 91 92 97 106 107 115 124 125 178 180 189

<i>Dupuya madagascariensis</i> (R. Vig.) J.H. Kirkbr.	FABACEAE
Synonymy : <i>Cordyla madagascariensis</i> R. Vig.	
Specimens : CR 6677, RIR 2876	
Local names : Karabo, Madiroala, Maimbohazo, Lakarabo, Lazalaza	
<p>PLANT DESCRIPTION Tree up to 20 m high Endemic to Madagascar Exploited species.</p>	
<p>DISTRIBUTION <i>Elevation</i>: 0-499 m a.s.l. <i>Vegetation formation</i>: Forest <i>Bioclimate</i>: Dry, subarid <i>Protected areas</i> and other important sites : Analamerana, Ankarana, Bemaraha, Kirindy Mitea, Kirindy Antimena, Loky Manambato (Daraina) Montagne des Français, Vohibasia</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels mostly solitary and in radial multiples of 2 to 3 elements. Vessels large¹ and very rare². Axial parenchyma winged-aliform and confluent. Rays are thin³.</p> <p>¹Large: Distinct to the naked eye ²Very rare: < 5 vessels/mm² ³Thin: Indistinct to the naked eye</p>	 <p style="text-align: center;">CR 6677</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith round. Heterogeneous pith. Cells dimorphic. Laticifers and or intercellular canals. Pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles distinct. Vessels solitary and in long radial multiples of 2 to 5 elements.



RIR 2876 x 100

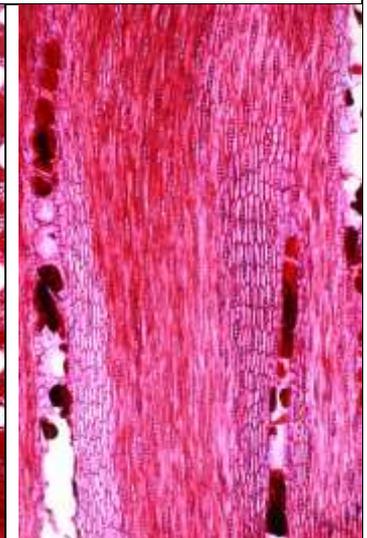
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries absent. Wood diffuse-porous. Tangential diameter of vessels 50-72-100 μm, 30-44-78 vessels/ mm². Tylosis common. Vessel element length 120-245-360 μm. Intervessel pits medium 6-8-12 μm in diameter. Fibres thin to thick-walled. Axial paratracheal lozenge-aliform and confluent. Homogeneous rays, all ray cells procumbent. Rays predominantly uniseriate. Ray height 100-291-550 μm. Rays 14-15-17 /mm.

Anatomical differences to stem xylem: Tangential diameter of vessel is larger in the branch (50-72-100/ 80-161-220 μm). Vessel density is higher in the branch 30-44-78 / 4-7-12 vessels/mm². Rays height and number are higher in the branch (100-291-550 / 50-130-170 μm) (14-15-17 / 9-11-14 rays/mm).



RIR 2876 x 100

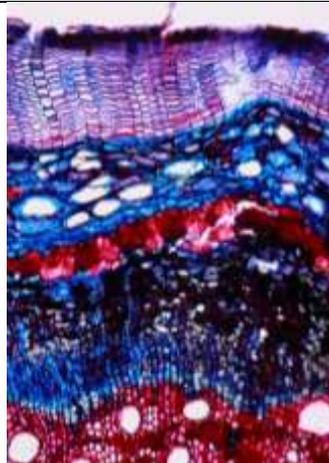


RIR 2876 x 100

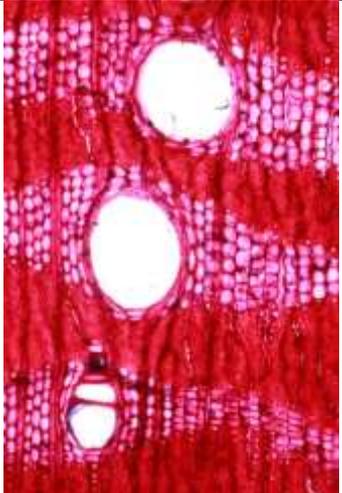
BARK ANATOMY

Branch bark: Collapsed, non-collapsed sieve tubes and dispersed fibres present in the phloem. The cortex is characterized by a band of sclereids, laticifers or intercellular canals and irregular blue-stained parenchyma cells.

Stem bark: -



RIR 2876 x 200

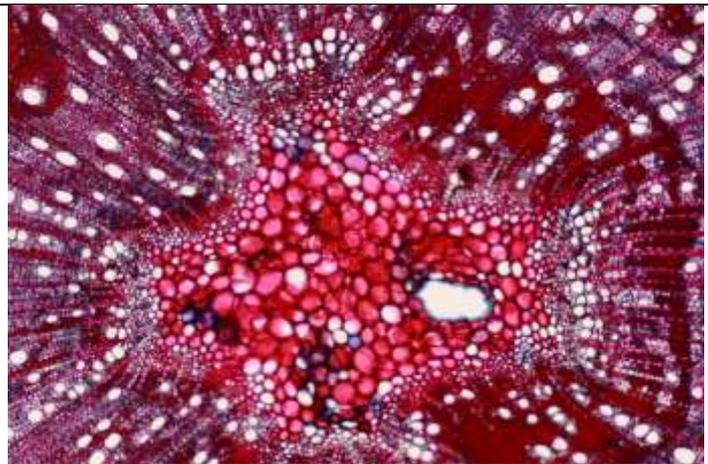
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries absent. Wood diffuse-porous. Vessels mostly solitary and in radial multiples of 2 to 4 elements. Tangential diameter of vessels 80-161-230 μm, 4-7-12 vessels/mm^2. Tyloses common. Fibres thin to thick-walled. Axial paratracheal winged-aliform and confluent. Rays 9-11-14 per mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 4-8-12 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 100-188-230 μm. Fibres with simple to minutely bordered pits. Homogeneous rays, all ray cells are procumbent. Prismatic crystal in upright and or square ray cell and in chambered axial parenchyma cells.</p>		
<p>Tangential section Rays uni- and biseriate. Ray height 50-130-170 μm, with 2-6-9 cells in height. Two, 3 to 4 cells per parenchyma strand. Rays, vessels and axial parenchyma cells storied. Number of ray tiers per axial mm: 3-4.</p>		
<p><i>Dupuva madagascariensis</i> (R. Vig.) J.H. Kirkbr.: RIR 2876 IAWA feature numbers 2 5 13 22 26 30 42 47 52 56 61 66 69 81 83 91 92 97 104 115 136 142 178 180 189 192 196</p>		

<i>Hymenaea verrucosa</i> Gaertn.	FABACEAE
Synonymy : <i>Trachylobium verrucosum</i> (Gaertn) Oliv., <i>Trachylobium hornemannianum</i> Hayne	
Specimens : RBE 2457	
Local names : Mandrorofa, Mandrozofa, Tandroho, Tandrome, Mandrirôfo, Mandroroforo, Tandro	
<p>PLANT DESCRIPTION Tree up to 20 m high Endemic to Madagascar.</p>	
<p>DISTRIBUTION Elevation: 0-1000 m a.s.l. Vegetation formation: Forest Bioclimate: Dry, humid and subhumid Protected areas: Montagne d'Ambre New protected areas: Vohibola</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 4 elements. Vessels large¹ and rare². Apotracheal axial parenchyma in bands. Paratracheal axial parenchyma confluent. Rays are thin³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thin: Indistinct to the naked eye</p>	 <p>RBE 2457</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith pentagonal. Thick-walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles indistinct. Vessels solitary and in short radial multiples of 2 to 3 elements.



RBE 2457 x 100

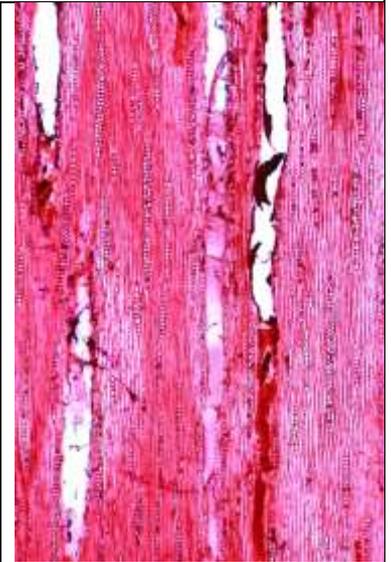
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries absent. Wood diffuse-porous. Tangential diameter of vessels 50-78-120 μm, 33-42-61 vessels/ mm². Vessel element length 70-183-310 μm. Intervessel pits minute 1-2-3 μm in diameter. Fibres thin to thin-walled. Axial paratracheal lozenge-aliform and confluent. Homogeneous and heterogeneous rays, body ray procumbent with one row upright or square marginal cell. Ray with 1 to 3 cells, predominantly biseriate. Ray height 70-191-490 μm. Rays 8-10-12 /mm.

Anatomical differences to stem xylem: Tangential diameter of vessel is larger in the stem (50-78-120 / 110-199-430 μm). Vessel density is higher in the branch 33-42-61 / 4-16-27 vessels/mm². Rays in the branch are shorter (70-191-490 / 100-378-980 μm). Ray number is higher in the branch (8-10-12 / 5-7-10 rays/mm).



RBE 2457 x 100

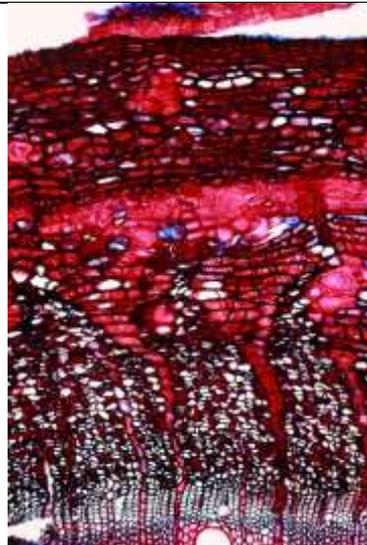


RBE 2457 x 100

BARK ANATOMY

Branch bark: Collapsed, non-collapsed sieve tubes and dispersed fibres present in the phloem. Ray dilatation present. The cortex is characterized by a band of sclereids and irregularly lignified parenchyma cells.

Stem bark: The phloem is composed by collapsed and noncollapsed sieve tubes, and tangentially distributed groups of fibres. Only some rays become dilated. The cortex is characterized by groups of sclereids irregularly distributed. The phellem is homogeneous and it consists of regularly arranged rectangular cells, indistinct in polarized light.



