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A PROVISIONAL DETERMINATION  
KEY TO 54 CONTINENTAL AFRICAN  
DICHAPETALUM SPECIES, BASED ON  
ANATOMICAL CHARACTERS OF THE  
SECONDARY XYLEM

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# A PROVISIONAL DETERMINATION KEY TO 54 CONTINENTAL AFRICAN *DICHAPETALUM* SPECIES, BASED ON ANATOMICAL CHARACTERS OF THE SECONDARY XYLEM

## 1. INTRODUCTION

The revision of all the African species of *Dichapetalum* by Breteler (1973) will take some more years. At this stage it was thought useful to present a provisional key of *Dichapetalum* species based on anatomical characters of the secondary xylem.

Unfortunately we could not get hold of wood samples of all the continental African species; only about 60% of the total amount of known species, is used in this key. Moreover Madagascar species are excluded because the samples available were very limited and we expect that the key is not valid for the about 12 partly very closely related species of this centre of distribution. The key is preceded by a general description of the wood of the genus *Dichapetalum*.

The supplement gives an alphabetical list of the investigated species, accompanied by the country where the examined specimens were collected, the name of the collector, the number of the wood sample (equal to the herbarium number) and a short description as far as it differs from the general one.

All specific names were checked taxonomically by Breteler of the Department of Plant Taxonomy and Plant Geography at Wageningen.

## 2. METHODS

Transverse, radial and tangential sections of the wood samples varying in thickness from 10—20  $\mu\text{m}$ , were made with a sledge microtome. Maceration was performed according to Jeffrey (Johansen, 1940). All sections were embedded in Kaiser's gelatin-glycerin (Johansen, 1940). Means of the number of wood rays per mm in tangential direction, ray height and width, radial vessel diameter and vessel-member length are based on at least twenty measurements. Vessel-member length was measured excluding the tails, from the middle of one perforation plate to that of the next one. The authors are aware that the vessel-member lengths measured in this way are not comparable with measurements including the tails, but it is felt, that for any functional consideration, the length of the body of the element is more significant than the total vessel-member length. Vessel frequency was determined over an area of at least 20 square mm in size, where possible these areas were not taken near the pith (axial wood). The means of ray height and width were based on the multiseriate rays; the uniseriate and aggregate ones were left out of consideration.

For our research in tropical woody species we have used the definition of

tracheids and libriform fibres given by Moll and Janssonius (1906-1936), Janssonius (1940) and Reinders (1935). Wood rays were classified according to Kribs (1935).

### 3. TERMS USED

Most of the terms used are defined according to the Multilingual Glossary of terms used in Wood Anatomy (IAWA, 1964):

Fibre, libriform wood	An elongated, commonly thick-walled cell with simple pits; usually distinctly longer than the cambial initial as inferred from the length of vessel members and parenchyma strands (see also Janssonius 1940, Reinders 1935).
Parenchyma, aliform	Axial parenchyma associated with the vessels or vascular tracheids, with wing-like lateral extensions, as seen in cross section.
Parenchyma, axial	Parenchyma cells derived from fusiform cambial initials.
Parenchyma, multiseriate bands	Axial parenchyma forming concentric bands, as seen in cross section. These bands are more than one cell wide in radial direction.
Parenchyma, uniseriate bands	Axial parenchyma forming concentric bands, as seen in cross section. These bands are one cell wide in radial direction.
Parenchyma, ray	Parenchyma composing the rays wholly or in part.
Phloem, included	Phloem strands or layers included in the secondary xylem.
Ray, aggregate	A group of small, narrow, xylem rays appearing to the unaided eye or at low magnification as a single large ray.
Ray, height	Longitudinal dimension of a ray as seen in tangential section.
Ray tissue, heterogeneous	Ray tissue in which the individual rays are composed of procumbent cells and upright- or square cells. According to the method of Kribs (1935) the ray tissue can also be divided in: type I: uniseriate rays and multiseriate rays with long uniseriate tails; type II: uniseriate rays and multiseriate rays with short uniseriate tails; type III: only uniseriate rays are present.

Ray tissue, homogeneous	Ray tissue in which the individual rays are composed wholly of procumbent cells or wholly of upright- or square cells.
Ray, multiseriate	A ray two or more cells wide as seen in tangential section.
Ray, tail	The uniseriate upper- or lower margin of a multiseriate ray, as seen in tangential section.
Ray, uniseriate	A ray one cell wide as seen in tangential section.
Ray, 4-seriate	A ray four cells wide as seen in tangential section.
Ray, 12 per mm	Twelve rays visible in cross section perpendicular to 1 mm in tangential direction.
Ray cell, procumbent	A ray cell with its longest axis radial.
Ray cell, square	A ray cell approximately square as seen in radial section.
Ray cell, upright	A ray cell with its longest dimension axial.
Tracheid	An imperforate wood cell with bordered pits to congeneric elements.
Vessel, diameter of	Radial dimension of a vessel as seen in cross section.
Vessel-member, length	Length of a member measured from the middle of one perforation plate to that of the next one.

#### 4. THE SECONDARY XYLEM OF DICHAPETALUM

This general description is based on the examined African specimens. Growth rings absent to fairly distinct. Growth-ring boundaries marked by flattened fibres, radially short ray cells and often a concentration of simple crystals in these ray cells.

Vessels: round to oval in cross section; mainly solitary but also present in radial pore multiples of less than 5 vessels, usually less than 4 vessels and in clusters; scattered but usually less abundant in libriform fibre areas; average diameter 95 (40—220)  $\mu\text{m}$ , near the pith nearly always smaller, increasing gradually towards the bark; an average of 30 (12—75) per square mm; perforations simple, perforation plate horizontal to oblique; intervascular bordered pits usually less than 4  $\mu\text{m}$  (horizontal dimension), alternate; pits in contact areas of vessel-ray cell and vessel-parenchyma cell are of the same size; average vessel-member length 470 (310—620)  $\mu\text{m}$ .

Fibre-tissue: ground tissue tracheids, but there are nearly always also present non-septate, thick-walled libriform fibres with simple or small bordered pits; libriform fibres often occur near the pith (axial wood), or in patches or tangential bands within the tracheid ground tissue.

Rays: heterogeneous II with rather few procumbent cells, sometimes homogeneous II composed of upright- and square cells; tails of more than 4 marginal rows are always present; perforated ray cells are present; average 3-4-seriate, uniseriate rays always present and more than 10-seriate ones regularly; average height 1800 (800—2500)  $\mu\text{m}$ ; 14 (8—19) per tangential mm.

Parenchyma: rather abundant; vasicentric forming an usually incomplete sheath of one cell wide, diffuse or diffuse in aggregates and almost always short uni-, sometimes multiseriate, tangential bands.

Crystals: simple, only in the ray cells, especially near the growth-ring boundaries when they are present.

Included phloem: in those species where it is present there is usually less parenchyma and there are less libriform fibres.

Pith flecks: sometimes present.