RBE 2457 x 200

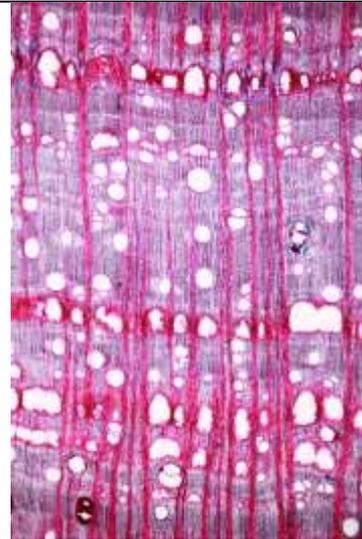


RBE 2457 x 20

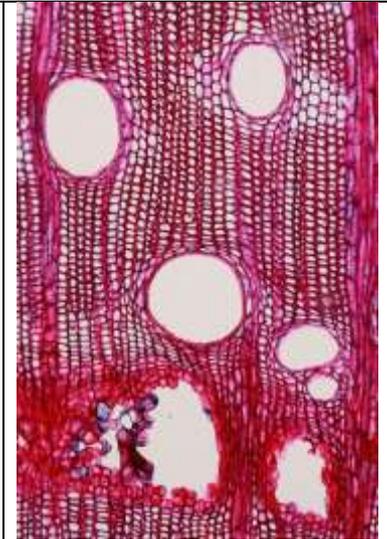
STEM XYLEM ANATOMY

Transverse section

Growth ring boundaries absent. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 5 elements. Tangential diameter of vessels 110-199-430 μm , 4-16-27 vessels/ mm^2 . Fibres thin to thick-walled. Axial parenchyma lozenge – aliform and winged-aliform. Rays 5-7-10 per mm.



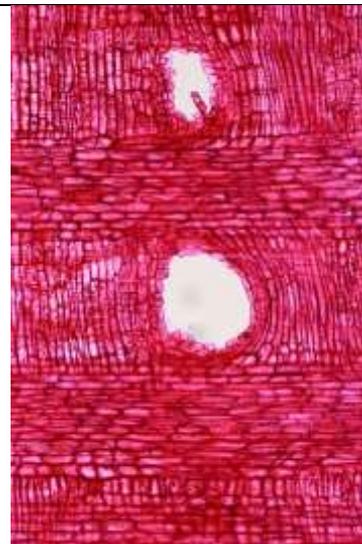
RBE 2457 x 40



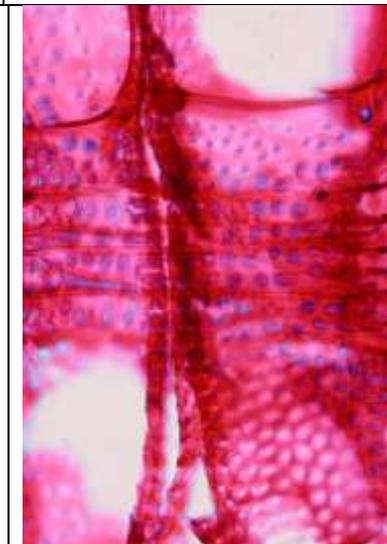
RBE 2457 x 200

Radial section

Simple perforation plates. Intervessel pits small oval to circular and alternate, 7-9-12 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 85-156-300 μm . Fibres with simple to minutely bordered pits. Heterogeneous rays, body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystal in chambered axial parenchyma cells.



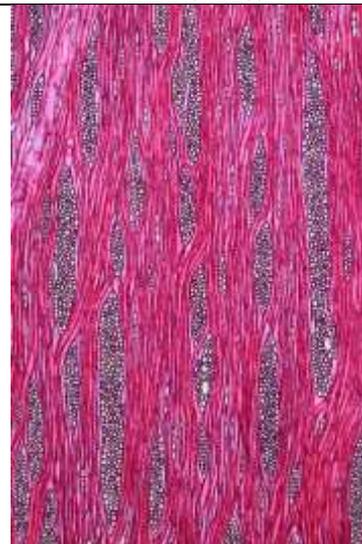
RBE 2457 x 200



RBE 2457 x 1000

Tangential section

Larger rays commonly 4 to 10 seriate. Ray height 100-378-980 μm , with 5-19-68 cells in height. Two, 3-4 and 5-8 cells per parenchyma strand.



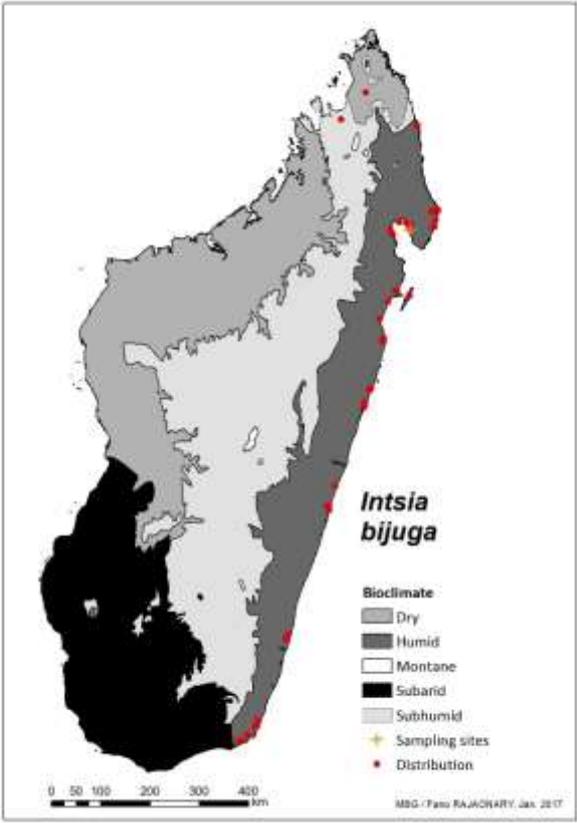
RBE 2457 x 100



RBE 2457 x 200

Hymenaea verrucosa Gaertn.: RBE 2457

IAWA feature numbers 2 5 13 22 26 29 30 42 47 52 61 66 69 81 82 91 92 93 98 106 115 136 142 178 179 180 189 196

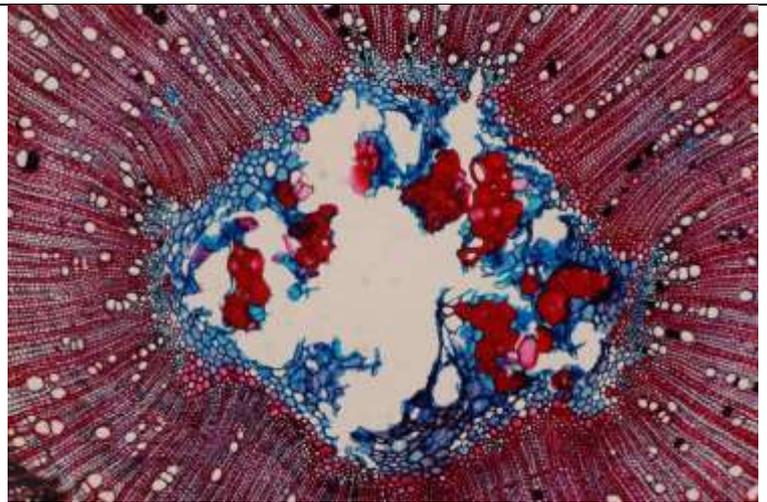
<i>Intsia bijuga</i> (Colebr.) Kuntze	FABACEAE
Synonymy: <i>Afzelia bijuga</i> (Colebr.), A Gray; <i>Afzelia bijuga</i> (Colebr.) A. Gray ; <i>Afzelia bijuga</i> fo. <i>sambiranensis</i> R. Vig. ; <i>Intsia madagascariensis</i> DC. ; <i>Macrolobium bijugum</i> Colebr.	
Specimens : RBE 2458	
Local names: Hintsy. Hintsina Haranzato Arandranto Hasandranto Tsararavina Intsina	
<p>PLANT DESCRIPTION</p> <p>Tree up to 15 m high 10 - 50 cm DBH</p>	
<p>DISTRIBUTION</p> <p><i>Elevation:</i> 0-500 m a.s.l. <i>Vegetation formation:</i> Forest <i>Bioclimate:</i> humid, subhumid <i>Protected areas and other important sites:</i> Masoala, Nosy Mangabe, Vohibola</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 3 elements. Vessels large¹ and rare². Paratracheal axial parenchyma vasicentric and lozenge-aliform. Rays are thin³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thin: Indistinct to the naked eye</p>	

RBE 2458

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith pentagonal. Thick-walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles indistinct. Vessels solitary and in short radial multiples of 2 to 3 elements.



RBE 2458 x 100

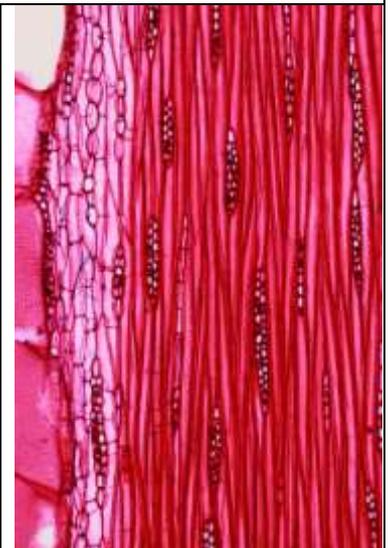
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries absent. Wood diffuse-porous. Vessel in diagonal or radial pattern. Tangential diameter of vessels 50-82-120 µm, 10-44-78 vessels/ mm². Vessel element length 80-183-270 µm. Intervessel pits small 4-5-7 µm in diameter. Fibres very thin-walled. Paratracheal parenchyma vasicentric and lozenge-aliform. Homogeneous rays, body ray procumbent with one row upright or square marginal cell. Ray width to 1 to 3 cells. Ray height 70-192-490 µm. Rays 5-8-11/mm.

Anatomical differences to stem xylem: Tangential diameter of vessel is larger in the stem (50-82-120 / 80-122-170 µm). Vessel density is higher in the branch 10-44-78 / 5-8-14 vessels/mm². Rays in the branch are shorter (70-192-490 / 90-231-440 µm) while ray number is comparable (5-8-11 / 7-9-13-rays/mm).



RBE 2458 x 100

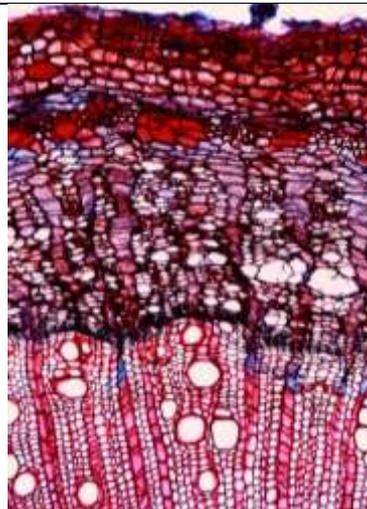


RBE 2458 x 100

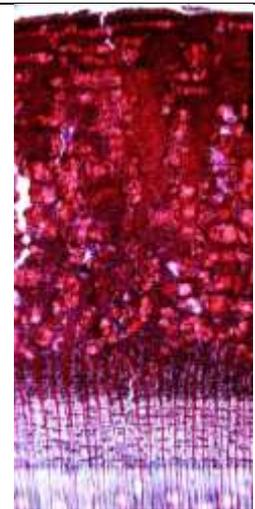
BARK ANATOMY

Branch bark: Collapse and non collapsed sieve tubes present in the phloem. Ray dilatation present. The cortex is characterized by irregular tangential groups of fibres.

Stem bark: The phloem consists of collapsed and non-collapsed sieve tubes, and irregularly tangential groups of fibres. Ray dilatation present. The cortex is characterized by irregular groups of sclereids. Parenchyma dilatation present.



RBE 2458 x 200



RBE 2458 x 20

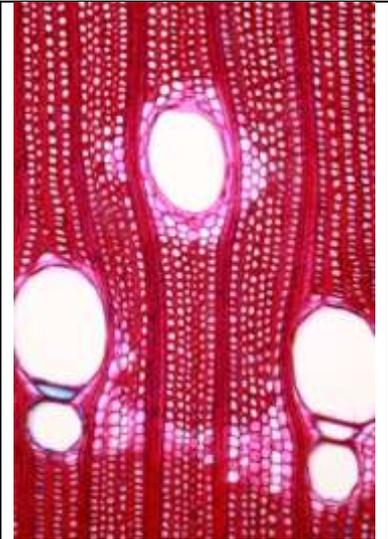
STEM XYLEM ANATOMY

Transverse section

Growth ring boundaries absent. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 3 elements. Tangential diameter of vessels 80-122-170 μm , 5-8-14 vessels/ mm^2 . Fibres thin to thick-walled. Axial parenchyma aliform, lozenge-aliform. Rays 7-9-13 per mm.



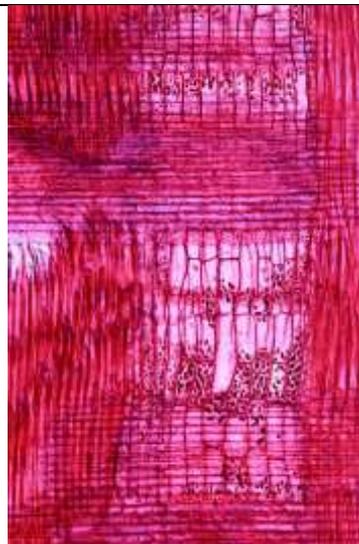
RBE 2458 x 40



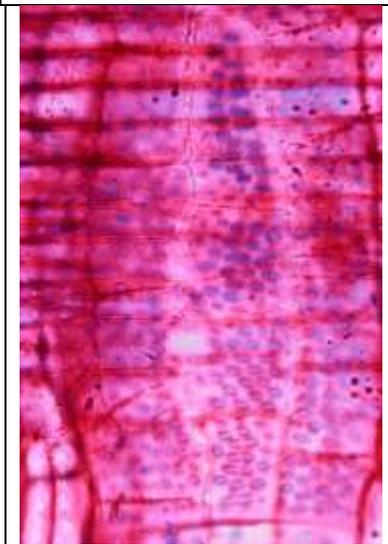
RBE 2458 x 200

Radial section

Simple perforation plates. Intervessel pits small oval to circular and alternate, 5-7-10 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 130-212-340 μm . Fibres with simple to minutely bordered pits. Homogeneous rays, all ray cells are procumbent. Prismatic crystal in chambered axial parenchyma cells.



RBE 2458 x 200



RBE 2458 x 1000

Tangential section

Larger rays commonly 4 to 10 seriate. Ray height 138-227-278 μm , with 11-13-15 cells in height. Two, 3-4, 5-8 cells per parenchyma strand.



RBE 2458 x 100



RBE 2458 x 400

Intsia bijuga (Colebr.) Kuntze.: RBE 2458

IAWA feature numbers 2 5 13 22 25 30 42 47 52 61 66 69 80 81 91 92 93 98 104 116 136 142 168 169 189 192 196

Neobeguea mahafalensis J. F. Leroy

MELIACEAE

Synonymy : -

Specimens : CR 6693

Local names: Handy, Handigny, Hazolava, Andy, Andy-Pasy, Bemahova

PLANT DESCRIPTION

Tree | up to 20 m high |
Endemic to Madagascar
Exploited species.

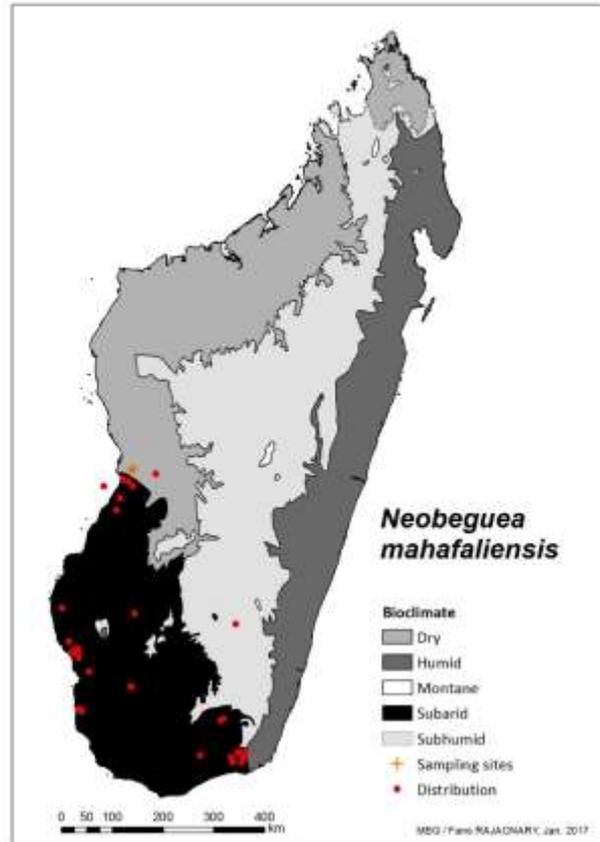
DISTRIBUTION

Elevation: 0-999 m a.s.l.

Vegetation formation: Forest

Bioclimate: Dry, subarid, subhumid

Protected areas and other important sites :
Amaron'i Onilahy, Andohahela, Andranomena,
Angavo, Bezà Mahafaly, Complexe Vohilava-
Betsimalaho, Kirindy Mitea, Menabe Antimena,
Mikea, Ranobe PK 32, Tsimanampetsotsa,
Tsinjoariake (La Table/St Augustin).



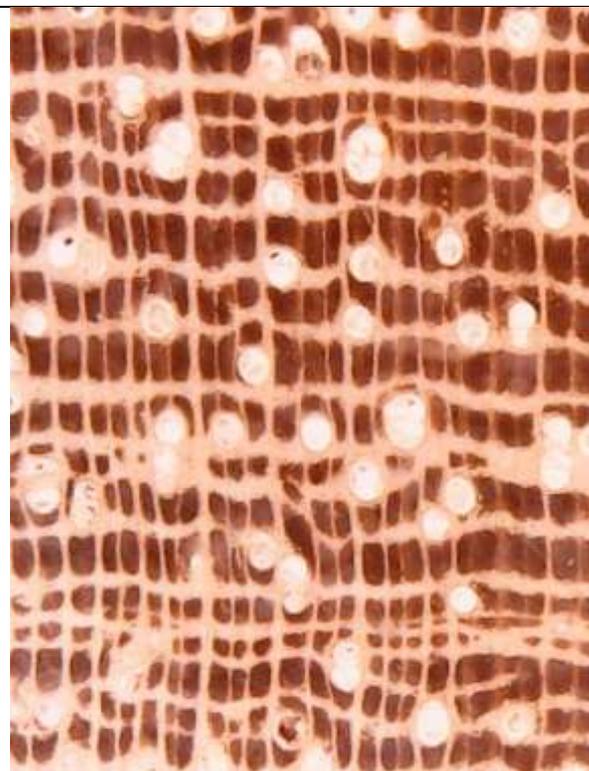
STEM XYLEM DESCRIPTION

Growth ring boundaries absent. Vessels mostly solitary and in radial multiples of 2 elements. Vessels large¹ and rare². Axial parenchyma confluent and reticulate. Rays are thick³.

¹Large: Distinct to the naked eye

²Rare: 5 - 20 vessels/mm²

³Thick: Distinct to the naked eye

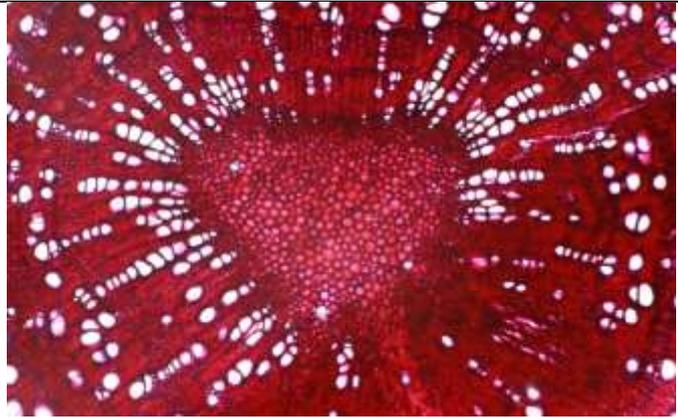


CR 6693

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith triangular. Thick-walled parenchyma cells present. Cells dimorphic. Laticifers and or intercellular canals present. Pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles indistinct. Vessels solitary and in long radial multiples of 2 to 6 elements.



CR 6693 x 100

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries absent. Wood diffuse-porous. Tangential diameter of vessels 50-72-100 μm , 30-44-78 vessels/ mm^2 . Gums and other deposits in vessels. Vessel element length 150-233-300 μm . Intervessel pits medium 3-7-10 μm in diameter. Fibres thin to thick-walled. Axial paratracheal confluent and in bands more than 3 cells wide. heterogeneous rays, body ray cells procumbent with one row of upright and/or square marginal cells. Larger rays commonly 4 to 10 seriate. Ray height 130-225-400 μm . Rays 8-9-9 /mm.

Anatomical differences to stem xylem: Tangential diameter of vessel is larger in the stem (50-101-140 / 120-157-200). Vessel density is higher in the branch 29-41-52 / 5-13-25 vessels/ mm^2 . Rays are higher in the stem (130-225-400 / 210-377-640 μm) while ray number is higher in the branch (8-9-9 / 4-5-6 rays/mm).



CR 6693 x 100

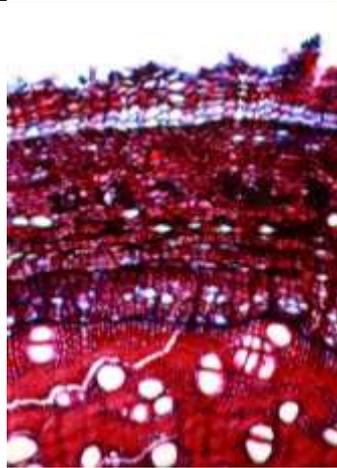


CR 6693 x 100

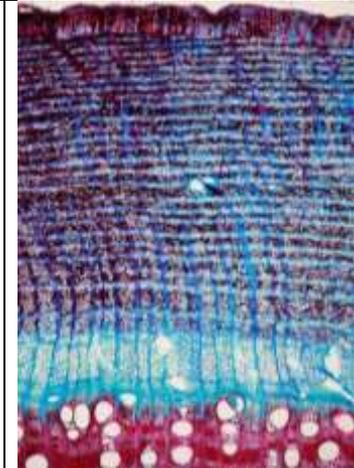
BARK ANATOMY

Branch bark: The phloem consists of alternating collapse and non-collapsed sieve tubes. Collapsed, non-collapsed sieve tubes and dispersed fibres present in the phloem. The cortex is characterized by laticifers or intercellular canals and irregular lignified parenchyma cells.

Stem bark: The phloem consists of alternating parenchyma cells and collapse and non-collapsed sieve tubes. Druses present. The phellem is homogenous and it consists of arranged rectangular parenchyma cells with dark staining substances.