## 5. USE OF THE KEY

The key is mainly based on the number of vessels per square mm, radial vessel diameter, vessel-member length and ray height. These characteristics are rather variable, especially in species like *D. madagascariense*, *D. minutiflorum*, *D. mundense* and *D. ndongense*. This means that many species appear at different places in the key. The variability of the characters of the secondary xylem is caused among others by the fact that a special species can appear as a tree, shrub or climber; also the habitat and the place of the taken wood sample out of the stem are important factors. The secondary xylem near the pith usually has a quite different structure from that near the cambium.

When a special characteristic of the wood sample to be identified lies very near to the value mentioned in the strictly dichotomous key, both mentioned paths a and b can be taken.

Users of this key are kindly requested to communicate their comments to the authors, which will help to make a more satisfactory definite key.

## 6. THE KEY

- |    |   |    |                                 |
|----|---|----|---------------------------------|
| 1a | More than 40 vessels per square mm                | 2  |                                 |
| b  | Less than 40 vessels per square mm                | 43 |                                 |
| 2a | Average vessel diameter 100 $\mu\text{m}$ or more | 3  |                                 |
| b  | Average vessel diameter less than 100 mm          | 8  |                                 |
| 3a | Rays more than 10-seriate absent                  |    | <b>D. madagascariense</b> Poir. |
| b  | Rays more than 10-seriate present                 | 4  |                                 |
| 4a | Less than 12 rays per mm                          | 5  |                                 |
| b  | More than 12 rays per mm                          | 6  |                                 |

5 a	About 35 vessels per square mm; about 13 rays per mm	<b>D. minutiflorum</b> Engl. et Ruhl.
b	About 45 vessels per square mm; about 9 rays per mm	<b>D. staudtii</b> Engl.
6 a	Average vessel-member length less than 400 um tylosis abundant; libriform fibres present	<b>D. dictyospermum</b> Bret.
b	Average vessel-member length more than 400 um; tylosis absent; libriform fibres absent	7
7 a	Cambium circular or oval in cross section	<b>D. minutiflorum</b> Engl. et Ruhl.
b	Cambium strongly undulated in cross section	<b>D. mundense</b> Engl.
8 a	Rays homogeneous	9
b	Rays heterogeneous	12
9 a	Average vessel-member length less than 450 um	10
b	Average vessel-member length more than 450 um	<b>D. madagascariense</b> Poir.
10 a	Libriform fibres only near the pith; about 55 vessels per square mm	<b>D. mombuttense</b> Engl.
b	Libriform fibres throughout the xylem; about 35 vessels per square mm	11
11 a	Vessels nearly always surrounded by axial paren- chyma cells	<b>D. madagascariense</b> Poir.
b	Vessels occasionally surrounded by axial paren- chyma cells	<b>D. insigne</b> Engl.
12 a	Rays more than 10-seriate present	13
b	Rays more than 10-seriate absent	23
13 a	Average ray 3-4-seriate	<b>D. barteri</b> Engl.
b	Average ray 5- or more -seriate	14
14 a	Tangential bands of axial parenchyma cells absent	<b>D. chalotti</b> Pellegr.
b	Tangential bands of axial parenchyma cells present	15
15 a	Average vessel-member length more than 500 um	16
b	Average vessel-member length less than 500 um	17
16 a	Avery ray-height 1000 um	<b>D. madagascariense</b> Poir.
b	Avery ray-height 2500 um	<b>D. mundense</b> Engl.
17 a	Predominantly procumbent ray cells	<b>D. minutiflorum</b> Engl. et Ruhl.
b	Not predominantly procumbent ray cells	18
18 a	Average vessel diameter about 100 um	19
b	Average vessel diameter about 70 um	20
19 a	About 15 rays per mm	<b>D. mundense</b> Engl.
b	About 10 rays per mm	<b>D. staudtii</b> Engl.
20 a	Included phloem present	<b>D. unguiculatum</b> Engl.
b	Included phloem absent	21
21 a	Rays with a height of 7000 um frequently present	<b>D. cymulosum</b> (Oliv.) Engl.
b	Rays with a height of 7000 um absent	22

22 a	Average ray height 1000 $\mu\text{m}$ ; multiseriate tangential bands of axial parenchyma cells present	<b>D. madagascariense</b> Poir.
b	Average ray height 2000 $\mu\text{m}$ ; multiseriate tangential bands of axial parenchyma cells absent	<b>D. staudtii</b> Engl.
23(12)a	Horizontal diameter of bordered vessel pit-pairs more than 4 $\mu\text{m}$	24
b	Horizontal diameter of bordered vessel pit-pairs less than 4 $\mu\text{m}$	26
24 a	About 55 vessels per square mm	<b>D. mombuttense</b> Engl.
b	About 40 vessels per square mm	25
25 a	Average ray height less than 2000 $\mu\text{m}$ ; average ray 4-seriate; predominantly square- and upright ray cells	<b>D. unguiculatum</b> Engl.
b	Average ray height more than 2500 $\mu\text{m}$ ; average ray 3-seriate	<b>D. eickii</b> Ruhl.
26 a	Average ray height 1500 $\mu\text{m}$ or less	27
b	Average ray height more than 1500 $\mu\text{m}$	30
27 a	About 18 rays per mm	<b>D. oblongum</b> (Hook. f. ex Bth.) Engl.
b	About 13 rays per mm	28
28 a	Average ray height about 1300 $\mu\text{m}$	<b>D. arenarium</b> Bret.
b	Average ray height less than 1000 $\mu\text{m}$	29
29 a	Aliform axial parenchyma cells absent or hardly present	<b>D. madagascariense</b> Poir.
b	Aliform axial parenchyma cells often present	<b>D. barteri</b> Engl.
30 a	Average vessel-member length less than 400 $\mu\text{m}$	31
b	Average vessel-member length more than 400 $\mu\text{m}$	35
31 a	Average number of vessels more than 80 per square mm	<b>D. parvifolium</b> Engl.
b	Average number of vessels less than 80 per square mm	32
32 a	Libriform fibres absent	<b>D. filicaule</b> Bret.
b	Libriform fibres present	33
33 a	Rays 8-seriate often present	<b>D. cymulosum</b> (Oliv.) Engl.
b	Rays 8-seriate absent	34
34 a	Average vessel diameter 80 $\mu\text{m}$	<b>D. eickii</b> Ruhl.
b	Average vessel diameter 55 $\mu\text{m}$	<b>D. oliganthum</b> Bret., ined.
35 a	Average ray height 2500 $\mu\text{m}$ or more	36
b	Average ray height less than 2500 $\mu\text{m}$	38
36 a	Predominantly square- and upright ray cells	<b>D. rudatisii</b> Engl.
b	Not predominantly square- and upright ray cells	37
37 a	Average ray 5-seriate	<b>D. cymulosum</b> (Oliv.) Engl.
b	Average ray 3-seriate	<b>D. eickii</b> Ruhl.
38 a	Less than 15 rays per mm	<b>D. arenarium</b> Bret.
b	More than 15 rays per mm	39