CR 6693 x 200

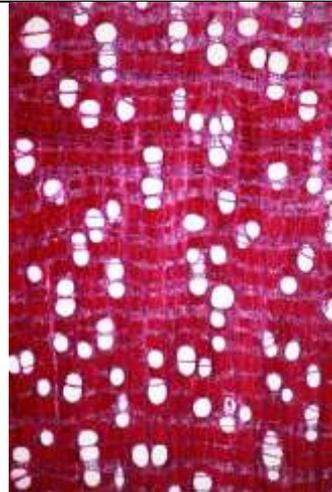


CR 6693 x 40

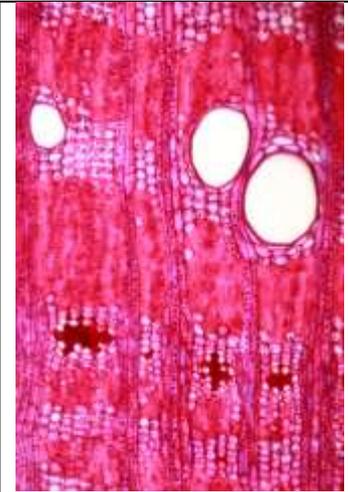
STEM XYLEM ANATOMY

Transverse section

Growth ring boundaries absent. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 5 elements. Tangential diameter of vessels 120-157-200 μm , 5-13-25 vessels/ mm^2 . Fibres thin to thick-walled. Axial paratracheal confluent, in bands up to 3 and more than 3 cells wide. Rays 4-5-6 per mm. Axial canals in long tangential lines.



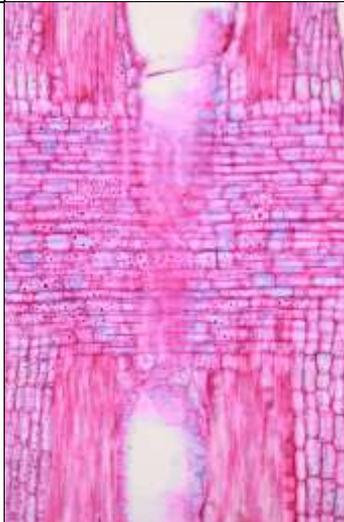
CR 6693 x 40



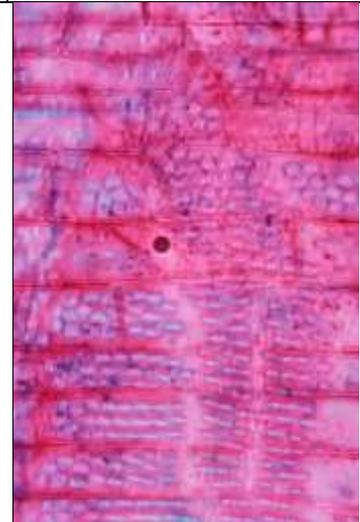
CR 6693 x 200

Radial section

Simple perforation plates. Intervessel pits small oval to circular and alternate, 6-8-10 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 120-297-360 μm . Fibres with simple to minutely bordered pits. Heterogeneous rays, body ray cell procumbent with one row of upright and or square marginal cells. Prismatic crystal in upright and or square ray cell and in chambered axial parenchyma cells.



CR 6693 x 200



CR 6693 x 1000

Tangential section

Larger rays commonly 4 to 10 seriate. Ray height 50-130-170 μm , with 2-6-9 cells in height. Three to 4, 5 to 8 cells per parenchyma strand.



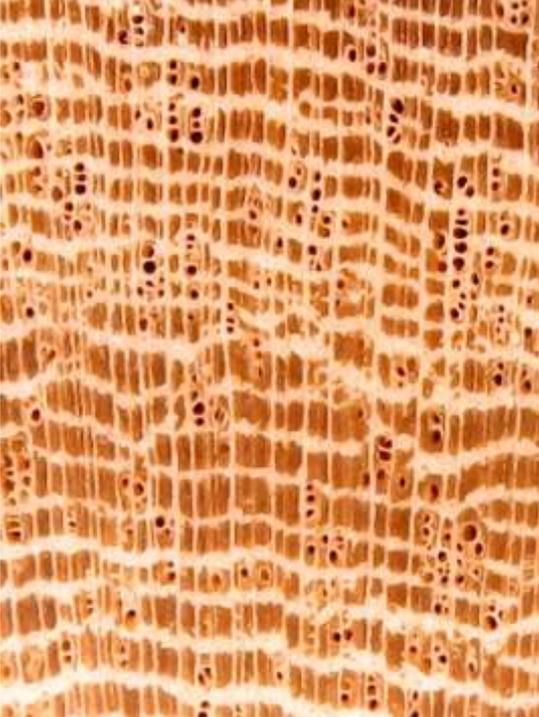
CR 6693 x 100



CR 6693 x 200

Neobeguea mahafaliensis J. F. Leroy.: CR 6693

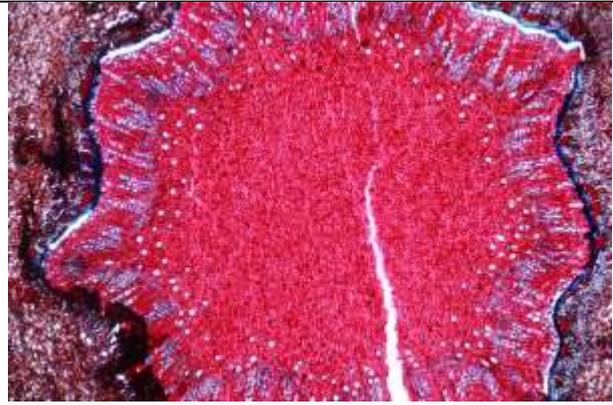
IAWA feature numbers 2 5 13 22 26 30 42 47 52 61 66 69 83 85 86 92 93 98 106 115 127 136 137 142 178 180 189

<i>Sideroxylon gerrardianum</i> (Hook. f.) Lecomte	SAPOTACEAE
Synonymy: -	
Specimens : RZK 8038	
Local names: Malambovony, Nanto	
<p>PLANT DESCRIPTION</p> <p>Tree up to 15 m high Endemic to Madagascar</p>	
<p>DISTRIBUTION</p> <p>Elevation: 0-999 m Vegetation Formation: Forest Bioclimate: Humid Protected areas and other important sites: Analalava, Masoala, Montagne d'Ambre</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries indistinct. Vessels solitary and in radial multiples of 2 to 5 elements. Vessels large¹ and rare². Axial parenchyma in bands. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">RZK 8038</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith pentagonal. Thick walled-parenchyma cells and fibres present. Unlignified cells irregularly dispersed around the pith. Pith visible in polarized light.

Primary xylem: Vascular bundles indistinct. Vessels solitary and in short radial multiples of 2 to 3 elements.



RZK 8038 x 40

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries absent. Wood diffuse-porous. Vessel in diagonal or radial pattern. Tangential diameter of vessels 35-47-60 µm, 60-88-115 vessels/ mm². Vessel element length 190-363-550 µm. Intervessel pits small 4-5-6 µm in diameter. Fibres very thin-walled. Axial paratracheal scalariform and in narrow lines up to 3 cells wide. Heterogeneous rays, body ray procumbent with one, 2-4 rows upright or square marginal cell. Ray width to 1 to 3 cells, predominantly biseriate. Ray height 150-318-630 µm. Rays 11-14-16 /mm.

Anatomical differences to stem xylem: Tangential diameter of vessel is larger in the stem (35-47-60 / 50-66-90 µm). Vessel density is higher in the branch 60-88-115 / 11-26-46 vessels/mm². Rays in the branch are shorter (150-318-630 / 110-340-580 µm) but ray number is higher (11-14-16 / 7-10-13 rays/mm).



RZK 8038 x 40



RZK 8038 x 100

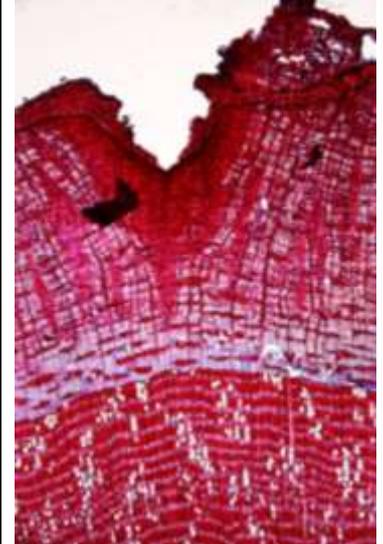
BARK ANATOMY

Branch bark: Collapsed and non-collapsed sieve tubes and tangentially distributed groups of fibres. The cortex is composed only of sieve tubes and parenchyma cells.

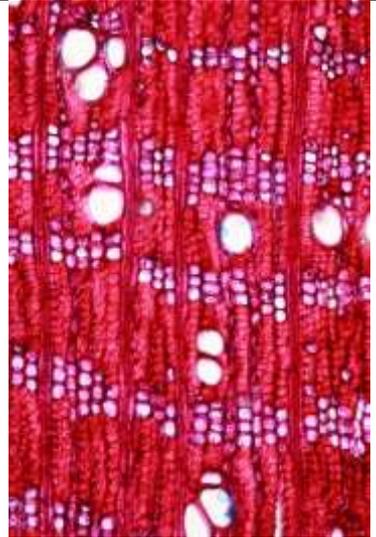
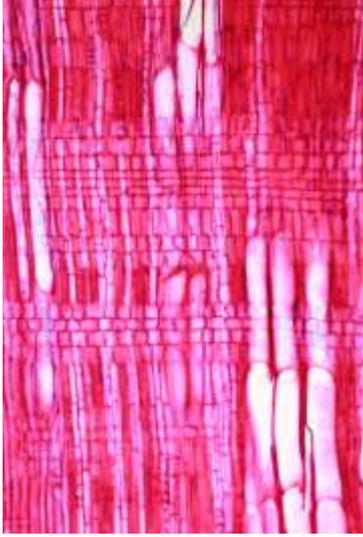
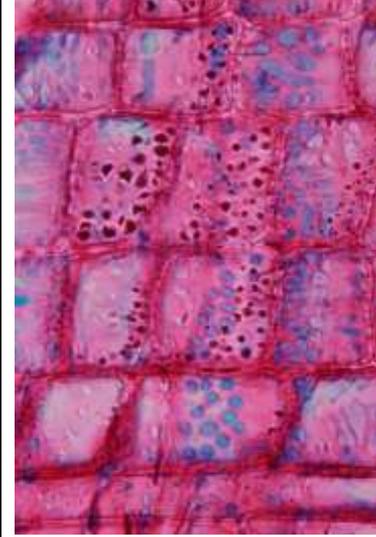
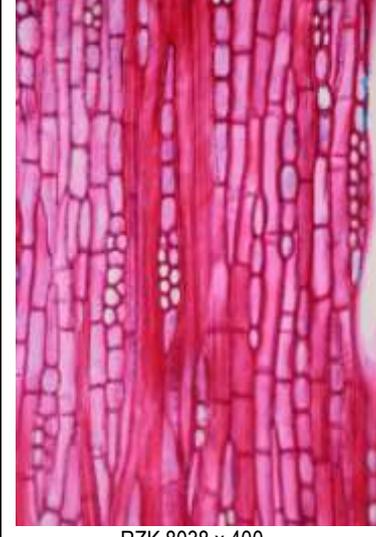
Stem bark: The phloem is composed only of sieve tubes tangentially distributed groups of sclereids. Ray and parenchyma dilatation present. The phellem cells are homogeneous and it consist of regularly arranged rectangular cells, indistinct in polarized light.

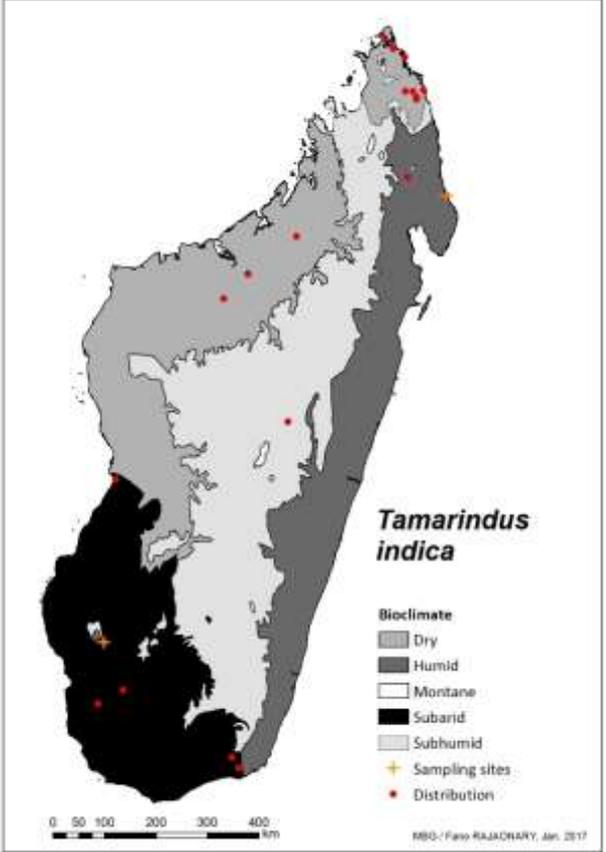


RZK 8038 x 200



RZK 8038 x 20

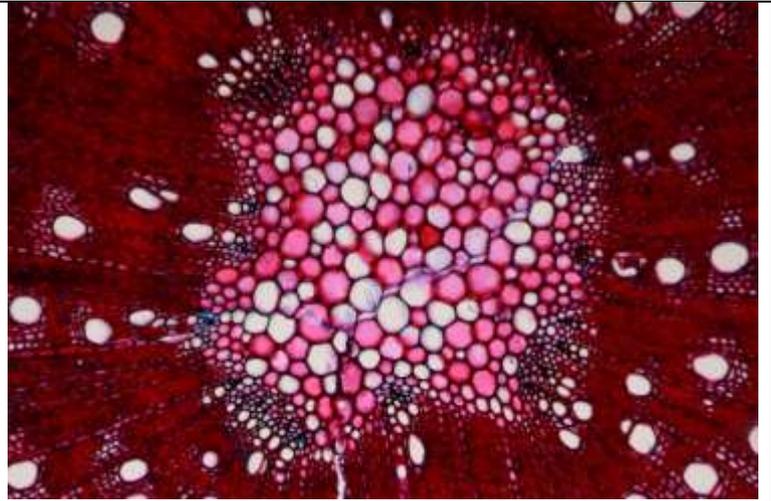
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries absent. Wood diffuse-porous. Vessels in diagonal and/or radial pattern. Vessels solitary and in radial multiples of 2 to 6 elements. Tangential diameter of vessels 50-66-90 μm, 11-26-46 vessels/mm^2. Fibres thick-walled. Axial parenchyma scalariform, in bands up to 3 and more than 3 cells wide. Rays 7-10-13 per mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 5-6-10 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 200-433-710 μm. Fibres with simple to minutely bordered pits. Heterogeneous rays, body ray cells procumbent with one, 2-4 rows of upright and/or square marginal cells. Prismatic crystal in chambered upright and / or square cells.</p>		
<p>Tangential section Ray width to 1 to 3 cells, predominantly biseriata. Ray height 110-340-580 μm, with 4-14-26 cells in height. Five to 8 and over 8 cells per parenchyma strand.</p>		
<p><i>Sideroxylon gerrardianum</i> (Hook. f.) Lecomte : RZK 8038 IAWA feature numbers 2 5 7 13 25 30 41 48 52 61 70 85 86 88 93 94 97 106 107 115 136 140 180 189 196</p>		

<i>Tamarindus indica</i> L.	FABACEAE
Synonymy: -	
Specimens : RBE 2453	
Local names: Madiro, Madiro, Matsiko, Kily.	
<p>PLANT DESCRIPTION</p> <p>Tree up to 25 m high 10 - 50 cm DBH Native species</p>	
<p>DISTRIBUTION</p> <p>Elevation: 0-499 m Vegetation Formation: Anthropic, bushland, forest, wooded grassland Bioclimate: Dry, Subarid Protected areas and other important sites: Andohahela, Ankarafantsika, Bezà Mahafaly, Kirindy Mitea, Loky Manambato (Daraina)</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries distinct marked by marginal parenchyma. Vessels solitary and in radial multiples of 2 to 4 elements. Vessels large¹ and rare². Tyloses present in the vessels. Paratracheal axial parenchyma vasicentric and lozenge-aliform. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">RBE 2453</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith pentagonal. Thick-walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles indistinct. Vessels solitary and in short radial multiples of 2 to 3 elements.

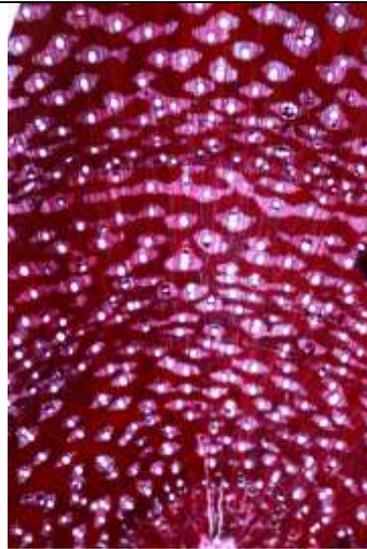


RBE 2453 x 200

BRANCH XYLEM ANATOMY

Description: Growth rings boundaries distinct. Wood semi-porous. Tangential diameter of vessels 40-70-140 μm , 39-63-108 vessels/ mm^2 . Gums and/or other deposits in heartwood vessels. Vessel element length 90-154-230 μm . Intervessel pits medium 4-5-7 μm in diameter. Fibres very thin- and thick-walled. Paratracheal parenchyma lozenge-aliform, vasicentric and confluent. Homogeneous rays, all ray cells are procumbent. Ray width to 1 to 3 cells. Ray height 50-128-213 μm . Rays 11-13-16/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel in the stem is larger (40-70-140 / 80-138-170 μm). Vessel density is higher in the branch 39-63-108 / 5-11-18 vessels/ mm^2 . Rays in the branch are shorter (50-128-213 / 110-195-330 μm) while ray number is comparable (11-13-16 / 9-12-15 rays/mm).



RBE 2453 x 40



RBE 2453 x 100

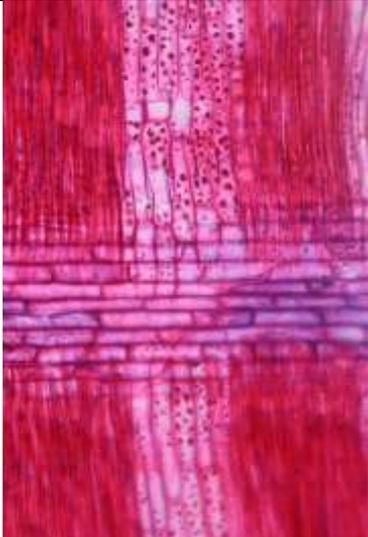
BARK ANATOMY

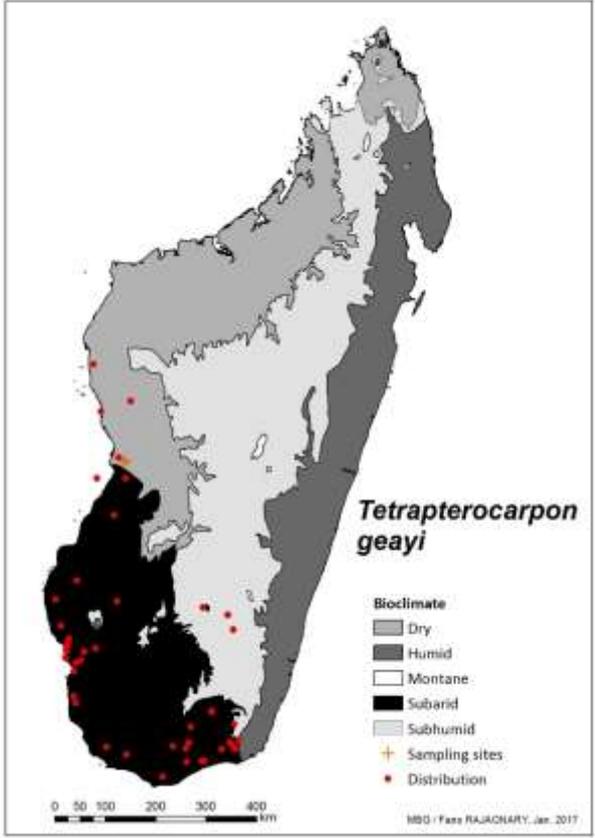
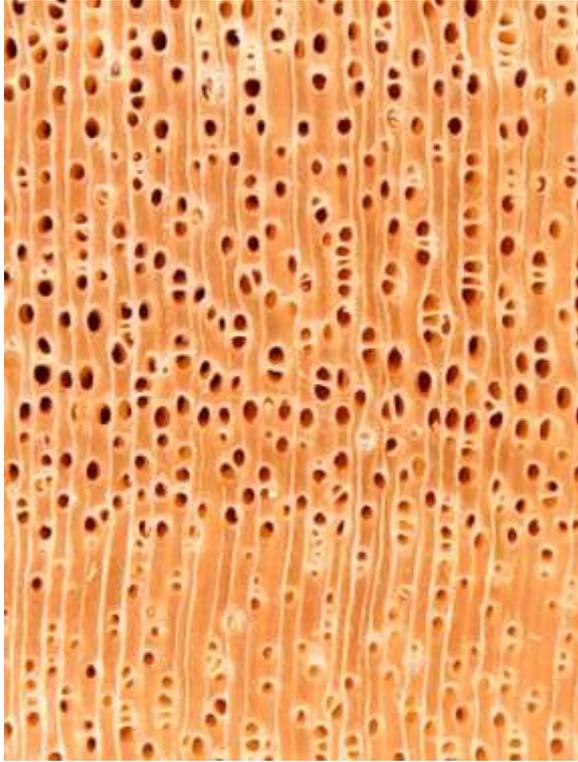
Branch bark: -

Stem bark: Sieve tubes, group of lignified fibres present in the phloem. The cortex consists of alternating collapse sieve tube and sclereids in radial rows. Prismatic crystals present within sclereids groups.