39 a	Average number of vessels about 60 per square mm	<b>D. dewildii</b> Bret.
b	Average number of vessels about 40 per square mm	40
40 a	Predominantly square- and upright ray cells	41
b	Not predominantly square- and upright ray cells	<b>D. oliganthum</b> Bret., ined.
41 a	Rays 8-seriate present	<b>D. unguiculatum</b> Engl.
b	Rays 8-seriate absent	42
42 a	Procumbent ray cells often present	<b>D. rudatisii</b> Engl.
b	Procumbent ray cells hardly present	<b>D. madagascariense</b> Poir.
43(1)a	Average vessel diameter more than 100 $\mu$ m	44
b	Average vessel diameter less than 100 $\mu$ m	114
44 a	Rays heterogeneous	45
b	Rays homogeneous	112
45 a	Rays more than 10-seriate absent	46
b	Rays more than 10-seriate present	73
46 a	Horizontal diameter of bordered vessel pit-pairs less than 4 $\mu$ m	47
b	Horizontal diameter of bordered vessel pit-pairs more than 4 $\mu$ m	63
47 a	Included phloem absent	48
b	Included phloem present	61
48 a	Rays 12 or more per mm	49
b	Rays less than 12 per mm	58
49 a	Average ray height less than 1500 $\mu$ m	50
b	Average ray height more than 1500 $\mu$ m	53
50 a	Average ray 2-3-seriate	51
b	Average ray 4-seriate or more	52
51 a	Ray tails of more than 4 cells high seldom present	<b>D. zenkeri</b> Engl.
b	Ray tails of more than 4 cells high often present	<b>D. altescandens</b> Engl.
52 a	Average vessel diameter about 100—110 $\mu$ m	<b>D. zenkeri</b> Engl.
b	Average vessel diameter about 160 $\mu$ m	<b>D. madagascariense</b> Poir.
53 a	Average vessel-member length less than 400 $\mu$ m	<b>D. dewevrei</b> De Wild. et Th. Dur.
b	Average vessel-member length more than 400 $\mu$ m	54
54 a	Predominantly square- and upright ray cells	55
b	Not predominantly square- and upright cells	57
55 a	Average vessel-member length more than 550 $\mu$ m	<b>D. gabonense</b> Engl.
b	Average vessel-member length less than 550 $\mu$ m	56
56 a	Average vessel diameter about 90—100 $\mu$ m; more than 15 rays per mm	<b>D. crassifolium</b> Chod.
b	Average vessel diameter about 120 $\mu$ m; less than 15 rays per mm	<b>D. reticulatum</b> Engl.
57 a	Average vessel diameter 160 $\mu$ m; about 15 vessels per square mm	<b>D. librebillense</b> Pellegr.
b	Average vessel diameter about 120 $\mu$ m; about 25 vessels per square mm	<b>D. heudelotii</b> (Planch. ex Oliv.) Baill.



58 a	Average ray height less than 1500 um	59
b	Average ray height 1500 um or more	60
59 a	Multiseriate tangential bands of axial parenchyma cells present	<b>D. zenkeri</b> Engl.
b	Multiseriate tangential bands of axial parenchyma cells absent	<b>D. madagascariense</b> Poir.
60 a	Average vessel diameter 200 um; predominantly procumbent- and square ray cells	<b>D. choristilum</b> Engl.
b	Average vessel diameter 160 um; predominantly upright- and square ray cells	<b>D. crassifolium</b> Chod.
61(47)a	Average ray height about 1800 um or more	62
b	Average ray height about 1300 um	<b>D. liberiae</b> Engl. et Dinkl.
62 a	Ray height of 6000 um present	<b>D. choristilum</b> Engl.
b	Ray height of 6000 um absent	<b>D. pallidum</b> (Oliv.) Engl.
63(46)a	Included phloem present	<b>D. tomentosum</b> Engl.
b	Included phloem absent	64
64 a	Less than 20 vessels per square mm	65
b	More than 20 vessels per square mm	70
65 a	Average ray 3-4-seriate	66
b	Average ray more than 5-seriate	69
66 a	About 13 rays per mm	67
b	About 19 rays per mm	<b>D. arachnoideum</b> Bret.
67 a	Average vessel diameter about 110 um	<b>D. sp. aff. D. unguiculatum</b> Engl.
b	Average vessel diameter about 160 um	68
68 a	Average vessel-member length 390 um	<b>D. madagascariense</b> Poir.
b	Average vessel-member length 550 um	<b>D. toxicarium</b> (G. Don) Baill.
69 a	Average vessel diameter about 200 um	<b>D. sp. aff. D. unguiculatum</b> Engl.
b	Average vessel diameter about 120 um	<b>D. toxicarium</b> (G. Don) Baill.
70 a	About 33 vessels per square mm	71
b	About 23 vessels per square mm	72
71 a	Cambium strongly undulated in cross section	<b>D. hispidum</b> (Oliv.) Baill.
b	Cambium circular or oval in cross section	<b>D. pedunculatum</b> (DC.) Baill.
72 a	Average vessel-member length 430 um	<b>D. sp. aff. D. unguiculatum</b> Engl.
b	Average vessel-member length 580 um	<b>D. gabonense</b> Engl.
73(45)a	Horizontal diameter of bordered vessel pit-pairs less than 4 um	74
b	Horizontal diameter of bordered vessel pit-pairs more than 4 um	88
74 a	More than 11 rays per mm	75
b	Per mm 11 or less rays	<b>D. minutiflorum</b> Engl. et Ruhl.
75 a	Tangential bands of axial parenchyma cells present	76
b	Tangential bands of axial parenchyma cells absent or hardly present	86

76 a	Included phloem absent	77
b	Included phloem present	83
77 a	Average vessel diameter about 110 um or less	78
b	Average vessel diameter 140 um or more	82
78 a	Average vessel-member length less than 400 um	<b>D. dictyospermum</b> Bret.
b	Average vessel-member length more than 400 um	79
79 a	About 40 vessels per square mm	<b>D. mundense</b> Engl.
b	About 30 vessels per square mm or less	80
80 a	Rays with a height of 9000 um absent	<b>D. ndongense</b> Engl.
b	Rays with a height of 9000 um present	81
81 a	Predominantly square- and upright ray cells; libriform fibres present	<b>D. reticulatum</b> Engl.
b	Predominantly procumbent ray cells; libriform fibres absent	<b>D. minutiflorum</b> Engl. et Ruhl.
82 a	About 25 vessels or more per square mm	<b>D. heudelotii</b> (Planch. ex Oliv.) Bail.
b	About 15 vessels per square mm	<b>D. acuminatum</b> De Wild.
83 a	Average ray height more than 1500 um; average vessel diameter about 120 um	84
b	Average ray height less than 1500 um; average vessel diameter about 150 um	<b>D. liberiae</b> Engl. et Dinkl.
84 a	About 35 vessels per square mm or more	<b>D. mundense</b> Engl.
b	About 25 vessels per square mm	85
85 a	Average vessel diameter about 130 um	<b>D. choristilum</b> Engl.
b	Average vessel diameter about 110 um	<b>D. ndongense</b> Engl.
86 a	About 15 vessels per square mm	<b>D. acuminatum</b> De Wild.
b	About 25 vessels per square mm	87
87 a	Average vessel diameter about 100 um; average ray height about 2000 um	<b>D. ndongense</b> Engl.
b	Average vessel diameter about 140 um; average ray height about 1200 um	<b>D. choristilum</b> Engl.
88(73)a	More than 10 rays per mm	89
b	Less than 10 rays per mm	107
89 a	Average ray more than 5-seriate	90
b	Average ray less than 5-seriate	104
90 a	Average vessel-member length less than 500 um	91
b	Average vessel-member length more than 500 um	96
91 a	Included phloem present	92
b	Included phloem absent	93
92 a	Ray height of 6000 um present; average ray height 2500 um	<b>D. ndongense</b> Engl.
b	Ray height of 6000 um absent; average ray height 1800 um	<b>D. congoense</b> Engl. et Ruhl.