RBE 2453 x 40

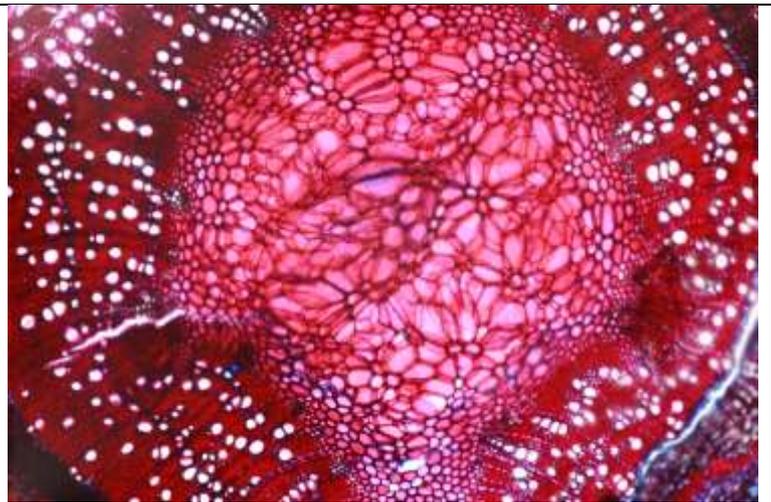
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries distinct, marked by marginal parenchyma. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 4 elements. Tangential diameter of the vessels 80-138-170 μm, 5-11-18 vessels per mm^2. Gums and other deposits in heartwood vessels. Fibres thin to thick-walled. Apotracheal parenchyma diffuse. Paratracheal parenchyma vasicentric, lozenge-aliform, confluent. Rays 9-12-15/ mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits oval to circular and alternate, 5-9-12 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 120-226-300 μm. Fibres with simple to minute bordered pits. Homogeneous rays, all ray cells are procumbent. Prismatic crystal in chambered axial parenchyma cells.</p>		
<p>Tangential section Ray with 1 to 3 cells. Ray height 110-195-330 μm, with 5-12-18 cells in height. Fusiform parenchyma cells present. Two, 3 to 4 cells per parenchyma strand.</p>		
<p><i>Tamarindus indica</i> L.: RBE 2453 IAWA feature numbers 1c 5 13 22 26 29 30 47 52 58 61 66 69 76 79 81 83 89 91 92 97 104 115 136 142 178 179 189 192 196</p>		

<i>Tetrapterocarpon geayi</i> Humbert	FABACEAE
Synonymy: -	
Specimens : CR 6694	
Local names: Vovy, Mendoravy, Hazolava, Vaovy, Sarifary, Fandrianakanga	
<p>PLANT DESCRIPTION</p> <p>Shrub to tree less than 10m high Endemic to Madagascar</p>	
<p>DISTRIBUTION</p> <p>Elevation: 0-499 m Vegetation Formation: Thicket, Woodland Bioclimate: Dry, Subarid Protected areas and other important sites: Amoron'i Onilahy, Andohahela, Angavo, Behara-Tranomaro, Bemaraha, Complexe Mangoky Ihotry, Complexe Vohidava-Betsimalaho (Anadabolava), Kirindy Mitea, Menabe Antimena, Mikea, Ranobe PK 32, Tsimanampetsotse, Tsimembo Manambolomaty, Tsinjoriake (La Table/St Augustin)</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries indistinct or absent. Vessels solitary and in radial multiples of 2 to 4 elements. Vessels large¹ and numerous². Tyloses present in the vessels. Paratracheal axial parenchyma vasicentric and lozenge-aliform. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Numerous: 20-40 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">CR 6694</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith pentagonal. Cells dimorphic. Thick-walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls.

Primary xylem: Vascular bundles clearly separate to not distinct. Vessels solitary and in long radial multiples of 2 to 5 elements.

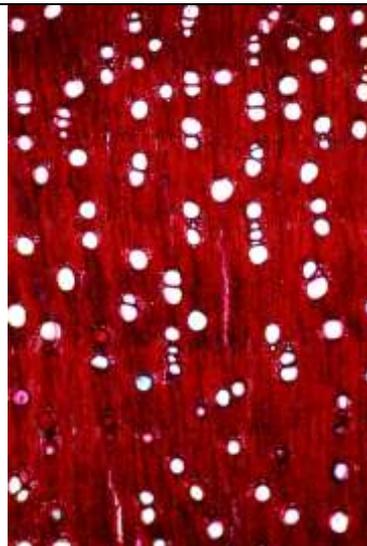


CR 6694 x 100

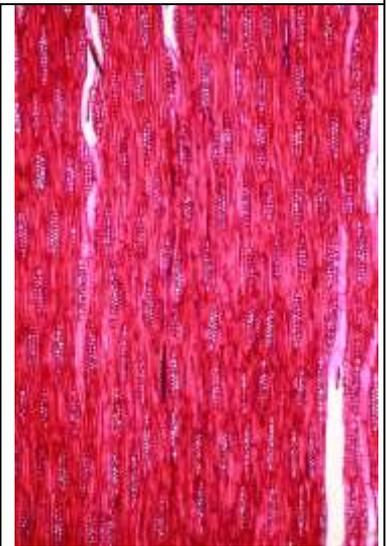
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries absent. Wood diffuse-porous. Tangential diameter of vessels 30-56-80 µm, 35-51-70 vessels/ mm². Gums and/or other deposits in heartwood vessels. Vessel element length 70-188-260 µm. Intervessel pits small 3-5-8 µm in diameter. Fibres very thin- to thick-walled. Axial parenchyma extremely rare. Paratracheal parenchyma scanty. Homogeneous and heterogeneous rays both present. Body ray procumbent with 1, 2-4 rows upright or square marginal cells. Ray width to 1 to 3 cells. Ray height 100-171-350 µm. Rays 7-10-11/mm.

Anatomical differences to stem xylem: Mean tangential diameter of vessel in the stem is larger (30-56-80 / 60-91-120 µm). Vessel density is higher in the branch 35-51-70 / 52-59-66 vessels/mm². Rays in the branch are shorter (100-171-350 / 150-246-320 µm) while ray number is comparable (7-10-11 / 8-10-12 rays/mm).



CR 6694 x 100



CR 6694 x 100

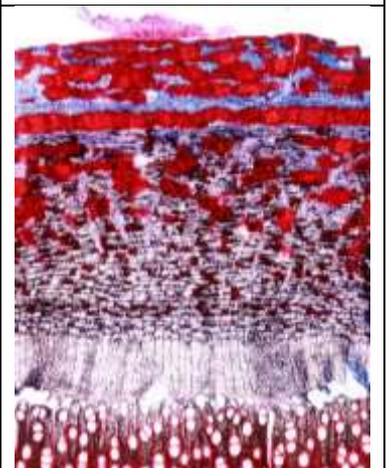
BARK ANATOMY

Branch bark: Sieve tubes and grouped fibres in tangential bands. The cortex is characterized by irregularly blue-stained parenchyma cells.

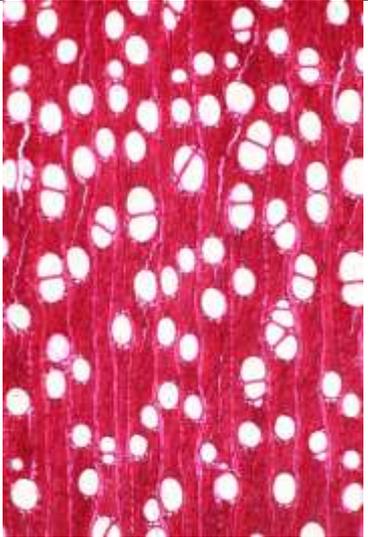
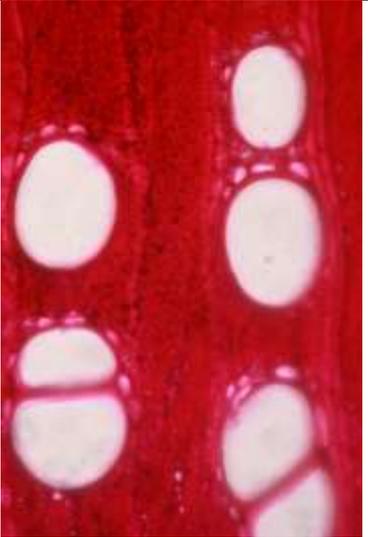
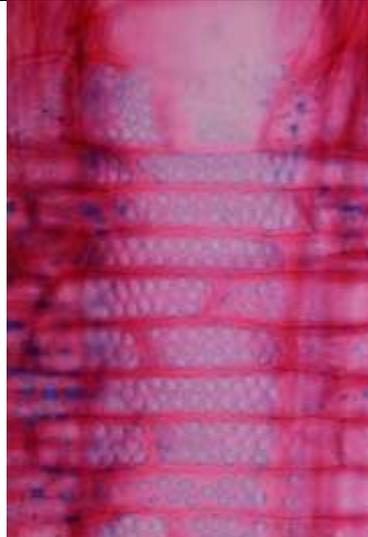
Stem bark: Collapsed and non-collapsed sieve tubes present in the phloem. Groups of dispersed sclereids present. Some rays become dilated. Prismatic crystals present within sclereids groups. The cortex is characterized by a band of sclereids.

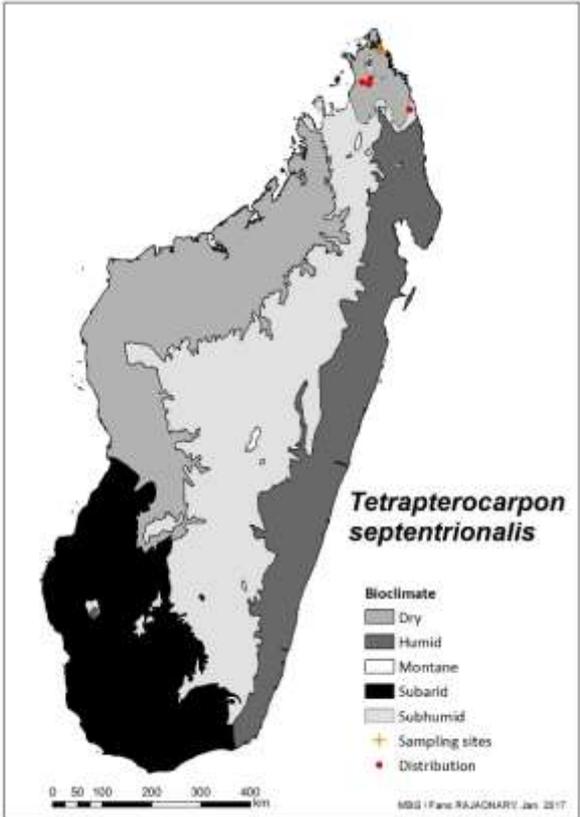


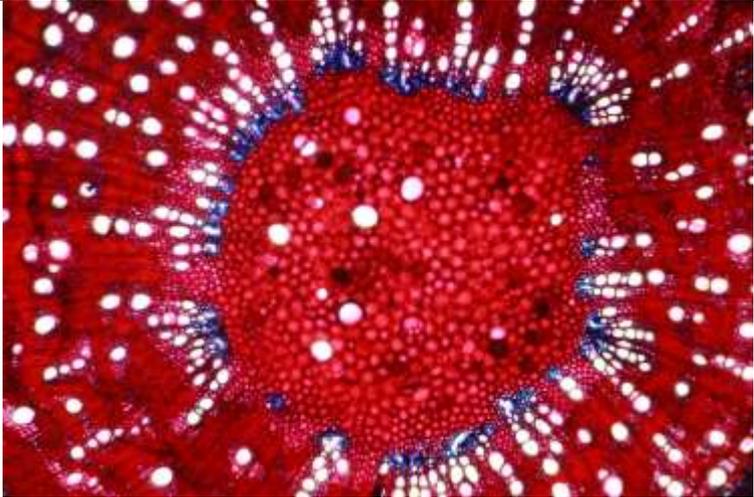
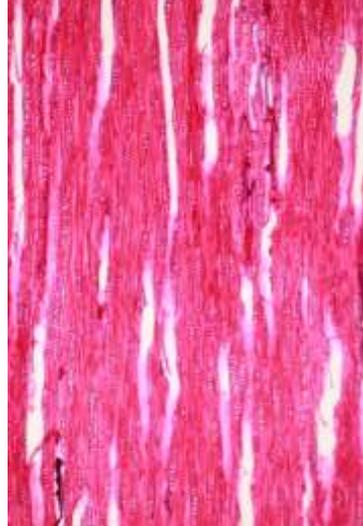
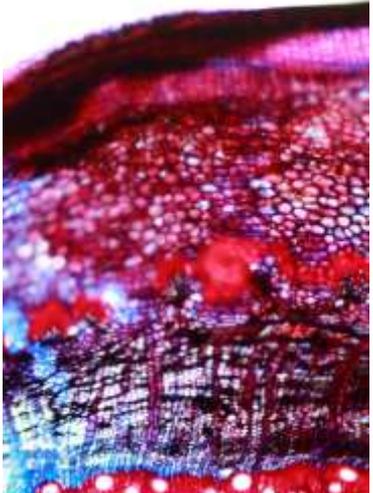
CR 6694 x 400