93 a	Average vessel diameter 100 um	94
b	Average vessel diameter about 150 um	95
94 a	Average vessel-member length about 420 um	<b>D. longitubulosum</b> Engl.
b	Average vessel-member length about 500 um	<b>D. ndongense</b> Engl.
95 a	About 25 vessels per square mm	<b>D. choristilum</b> Engl.
b	About 15 vessels per square mm	<b>D. toxicarium</b> (G. Don) Baill.
96 a	Multiseriate tangential bands of axial parenchyma cells present	<b>D. heudelotii</b> (Planch. ex Oliv.) Baill.
b	Multiseriate tangential bands of axial parenchyma cells absent	97
97 a	Included phloem present	98
b	Included phloem absent	99
98 a	Ray height of 6000 um present; average ray height 2500 um	<b>D. ndongense</b> Engl.
b	Ray height of 6000 um absent; average vessel diameter about 140 um	<b>D. congoense</b> Engl. et Ruhl.
c	Ray height of 6000 um absent; average vessel diameter about 110 um	<b>D. lujaei</b> De Wild. et Th. Dur.
99 a	Average vessel diameter about 130 um	100
b	Average vessel diameter about 90 um	102
100 a	Average vessel-member length 600 um	101
b	Average vessel-member length 500 um; ray height about 2500 um	<b>D. toxicarium</b> (G. Don) Baill.
101 a	Cambium circular or oval in cross section	<b>D. angolense</b> Chod.
b	Cambium strongly undulated in cross section	<b>D. heudelotii</b> (Planch. ex Oliv.) Baill.
102 a	Ray height of 6000 um present	103
b	Ray height of 6000 um absent	<b>D. lujaei</b> De Wild. et Th. Dur.
103 a	Rays 15-seriate present	<b>D. umbellatum</b> Chod.
b	Rays 15-seriate absent	<b>D. ndongense</b> Engl.
104(89) a	Average vessel diameter about 180 um	105
b	Average vessel diameter about 100 um	106
105 a	Libriform fibres absent	<b>D. rugosum</b> (Vahl) Prance.
	Libriform fibres present	<b>D. angolense</b> Chod.
106 a	About 20 vessels per square mm	<b>D. umbellatum</b> Chod.
b	About 30 vessels per square mm	<b>D. lujaei</b> De Wild. et Th. Dur.
107(88) a	Tangential bands of axial parenchyma cells absent	108
b	Tangential bands of axial parenchyma cells present	109
108 a	About 12 vessels per square mm	<b>D. rugosum</b> (Vahl) Prance.
b	About 5 vessels per square mm	<b>D. angolense</b> Chod.
109 a	Multiseriate tangential bands of axial parenchyma cells present	<b>D. rugosum</b> (Vahl) Prance.
b	Multiseriate tangential bands of axial parenchyma cells absent	110
110 a	Average vessel diameter about 130 um	<b>D. mombuttense</b> Engl.
b	Average vessel diameter about 180 um	111

111 a	Average vessel-member length about 480 um	<b>D. sp. aff. D. unguiculatum</b> Engl.
b	Average vessel-member length about 640 um	<b>D. staudtii</b> Engl.
112(44)a	Average ray height less than 1500 um	<b>D. lujaei</b> De Wild. et Th. Dur.
b	Average ray height more than 1500 um	113
113 a	About 30 vessels per square mm	<b>D. lujaei</b> De Wild. et Th. Dur.
b	About 20 vessels per square mm	<b>D. albidum</b> Chev. ex Pellegr.
114(43)a	Rays homogeneous, sometimes heterogeneous	115
b	Rays only heterogeneous	128
115 a	Horizontal diameter of bordered vessel pit-pairs more than 4 um	116
b	Horizontal diameter of bordered vessel pit-pairs less than 4 um	119
116 a	Average ray 2-3-seriate	117
b	Average ray 3-4-seriate	118
117 a	About 20 vessels per square mm; multiseriate tangential bands of axial parenchyma cells present	<b>D. arachnoideum</b> Bret.
b	About 35 vessels per square mm; multiseriate tangential bands of axial parenchyma cells absent	<b>D. madagascariense</b> Poir.
118 a	Vessel diameter about 60 um	<b>D. arachnoideum</b> Bret.
b	Vessel diameter about 90 um	<b>D. lujaei</b> De Wild. et Th. Dur.
119 a	Rays 13-seriate present	<b>D. madagascariense</b> Poir.
b	Rays 13-seriate absent	120
120 a	Average ray height less than 1500 um	125
b	Average ray height more than 1500 um	121
121 a	Less than 25 vessels per square mm	122
b	More than 30 vessels per square mm	126
122 a	Rays homogeneous but also heterogeneous ones present	123
b	Rays only homogeneous	124
123 a	Rays 8-seriate present	<b>D. glomeratum</b> Engl.
b	Rays 8-seriate absent	<b>D. librevillense</b> Pellegr.
124 a	Average vessel diameter about 90 um	<b>D. albidum</b> Chev. ex Pellegr.
b	Average vessel diameter about 70 um	125
125 a	Average vessel diameter about 40 um	<b>D. sp.</b> Bret. ined.
b	Average vessel diameter about 70 um	<b>D. liberiae</b> Engl. et Dinkl.
126 a	Average vessel diameter about 40 um	<b>D. librevillense</b> Pellegr.
b	Average vessel diameter about 60 um or more	127
127 a	Ray height of 5000 um present	<b>D. madagascariense</b> Poir.
b	Ray height of 5000 um absent	<b>D. insigne</b> Engl.
128(114)a	Rays more than 10-seriate present	129
b	Rays more than 10-seriate absent	144