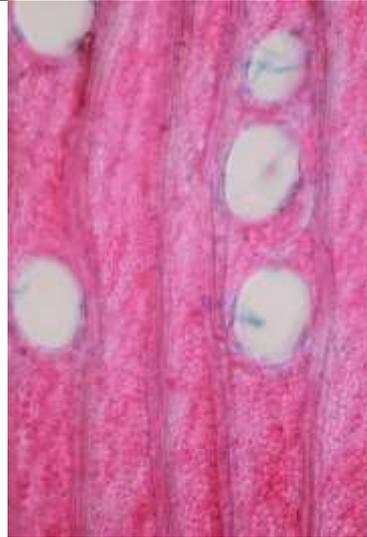
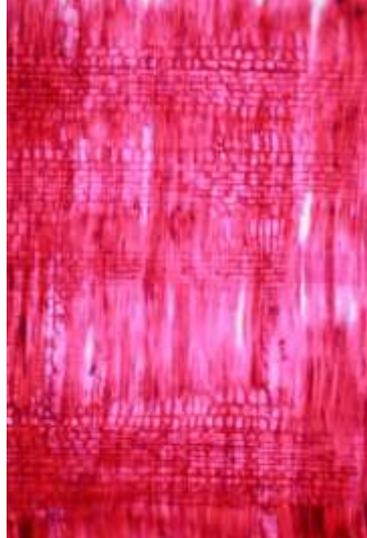
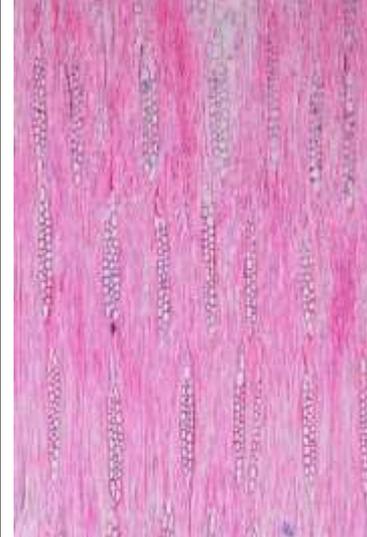


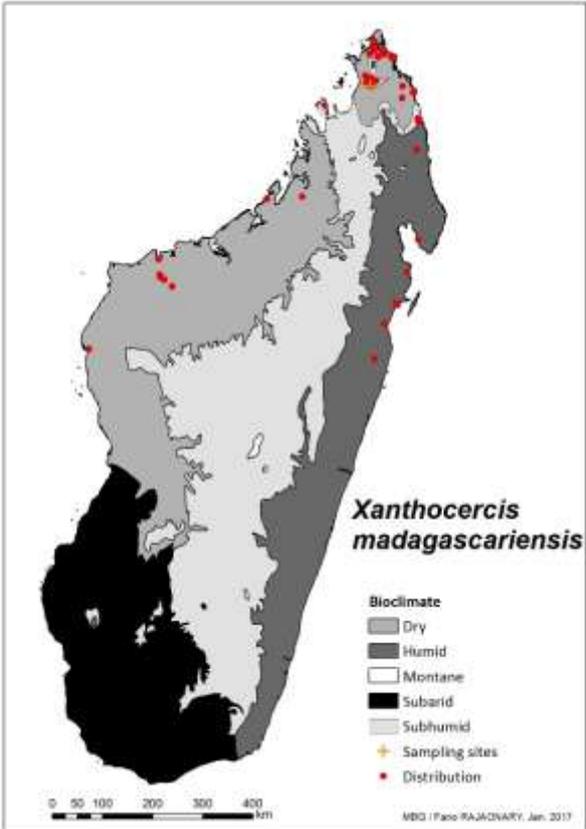
CR 6694 x 40

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries absent. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 5 elements. Tangential diameter of vessels 60-91-120 μm, 52-59-66 vessels/mm^2. Fibres very thick-walled. Axial parenchyma extremely rare. Paratracheal parenchyma scanty. Rays 8-10-12 per mm.</p>	 <p>CR 6694 x 100</p>	 <p>CR 6694 x 400</p>
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 4-5-6 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 210-282-330 μm. Fibres with simple to minutely bordered pits. Homogeneous and heterogeneous rays both present. Body ray procumbent with 1, 2-4 rows upright or square marginal cells. Prismatic crystal in chambered axial parenchyma cells.</p>	 <p>CR 6694 x 200</p>	 <p>CR 6694 x 1000</p>
<p>Tangential section Rays predominantly biseriata. Ray height 150-246-320 μm, with 7-14-18 cells in height. Two, 3-4 cells per parenchyma strand. Rays and/or axial elements irregularly storied.</p>	 <p>CR 6694 x 100</p>	 <p>CR 6694 x 400</p>
<p><i>Tetrapterocarpon geayi</i> Humbert: CR 6694 IAWA feature numbers : 2 5 13 22 25 29 30 41 49 52 61 66 70 75 78 91 92 91 97 106 107 115 122 136 142 178 180 189 190 196</p>		

<i>Tetrapterocarpon septentrionale</i> Du Puy et Rabev.	FABACEAE
Synonymy: <i>Cadia anomala</i> Vatke, <i>Pseudocadia anomala</i> (Vatke) Harms	
Specimens : RIR 2841	
Local names: Marody, Kintsakintsanala, Vaovy	
<p>PLANT DESCRIPTION</p> <p>Tree less than 10m high 17 cm DBH Endemic to Madagascar</p>	
<p>DISTRIBUTION</p> <p>Elevation: 0-499 m Vegetation Formation: Forest Bioclimate: Dry, Humid, Subhumid Protected areas and other important sites: Ankarana, Loky Manambato (Daraina), Mananara Nord, Montagne des Français, Namoroka</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries indistinct or absent. Vessels mostly solitary. Vessels large¹ and rare². Tyloses present in the vessels. Rays are thick³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thick: Distinct to the naked eye</p>	 <p style="text-align: center;">RIR 2841</p>

<p>PITH AND PRIMARY XYLEM ANATOMY</p> <p>Pith: Shape of pith pentagonal. Cells dimorphic. Pits in transverse cell walls.</p> <p>Primary xylem: Vascular bundles clearly separate. Vessels solitary and in long radial multiples of 2 to 5 elements.</p>	 <p>RIR 2841 x 100</p>	
<p>BRANCH XYLEM ANATOMY</p> <p>Description: Growth rings boundaries absent. Wood diffuse-porous. Vessel in diagonal or radial pattern. Tangential diameter of vessels 45-58-80 μm, 108-136-167 vessels/ mm^2. Vessel element length 110-173-240 μm. Intervessel pits small 4-5-7 μm in diameter. Fibres very thin- to thick-walled. Axial parenchyma extremely rare. Paratracheal parenchyma scanty and winged-aliform. Homogeneous and heterogeneous rays both present. Body ray procumbent with 1, 2-4 rows upright or square marginal cells. Ray width to 1 to 3 cells. Ray height 90-188-650 μm. Rays 11-12-13/mm.</p> <p>Anatomical differences to stem xylem: Mean tangential diameter of vessel in the stem is larger (45-58-80 / 44-79-130 μm). Vessel density is higher in the branch 108-136-167 / 31-43-55 vessels/mm^2. Rays in the branch are shorter (90-188-650 / 138-227-278 μm) while ray number is comparable (11-12-13 / 9-11-14 rays/mm).</p>	 <p>RIR 2841 x 100</p>	 <p>RIR 2841 x 100</p>
<p>BARK ANATOMY</p> <p>Branch bark: Collapse and non collapsed sieve tubes present in the phloem. The cortex is characterized by a band of fibre and irregularly parenchyma cells.</p> <p>Stem bark: -</p>	 <p>RIR 2841 x 200</p>	

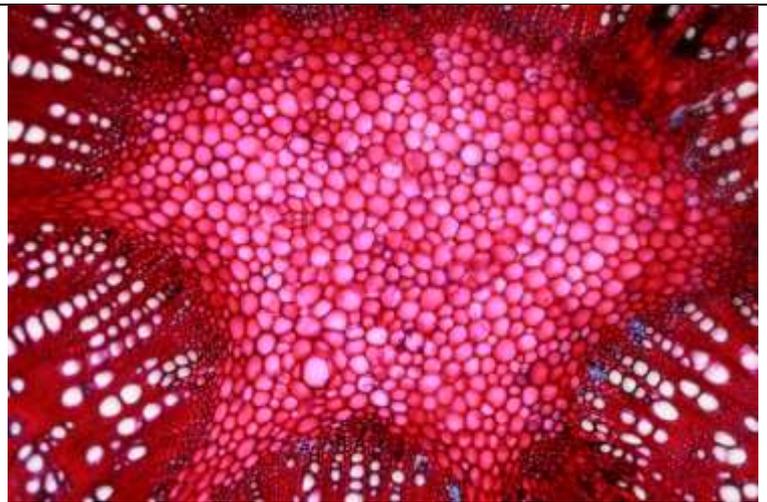
<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries absent. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 5 elements. Tangential diameter of vessels 44-79-130 μm, 31-43-55 vessels/mm^2. Fibres very thick-walled. Axial parenchyma extremely rare. Paratracheal parenchyma scanty. Rays 8-10-12 per mm.</p>	 <p>RIR 2841 x 100</p>	 <p>RIR 2841 x 400</p>
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 5-6-7 μm in diameter. Vestured pits present. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 55-190-310 μm. Fibres with simple to minutely bordered pits. Homogeneous and heterogeneous rays both present. Body ray procumbent with 1, 2-4 rows upright or square marginal cells. Prismatic crystal in chambered upright and/or square ray cells.</p>	 <p>RIR 2841 x 200</p>	 <p>RIR 2841 x 1000</p>
<p>Tangential section Ray width 1 to 3 cells wide, predominantly triseriate. Ray height 138-227-278 μm, with 11-13-15 cells in height. Two, 3-4 cells per parenchyma strand. Rays and/or axial elements irregularly storied.</p>	 <p>RIR 2841 x 100</p>	 <p>RIR 2841 x 200</p>
<p><i>Tetrapterocarpon septentrionale</i> Du Puy et Rabev.: RIR 2841 IAWA feature numbers : 2 5 13 22 25 29 30 41 49 52 61 66 70 75 78 91 92 91 97 106 107 115 122 136 140 178 180 189 196</p>		