129 a	Horizontal diameter of bordered vessel pit-pairs more than 4 $\mu\text{m}$	130	
b	Horizontal diameter of bordered vessel pit-pairs less than 4 $\mu\text{m}$	136	
130 a	Average vessel diameter about 60 $\mu\text{m}$	131	
b	Average vessel diameter about 90 $\mu\text{m}$	132	
131 a	About 20 vessels per square mm		<b>D. ndongense</b> Engl.
b	About 30 vessels per square mm		<b>D. thollonii</b> Pellegr.
132 a	About 30 vessels or less per square mm	133	
b	About 40 vessels per square mm		<b>D. unguiculatum</b> Engl.
133 a	Average ray height about 1300 $\mu\text{m}$		<b>D. lujaei</b> De Wild. et Th. Dur.
b	Average ray height about 2000 $\mu\text{m}$ or more	134	
134 a	Average vessel-member length about 400 $\mu\text{m}$		<b>D. longitubulosum</b> Engl.
b	Average vessel-member length about 500 $\mu\text{m}$	135	
135 a	Upright- and square ray cells as much present as procumbent ones		<b>D. ndongense</b> Engl.
b	Procumbent ray cells dominating		<b>D. umbellatum</b> Chod.
136 a	Less than 12 rays per mm	137	
b	More than 12 rays per mm	138	
137 a	Multiseriate tangential bands of axial parenchyma cells often present		<b>D. barteri</b> Engl.
b	Multiseriate tangential bands of axial parenchyma cells not or hardly present		<b>D. minutiflorum</b> Engl. et Ruhl.
138 a	About 22 vessels per square mm	139	
b	About 35 vessels per square mm	140	
139 a	Vessel-member length about 500 $\mu\text{m}$		<b>D. ndongense</b> Engl.
b	Vessel-member length about 380 $\mu\text{m}$		<b>D. dewevrei</b> De Wild. et Th. Dur.
140 a	Average vessel diameter about 100 $\mu\text{m}$	141	
b	Average vessel diameter about 75 $\mu\text{m}$	142	
141 a	About 40 vessels per square mm		<b>D. mundense</b> Engl.
b	About 30 vessels per square mm		<b>D. minutiflorum</b> Engl. et Ruhl.
142 a	Included phloem present		<b>D. unguiculatum</b> Engl.
b	Included phloem absent	143	
143 a	Uniseriate tangential bands of axial parenchyma cells present		<b>D. staudtii</b> Engl.
b	Uniseriate tangential bands of axial parenchyma cells absent		<b>D. chalotii</b> Pellegr.
144(128)a	Included phloem present	145	
b	Included phloem absent	147	
145 a	Average ray height less than 1500 $\mu\text{m}$		<b>D. liberiae</b> Engl. et Dinkl.
b	Average ray height more than 1500 $\mu\text{m}$	146	
146 a	Tangential bands of axial parenchyma cells present		<b>D. dewevrei</b> De Wild. et Th. Dur.
b	Tangential bands of axial parenchyma cells absent or hardly present		<b>D. tomentosum</b> Engl.

147 a	Horizontal diameter of bordered vessel pit-pairs more than 4 $\mu\text{m}$	148	
b	Horizontal diameter of bordered vessel pit-pairs less than 4 $\mu\text{m}$	157	
148 a	Tangential bands of axial parenchyma cells almost absent	149	
b	Tangential bands of axial parenchyma cells often present	150	
149 a	Libriform fibres hardly present		<b>D. thollonii</b> Pellegr.
b	Libriform fibres often present		<b>D. congoense</b> Engl. et Ruhl.
150 a	Average ray height 1500 $\mu\text{m}$ or less		<b>D. longitubulosum</b> Engl.
b	Average ray height more than 1500 $\mu\text{m}$	151	
151 a	Less than 15 rays per mm	152	
b	More than 15 rays per mm	154	
152 a	About 35 vessels per square mm		<b>D. hispidium</b> (Oliv.) Baill.
b	About 25 vessels per square mm	153	
153 a	Average vessel-member length 430 $\mu\text{m}$		<b>D. sp. aff. D. unguiculatum</b> Engl.
b	Average vessel-member length 580 $\mu\text{m}$		<b>D. gabonense</b> Engl.
154 a	Average vessel diameter 60 $\mu\text{m}$		<b>D. angolense</b> Chod.
b	Average vessel diameter 80 $\mu\text{m}$	155	
155 a	About 40 vessels per square mm		<b>D. eickii</b> Ruhl.
b	About 25 vessels per square mm	156	
156 a	Rays 6-7-seriate present		<b>D. bangii</b> (F. Didr.) Engl.
b	Rays 6-7-seriate absent		<b>D. crassifolium</b> Chod.
157 a	Less than 12 rays per mm	158	
b	More than 12 rays per mm	160	
158 a	About 35 vessels per square mm		<b>D. madagascariense</b> Poir.
b	About 25 vessels per square mm	159	
159 a	Multiseriate tangential bands of axial parenchyma cells present; average ray 3-seriate		<b>D. zenkeri</b> Engl.
b	Multiseriate tangential bands of axial parenchyma cells absent; average ray 5-seriate or more		<b>D. toxicarium</b> (G. Don) Baill.
160 a	Average vessel diameter about 90 $\mu\text{m}$	161	
b	Average vessel diameter about 50 $\mu\text{m}$	173	
161 a	Average ray height less than 1500 $\mu\text{m}$	162	
b	Average ray height more than 1500 $\mu\text{m}$	164	
162 a	Ray tails of more than 4 cells high absent		<b>D. zenkeri</b> Engl.
b	Ray tails of more than 4 cells high present	163	
163 a	Average vessel diameter about 100 $\mu\text{m}$		<b>D. altescandens</b> Engl.
b	Average vessel diameter 80 $\mu\text{m}$		<b>D. toxicarium</b> (G. Don) Baill.
164 a	Average ray height more than 2000 $\mu\text{m}$	165	
b	Average ray height less than 2000 $\mu\text{m}$	168	

165 a	About 40 vessels per square mm	166	
b	About 25 vessels per square mm	167	
166 a	Small bands of libriform fibres near the pith		<b>D. rudatisii</b> Engl.
b	Wide bands of libriform fibres near the pith		<b>D. eickii</b> Ruhl.
167 a	Average vessel diameter about 100 $\mu$ m		<b>D. gabonense</b> Engl.
b	Average vessel diameter about 80 $\mu$ m		<b>D. bangii</b> (F. Didr.) Engl.
168 a	Average ray 5-seriate or more		<b>D. ndongense</b> Engl.
b	Average ray less than 5-seriate	169	
169 a	About 20 vessels per square mm	170	
b	About 30 vessels per square mm	171	
170 a	Average vessel-member length more than 450 $\mu$ m; about 17 rays per mm		<b>D. crassifolium</b> Chod.
b	Average vessel-member length less than 400 $\mu$ m; about 14 rays per mm		<b>D. dewevrei</b> De Wild. et Th. Dur.
171 a	Predominantly square- and upright ray cells	172	
b	No domination of certain ray cells; about 18 rays per mm		<b>D. pedunculatum</b> (DC.) Baill.
172 a	Rays 8-seriate present		<b>D. integripetalum</b> Engl.
b	rays 8-seriate absent		<b>D. rudatisii</b> Engl.
173(160) a	Tangential bands of axial parenchyma cells absent		<b>D. congoense</b> Engl. et Ruhl.
b	Tangential bands of axial parenchyma cells present	174	
174 a	Multiseriate tangential bands of axial parenchyma cells present		<b>D. zenkeri</b> Engl.
b	Multiseriate tangential bands of axial parenchyma cells absent	175	
175 a	Aliform axial parenchyma cells present	176	
b	Aliform axial parenchyma cells absent	177	
176 a	Average ray height less than 1000 $\mu$ m; about 18 rays per mm		<b>D. oblongum</b> (Hook. f. ex Bth.) Engl.
b	Average ray height more than 1000 $\mu$ m; about 14 rays per mm		<b>D. pedunculatum</b> (DC.) Baill.
177 a	About 20 vessels per square mm	178	
b	About 30 vessels or more per square mm	180	
178 a	Average ray height 2500 $\mu$ m		<b>D. integripetalum</b> Engl.
b	Average ray height less than 2500 $\mu$ m	179	
179 a	Average ray height more than 1500 $\mu$ m	188	
b	Average ray height less than 1500 $\mu$ m		<b>D. rudatisii</b> Engl.
180 a	Average ray height 2500 $\mu$ m or more	181	
b	Average ray height less than 2500 $\mu$ m	182	
181 a	About 40 vessels per square mm		<b>D. rudatisii</b> Engl.
b	About 25 vessels per square mm		<b>D. minutiflorum</b> Engl. et Ruhl.
182 a	Rays 17 or more per mm	183	
b	Rays less than 16 per mm	186	

183 a	About 30 vessels or less per square mm	184
b	About 40 vessels per square mm	185
184 a	Predominantly square- and upright ray cells.	<b>D. insigne</b> Engl.
b	No domination of certain ray cells	<b>D. pedunculatum</b> (DC.) Bail.
185 a	Average vessel diameter 80 um	<b>D. unguiculatum</b> Engl.
b	Average vessel diameter 50 um	<b>D. oliganthum</b> Bret., ined.
186 a	Average vessel diameter about 70 um	<b>D. integripetalum</b> Engl.
b	Average vessel diameter about 40 um	187
187 a	Average vessel-member length more than 500 um	<b>D. barbatum</b> Bret.
b	Average vessel-member length less than 500 um	<b>D. glomeratum</b> Engl.
188 a	Vessels regularly distributed	190
b	Vessels not regularly distributed	189
189 a	Ground tissue almost exclusively libriform fibres	<b>D. longitubulosum</b> Engl.
b	Ground tissue tracheids and libriform fibres	<b>D. glomeratum</b> Engl.
190 a	Average vessel-member length about 580 um	<b>D. minutiflorum</b> Engl. et Ruhl.
b	Average vessel-member length about 450 um	<b>D. germanii</b> Haum.

## 7. SUPPLEMENT

An alphabetical list of the investigated *Dichapetalum* species. Each name is followed by the country of origin, collector and number of the specimens examined. A short description is added as far as it differs from the general one; all figures are average values.

**D. acuminatum** de Wild. Zaïre: *Germain 4896; Louis 4140*.

Vessels: diam. 165 um; 14 per square mm; vessel-member length 540 um.

Fibre tissue: tracheids only.

Rays: more than 10-seriate present; height 1600 um; 12–14 per mm.

**D. albidum** Chev. ex. Pellegr. Liberia: *Versteegh and Jansen 820*.

Vessels: diam. 90 um; 21 per square mm; vessel-member length 450 um.

Rays: homogeneous II; height 1800 um; 16 per mm.

**D. altescandens** Engl. Cameroun: *Bos 3631*.

Vessels: diam. 110 um; 34 per square mm; vessel-member length 460 um.

Rays: 2-3-seriate; height 1300 um; 17 per mm.

**D. angolense** Chod. Cameroun: *Breteler 1532; Zaïre: Louis 2707; Donis 2015*.

Vessels: diam. 220 um, but also specimens with 60 um; 5 per square mm, but also specimens with 30 per square mm; intervascular pits more than 4 um; vessel-member length 410 um.

Rays: heterogeneous I and sometimes heterogeneous II; 3-5-seriate (more than 10-seriate present); height 1800–2500 um; 9–17 per mm.

Parenchyma: sometimes short uniseriate tangential bands.



**D. arachnoideum** Bret. Gabon: *Breteler 6772, 6906.*

Vessels: diam. 60–140 µm; 13–23 per square mm; intervascular pits more than 4 µm; vessel-member length 500 µm.

Rays: homogeneous I or II; 2-4-seriate; height 1600 µm; 19 per mm.

**D. arenarium** Bret. Kenya: *Leeuwenberg 10804.*

Vessels: diam. 60 µm; 75 per square mm; vessel-member length 420 µm.

Rays: 3-seriate; height 1100 µm; 13 per mm.

**D. bangii** (F. Didr.) Engl. Zaïre: *Germain 8495.*

Vessels: diam. 80 µm; 25 per square mm; intervascular pits sometimes more than 4 µm; vessel-member length 410 µm.

Rays: height 2000 µm; 16 per mm.

**D. barbatum** Bret. Cameroun: *Bos 4318.*

Vessels: diam. 40 µm; 31 per square mm; vessel-member length 540 µm.

Rays: height 2000 µm; 12 per mm.

**D. barteri** Engl. Ghana: *de Wit and Hall*; Ivory Coast: *Breteler 6173.*

Vessels: diam. 40–60 µm; 38–60 per square mm; vessel-member length 330–470 µm.

Rays: 3-5-seriate (more than 10-seriate sometimes present); height 850–1800 µm; 12 per mm.

Parenchyma: sometimes also aliform.

**D. chalotii** Pellegr. Gabon: *Breteler 6798.*

Vessels: diam. 80 µm; about 40 per square mm; vessel-member length 460 µm.

Rays: 5-seriate (more than 10-seriate present); height 2000 µm; 13 per mm.

**D. choristilum** Engl. Cameroun: *Bos 4971*; Ivory Coast: *Leeuwenberg 3739.*

Vessels: diam. 130–200 µm; 18–25 per square mm; vessel-member length 450–530 µm.

Rays: 3-5-seriate (more than 10-seriate sometimes present); height 1200–2800 µm; 9–14 per mm.

**D. congoense** Engl. et Ruhl. Cameroun: *Breteler 2965*; Zaïre: *Louis 6372.*

Vessels: diam. 70–140 µm; 20–31 per square mm; intervascular pits also more than 4 µm; vessel-member length 430–470 µm.

Rays: 2-3- or 5-seriate (more than 10-seriate with a width of more than 100 µm sometimes present); height 1500 µm; 15 per mm.

Parenchyma: sometimes short uniseriate tangential bands.

Included phloem: sometimes present.

**D. crassifolium** Chod. Cameroun: *Breteler 2771*; Culta, Wageningen: *Breteler 7002.*

Vessels: diam. 90–160 µm; 12–22 per square mm; vessel-member length 470–620 µm.

Rays: height 2000 µm; 9–17 per mm.

**D. cymulosum** (Oliv.) Engl. Cameroun: *Bos et Breteler 3066*.

Vessels: diam. 80 µm; 50 per square mm; vessel-member length 390 µm.

Rays: 5-seriate (more than 10-seriate present); height 2500 µm; 17 per mm.

**D. dewevrei** De Wild. et Th. Dur. Gabon: *Breteler 6433, 6602*.

Vessels: diam. 70–90 µm; 20–28 per square mm; vessel-member length 380–510 µm.

Rays: height 1800–2000 µm; 14 per mm.

Included phloem: often present.

**D. dewildii** Bret. Cameroun: *J. de Wilde 7751*

Vessels: diam. 60 µm; 62 per square mm; vessel-member length 460 µm.

Rays: height 2000 µm; 16 per mm.