<i>Xanthocercis madagascariensis</i> Baill.	FABACEAE
Synonymy : <i>Cadia anomala</i> Vatke, <i>Pseudocadia anomala</i> (Vatke) Harms	
Specimens : RIR 2871	
Local names : Voankazomeloky, Voankazomeloka, Antendriala, Haraka, Hidy, Kilioty, Manaritoloho, Vavanga, Vonanto, Atsendriala, Sandrazy	
<p>PLANT DESCRIPTION Tree 30 m high 86 cm DBH Endemic to Madagascar.</p>	
<p>DISTRIBUTION Elevation: 0-499 m a.s.l. Vegetation formation: Forest Bioclimate: Dry, humid and subhumid Protected areas and other important sites : Ankarana, Loky Manambato (Daraina), Mananara Nord, Montagne des Français, Namoroka</p>	
<p>STEM XYLEM DESCRIPTION</p> <p>Growth ring boundaries absent. Vessels solitary and in radial multiples of 2 to 4 elements. Vessels large¹ and rare². Apotracheal axial parenchyma in bands. Paratracheal axial parenchyma confluent. Rays are thin³.</p> <p>¹Large: Distinct to the naked eye ²Rare: 5-20 vessels/mm² ³Thin: Indistinct to the naked eye</p>	 <p style="text-align: center;">RIR 2871</p>

PITH AND PRIMARY XYLEM ANATOMY

Pith: Shape of pith pentagonal. Cells dimorphic. Pits in transverse cell walls. Pith visible in polarized light.

Primary xylem: Vascular bundles distinct. Vessels solitary and in long radial multiples of 2 to 7 elements.



RBE 2457 x 100

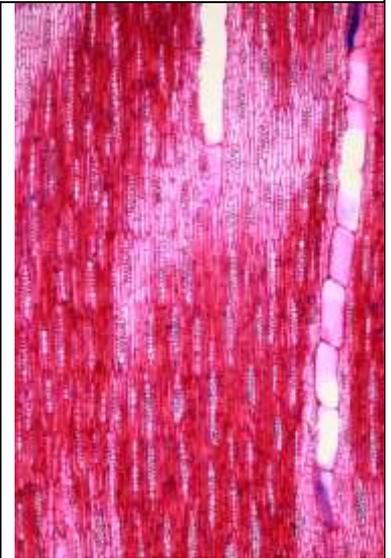
BRANCH XYLEM ANATOMY

Description: Growth rings boundaries absent. Wood diffuse-porous. Tangential diameter of vessels 40-61-100 μm, 16-23-30 vessels/ mm². Vessel element length 170-216-310 μm. Intervessel pits small 4-5-6 μm in diameter. Fibres thin to thick-walled. Axial paratracheal winged-aliform, confluent and in bands more than 3 cells wide. Homogeneous and heterogeneous rays, body ray procumbent with one, 2-4 rows upright or square marginal cell. Ray with 1 to 3 cells, predominantly biseriate. Ray height 120-210-360 μm. Rays 10-12-13 /mm.

Anatomical differences to stem xylem: Tangential diameter of vessel is larger in the stem (40-61-100 / 100-158-270 μm). Vessel density is higher in the branch 16-23-30 / 5-7-11 vessels/mm². Ray height is comparable (120-210-360 / 150-208-300 μm) while ray number is higher in the branch (10-12-13 / 5-8-9 rays/mm).



RIR 2871 x 100

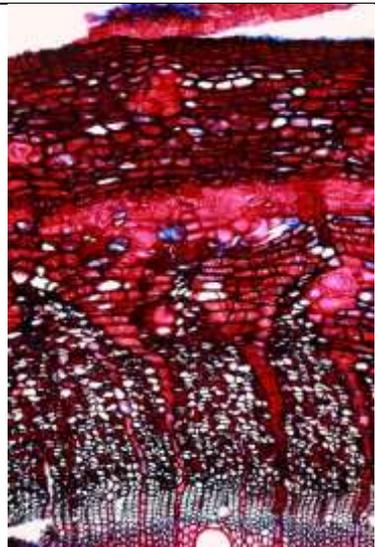


RIR 2871 x 100

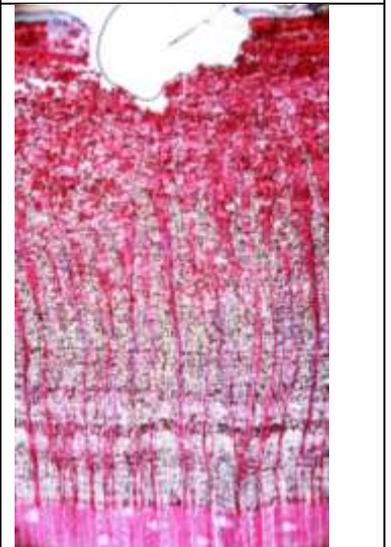
BARK ANATOMY

Branch bark: Collapsed, non-collapsed sieve tubes and dispersed fibres present in the phloem. Ray dilatation present. The cortex is characterized by a band of sclereids and irregularly lignified parenchyma cells.

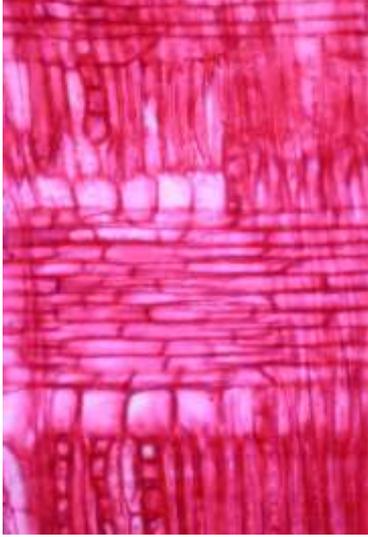
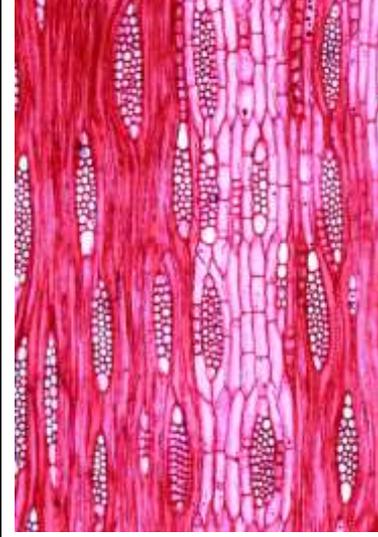
Stem bark: The phloem is composed by collapsed and noncollapsed sieve tubes, and tangentially distributed groups of fibres. Only some rays become dilated. The cortex is characterized by groups of sclereids irregularly distributed. The phellem is homogeneous and it consists of regularly arranged rectangular cells, indistinct in polarized light.



RIR 2871 x 200



RIR 2871 x 20

<p>STEM XYLEM ANATOMY Transverse section Growth ring boundaries absent. Wood diffuse-porous. Vessels solitary and in radial multiples of 2 to 5 elements. Tangential diameter of vessels 100-158-270 μm, 5-7-11 vessels/mm^2. Fibres thin to thick-walled. Axial paratracheal winged-aliform, confluent and in bands more than 3 cells wide. Rays 5-7-10 per mm.</p>		
<p>Radial section Simple perforation plates. Intervessel pits small oval to circular and alternate, 4-6-7 μm in diameter. Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. Vessel element length 200-266-320 μm. Fibres with simple to minutely bordered pits. Heterogeneous rays, body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystal in upright and or square ray cell and in chambered axial parenchyma cells.</p>		
<p>Tangential section Ray width 1 to 3 cells, predominantly triseriate. Ray height 100-378-980 μm, with 6-12-19 cells in height. Two and 3-4 cells per parenchyma strand.</p>		
<p><i>Xanthocercis madagascariensis</i> Baill.: RIR 2871 IAWA feature numbers 2 5 13 22 25 29 30 42 47 52 61 66 69 82 83 85 91 92 98 106 115 136 140 142 180 189 196</p>		

CONCLUSION

In total 125 samples were analyzed and descriptions of 44 species are given in the report.

⇒ **Dalbergia species** are well anatomically known now even though we still need more duplicates for some species to confirm their distinctive features. Almost all the 24 exploited *Dalbergia* species are described and an update identification key is given. It was proved that :

- the **origin** (West OR East) is the first needed information to divide them into 2 parts according to the porosity. Almost all the species from western part present growing rings except 4 species from the North West : *D. lemurica*, *D. emirnensis*, *D. suaresensis* and *D. chlorocarpa* and 2 species from the North East : *D. masoalensis*, *D. maritima* and *D. orientalis* which are semi-ring porous. In order to validate wood anatomy discrimination keys, including more duplicates per species is still needed;
- the **ray type** (homogeneous, heterogeneous and both) and subsequently **ray width** (exclusively uniseriate rays, uni- and biseriate rays and rays 2 to 3 cells wide) took the second and the third features. Additional features as **width of banded parenchyma** (up to three or more than three cells wide) is taken into account if two or more species fall in the same category. Finally storied structure can be used (number of ray tiers per axial mm) but sometimes this storied structure is irregular so it's complicate to count them.

⇒ Within **Diospyros species**, even we planned to analyze more samples, more of the target samples were poorly identified by final expert checking so we just did 8 species which 5 are new species not yet analyzed in the first atlas Ravaomanalina *et al*, 2017.

Concerning the look-alike species: 12 samples are analyzed, 6 of them are new species not yet analyzed by Rakoto Felana (2016).

The macroscopic description for all analyzed species have been added into this report in order to have an idea about their structure if someone want to stay in macroscopic level such as the forest agent or customers.

PERSPECTIVES

Establishment of reference collection is the one of the main goal in short time to be implemented by Madagascar according to the Decision 17 204 of CITES. Additionally, it is important to have many samples from the same species to test the reliability of the identification techniques and to capture anatomical features variation. Thanks to other projects carry out by the Scientific Authority of Madagascar, additional specimens and species were collected between January to october 2017 funded by the consortium ITTO-CITES, ETH Zurich, GIZ and FAO-FLEGT, **ready to be analyzed**. Most of these species recently collected produces replicates for validation of this wood anatomy keys and new species to be included in this publication. **The sampled species are summarized on the Table 2 below.**

Nowdays, the proposed key in this report is enough to recognize the wood structure of 24 exploited *Dalbergia* species each other but we can not yet published the results because more duplicates per species are still needed, at least 5 duplicates per species. For the moment, **identification on macroscopic level** is the possible catalog available to be trained to the agents in charge of export controls on its use.

Actions still to be carried on

- Complete this study by including more samples in order to develop a catalog on precious woods anatomical properties in short time (in one year), **with special focus on only stem wood analysis**;
- Rapidly set up quick and reliable wood anatomy log identification techniques that are accessible and easy to use by forestry and customs authorities with the most commercialized species which duplicates are enough analyzed during this study such as *D. louvelii* (rosewood), *D. orientalis*, *D. greveana*, *D. purpurascens*, *D. mollis* and *D. madagascariensis*.

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