**D. dictyospermum** Bret. Ivory Coast: *Versteegh and Den Outer 720*.

Vessels: diam. 120 µm, large variation in size; about 40 per square mm; tylosis and deposits abundant; vessel-member length 360 µm.

Rays: 5-seriate (more than 10-seriate present); height 2000 µm; 14 per mm.

**D. eickii** Ruhl. Kenya: *Breteler 7508*.

Vessels: diam. 80 µm; 44 per square mm; intervascular pits more than 4 µm; vessel-member length 430 µm.

Rays: 3-seriate; height 2500 µm; 18 per mm.

**D. filicaule** Bret. Ivory Coast: *Versteegh and Den Outer 561*.

Vessels: diam. 65 µm; 70 per square mm; vessel-member length 320 µm.

Fibre tissue: tracheids.

Rays: heterogeneous I, 3-seriate; height 1800 µm; 14 per mm.

Parenchyma: scanty, vasicentric, diffuse or diffuse in aggregates.

**D. gabonense** Engl. Cameroun: *Zenker 871*.

Vessels: diam. 110 µm; 25 per square mm; vessel-member length 580 µm.

Rays: height 2500 µm; 13 per mm.

**D. germainii** Haum. Zaïre: *Germain 8566*.

Vessels: diam. 50 µm; 21 per square mm; vessel-member length 450 µm.

Rays: 3-seriate; height 1800 µm; 13 per mm.

**D. glomeratum** Engl. Cameroun: *Breteler 2877*; Zaïre: *Germain 8292*; *Louis 7572*.

Vessels: diam. 40–60 µm; 20–30 per square mm; vessel-member length 470–510 µm.

Rays: height 1700–2000 µm; 14–19 per mm.

**D. heudelotii** (Planch. ex Oliv.) Baill. Cameroun: *Breteler 2976*; Ivory Coast: *Leeuwenberg 3772, 7906*; *Versteegh and Den Outer 265*.

Vessels: diam. 120–180 µm; 17–34 per square mm; intervascular pits also more than 4 µm; vessel-member length 490–580 µm.

Fibre tissue: tracheids and sometimes non-septate, thick-walled libriform fibres.

Rays: 3-5-seriate (more than 10-seriate often present, sometimes with a width of more than 100  $\mu\text{m}$ ); height 1800–2000  $\mu\text{m}$ ; 12–14 per mm.

**D. hispidum** (Oliv.) Baill. Gabon: *Hallé 3779*.

Vessels: diam. 100  $\mu\text{m}$ ; 33 per square mm; intervascular pits more than 4  $\mu\text{m}$ ; vessel-member length 430  $\mu\text{m}$ .

Rays: 5-seriate; height 1800  $\mu\text{m}$ ; 12 per mm.

**D. insigne** Engl. Gabon: *Breteler 5787, 6759*.

Vessels: diam. 60  $\mu\text{m}$ ; about 40 per square mm; vessel-member length 390–440  $\mu\text{m}$ .

Rays: homogeneous II, composed of upright- and square cells; height 1800–2000  $\mu\text{m}$ ; 16–19 per mm.

**D. integripetalum** Engl. Gabon: *Breteler 5769, 6237*.

Vessels: diam. 50–80  $\mu\text{m}$ ; 22–30 per square mm; vessel-member length 440  $\mu\text{m}$ .

Rays: height 1800–2500  $\mu\text{m}$ ; 14 per mm.

**D. liberiae** Engl. et Dinkl. Liberia: *Versteegh and Jansen 776*.

Vessels: diam. 70  $\mu\text{m}$ ; 12 per square mm; vessel-member length 460  $\mu\text{m}$ .

Rays: homogeneous II, composed of upright- and square cells; 2-3-seriate; height 1300  $\mu\text{m}$ ; 19 per mm.

**D. liberiae** Engl. et Dinkl. Ivory Coast: *Breteler 5285; Versteegh and Den Outer 120, 727*.

Vessels: diam. 90–150  $\mu\text{m}$ ; 17–24 per square mm; vessel-member length 400–480  $\mu\text{m}$ .

Fibre tissue: tracheids and sometimes non-septate, thick-walled libriform fibres.

Rays: more than 10-seriate sometimes present; height 1200–1400  $\mu\text{m}$ ; 14–17 per mm.

Included phloem: present.

Pith flecks: sometimes present.

**D. librevillense** Pellegr. Gabon: *Breteler 6383, 6840*.

Vessels: diam. 40–160  $\mu\text{m}$ ; 15–30 per square mm; vessel-member length 410–500  $\mu\text{m}$ .

Rays: height 2000–2300  $\mu\text{m}$ ; 13–17 per mm.

**D. longitubulosum** Engl. Cameroun: *Bos 4185; Bos and Breteler 3060*.

Vessels: 50–100  $\mu\text{m}$ ; 23 per square mm; intervascular pits more than 4  $\mu\text{m}$ ; vessel-member length 370–420  $\mu\text{m}$ .

Fibre tissue: tracheids or tracheids and non-septate, thick-walled libriform fibres.

Rays: 2-3- or 5-seriate (more than 10-seriate present); height 1500–1800  $\mu\text{m}$ ; 15–17 per mm.

Pith flecks: sometimes present.

**D. lujaei** De Wild. et Th. Dur. Zaïre: *Germain 8494*.

Vessels: diam. 100  $\mu\text{m}$ ; 29 per square mm; vessel-member length 460  $\mu\text{m}$ .

Rays: heterogeneous II and/or homogeneous II; height 1300  $\mu\text{m}$ ; 17 per mm.

**D. madagascariense** Poir. Cameroun: *Bos* 7082; Ivory Coast: *Chevalier* 22504; *Versteegh and Den Outer* 179, 235, 383, 626; Ghana: For. Dept. Bangor; *Metcalfe* 85 (Oxford 12095).

Vessels: diam. 50–80 (160)  $\mu\text{m}$ ; (18) 36–65 per square mm; vessel-member length 360–540  $\mu\text{m}$ .

Fibre tissue: tracheids with or without non-septate, thick-walled libriform fibres.

Rays: 2-4-seriate (more than 10-seriate nearly always present); height 800–1200 (1800)  $\mu\text{m}$ ; 8–18 per mm.

Crystals: very seldom absent.

**D. minutiflorum** Engl. et Ruhl. Cameroun: *Breteler* 2465; Gabon: *Breteler* 6580.

Vessels: diam. 40–100  $\mu\text{m}$ ; about 40 per square mm; vessel-member length 540–580  $\mu\text{m}$ .

Fibre tissue: tracheids and sometimes non-septate, thick-walled libriform fibres.

Rays: 3-5-seriate (more than 10-seriate sometimes present); height 2500  $\mu\text{m}$ ; 13–15 per mm.

**D. mombuttense** Engl. Cameroun: *Breteler* 2113.

Vessels: diam. 70  $\mu\text{m}$  (young stem) but also 130  $\mu\text{m}$ ; 55 (young stem) but also 17 per square mm; intervascular pits also more than 4  $\mu\text{m}$ ; vessel-member length 350 (young stem)- 570  $\mu\text{m}$ .

Rays: 5-seriate (more than 10-seriate sometimes present); height 2500  $\mu\text{m}$ ; 9–16 (young stem) per mm.

**D. mundense** Engl. Cameroun: *Breteler* 2054 and 2979.

Vessels: diam. 110  $\mu\text{m}$ ; 33–40 per square mm; vessel-member length 420–540  $\mu\text{m}$ .

Fibre tissue; tracheids and sometimes non-septate, thick-walled libriform fibres.

Rays: 5-seriate (more than 10-seriate present); height 1800–2500  $\mu\text{m}$ ; 12–16 per mm.

Included phloem: sometimes present.

**D. ndongense** Engl. Gabon: *Breteler* 6962, 6984; Ser. For. Nogent.

Vessels: 50–110  $\mu\text{m}$ ; 18–26 per square mm; intervascular pits sometimes more than 4  $\mu\text{m}$ ; vessel-member length 460–520  $\mu\text{m}$ .

Rays: 5-seriate (more than 10-seriate sometimes present); height 1600–2500  $\mu\text{m}$ ; 13–16 per mm.

Parenchyma: sometimes short uni- or multiseriate tangential bands.

Included phloem: sometimes present.

**D. oblongum** (Hook f. ex. Bth.) Engl. Ivory Coast: *Thijssen* 288; *Versteegh and Den Outer* 711, 713.

Vessels: diam. 40–50  $\mu\text{m}$ ; 36–67 per square mm; vessel-member length 420–560  $\mu\text{m}$ ; sometimes slight spiral thickenings present.

Fibre tissue: tracheids and sometimes non-septate, thick-walled libriform fibres.

Rays: 2-seriate; height 700–1100  $\mu\text{m}$ ; 18 per mm.

**D. oliganthum** Bret., ined. Cameroun: *Bos and Breteler 3050*.

Vessels: diam. 55 µm; 44 per square mm; vessel-member length 400 µm.

Rays: 3-seriate; height 2000 µm; 19 per mm.

**D. pallidum** (Oliv.) Engl. Cameroun: *Breteler 2742*.

Vessels: diam. 120–150 µm; 25 per square mm; vessel-member length 440–500 µm.

Fibre tissue: tracheids and sometimes non-septate, thick-walled libriform fibres.

Rays: height 1500–1800 µm; 11 per mm.

**D. parvifolium** Engl. Cameroun: *Breteler 1275*; Ivory Coast: *Leeuwenberg 3998*.

Vessels: diam. 55–70 µm; 90–100 per square mm; vessel-member length 310–360 µm.

Rays: height 1800–2000 µm; 13–16 µm.

Parenchyma: sometimes short uniseriate tangential bands.

Included phloem: sometimes present.

**D. pedunculatum** (DC.) Baill. Surinam: *Van Donselaar 3085, Heyligers 470*.

Vessels: diam. 70–120 µm; 30–33 per square mm; intervacular pits also more than 4 µm; vessel-member length 440 µm.

Rays: height 1700 µm; 14–18 per mm.

Parenchyma: sometimes also aliform.

Pith flecks: sometimes present.

**D. reticulatum** Engl. Cameroun: *Zenker 782*.

Vessels: diam. 120 µm; 24 per square mm; vessel-member length 480 µm.

Rays: more than 10-seriate present; height 2000 µm; 12 per mm.

**D. rudatisii** Engl. Cameroun: *Bos 3255, 3349*.

Vessels: diam. 50–70 µm; 21–41 per square mm; vessel-member length 470–500 µm.

Rays: heterogeneous I and II; height 1300–2000 µm; 17 per mm.

**D. rugosum** (Vahl) Prance. Brasil: *Krukoff 8519*; Surinam: *Van Donselaar 3488*.

Vessels: diam. 180–240 µm; 12–15 per square mm; intervacular pits also more than 4 µm; vessel-member length 500–550 µm.

Fibre tissue: tracheids.

Rays: 3–5-seriate (more than 10-seriate present); height 2000–2500 µm; 10–12 per mm.

Parenchyma: sometimes also aliform.

**D. sp.** Bret., ined. Cameroun: *Bos 5073*.

Vessels: diam. 40 µm; 18 per square mm; vessel-member length 490 µm.

Rays: homogeneous I and II, composed of upright- and square cells; height 2000 µm; 16 per mm.

**D. staudtii** Engl. Cameroun: *Breteler 1350, 2705*; Zaïre: *Germain 8520*.

Vessels: diam. 70–180 µm; 15–47 per square mm; intervacular pits sometimes

more than 4 µm; vessel-member length 420–640 µm.

Fibre tissue: tracheids and sometimes non-septate, thick-walled libriform fibres.

Rays: 5-seriate (more than 10-seriate present); height 2000–2500 µm; 8–15 per mm; brown deposits.

**D. thollonii** Pellegr. Gabon: *Breteler 6473*.

Vessels: diam. 60 µm; 31 per square mm; intervascular pits more than 4 µm; vessel-member length 480 µm.

Rays: 5-seriate; height 1500 µm; 12 per mm.

Parenchyma: vasicentric and diffuse or diffuse in aggregates.

**D. tomentosum** Engl. Cameroun: *Breteler 1409*.

Vessels: diam. 100 µm; 29 per square mm; intervascular pits more than 4 µm; vessel-member length 460 µm.

Rays: height 2000 µm; 13 per mm.

Parenchyma: sometimes short uniseriate tangential bands.

Included phloem: present.

**D. toxicarium** (G. Don) Baill. Ivory Coast: *Leeuwenberg 3802, 3999; Versteegh and Den Outer 219*.

Vessels: diam. 70–160 µm; 14–28 per square mm; intervascular pits also more than 4 µm; vessel-member length 410–550 µm.

Rays: 3-5-seriate; height 900–1200 µm; 11–17 per mm.

**D. umbellatum** Chod. Zaïre: *Donis 2224*.

Vessels: diam. 90 µm; 20 per square mm; intervascular pits more than 4 µm; vessel-member length 560 µm.

Rays: more than 10-seriate present; height 2000 µm; 14 per mm.

Parenchyma: vasicentric, diffuse or diffuse in aggregates.

**D. unguiculatum** Engl. Zaïre: *Louis 2935*.

Vessels: diam. 80 µm; 41 per square mm; vessel-member length 430 µm.

Rays: more than 10-seriate present; height 2000 µm; 17 per mm.

Included phloem: sometimes present.

**D. sp. aff. D. unguiculatum** Engl. (see Breteler 1978) Gabon: *Breteler 6434, 6469*.

Vessels: diam. 110–200 µm; 11–22 per square mm; intervascular pits more than 4 µm; vessel-member length 450 µm.

Fibre tissue: sometimes non-septate, thick-walled libriform fibres.

Rays: 3-5-seriate: height 2000 µm; 10–13 per mm.

Pith flecks: present.

**D. zenkeri** Engl. Cameroun: *Bos 3580; Zaïre: Donis 2011*.

Vessels: diam. 50–90 µm; 24–29 per square mm; vessel-member length 500 µm.

Fibre tissue: tracheids and sometimes non-septate, thick-walled libriform fibres.

Rays: height 900–1500 µm; 11–13 per mm.

## 8. REFERENCES

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