THE SYSTEMATIC WOOD ANATOMY OF THE MORACEAE (URTICALES)
III. TRIBE FICEAE[1]

by

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Summary

The wood anatomy of the tribe Ficeae, comprising one genus, *Ficus*, is described. Considering the large number of species, the genus is remarkably homogeneous. It is characterised by abundant axial parenchyma in regular apotracheal concentric bands and narrow vasicentric rings, and by relatively wide vessels. On the basis of these characters, *Ficus* can easily be recognised within the family.

No correlation between wood anatomy and subgeneric classification as proposed by recent taxonomists could be established, and relationships between character variation and geographical and ecological distribution were hardly found.

Key words: Systematic wood anatomy, Moraceae, Ficeae, *Ficus*.

Introduction

This paper is part of a series, in which the wood anatomy of the Moraceae is described in detail and discussed in relation to the taxonomy of the family. For an outline of the project as well as for the chapter Material and Methods we refer to our first contribution (Koek-Noorman et al., 1984).

The tribe Ficeae in the concept of Corner (1962, and his unpublished Flora Malesiana account of 1972) and Berg (1983) consists of the sole genus *Ficus*. The only genus mentioned as a possible close relative of *Ficus* is *Sparattosyce*. Corner (1962) however, considered the similarities as a result of parallel developments.

Ficus is the largest genus of the family with about 700 species in the Australasian region, about 200 species in tropical Africa and about 200 species in tropical America. In his monograph of the Asiatic and Australasian species, Corner (1960, 1962) distinguished between four subgenera, *Urostigma* (Gasp.) Miq., *Pharmacosycea* (Miq.) Miq., *Sycomorus* (Gasp.) Miq., and *Ficus* L. Berg maintained this subdivision in his treatment of the Neotropical species (1975) and the African species (in preparation). All subgenera are represented in Asia, Australasia, and Africa; in tropical America only one section of subgenus *Pharmacosycea* and one of subgenus *Urostigma* are represented.

Within *Ficus*, a tremendous diversification in habit is found, varying from erect or strangling shrubs and lianas to free-growing or epiphytic trees. This variation is neither strictly correlated with the subgeneric division, nor with geographical distribution or habitat. Species of *Ficus* can be found in tropical rainforest, secondary growths and savannah.

Notwithstanding the strong variation in habit and habitat, found in all four subgenera, wood anatomically the species are similar in such a degree, that we decided to compile our data in one generic description.

Wood anatomy of Ficus L. (Figs. 1–8)

Material studied: While selecting the wood samples to be studied we aimed at a representative set of specimens. Nevertheless, due to the relatively few Asiatic species represented in the Utrecht wood collection a disproportionally high number of Neotropical and African samples was used.

Ficus albert-smithii Standl. Brazil, Amazonas: Prance & Berg 17966 (Uw 20878); Guyana: A.C. Smith 3651 (Uw 21708). – *F. broadwayi* Urban. Surinam: Lindeman & Stoffers 464 (Uw 21826). – *F. cabalina* Standl. Brazil, Amazonas: Krukoff 6446 (Uw 7732). – *F. calimana* Dugand. Colombia, Chocó: Cuatrecasas 16648 (Uw 25219). – *F. callosa* Willd. Philippines: FB 17540 (Uw 24221). – *F. carica* L. Syria: W.v.Zeist s.n. (Uw 25998); U.S.A. (cult.): A.F. Wilson T-47 (Uw 10200), US Nat. Herb. s.n. (Uw 7415). – *F. citrifolia* P. Miller. Surinam: Lanjouw & Lindeman 1075 (Uw 1380). – *F. clusiaefolia* Schott in Sprengel. Surinam: Lindeman 5425 (Uw 3768). – *F. ernestiana* Pitt. Surinam: Lanjouw & Lindeman 477 (Uw 1249), Lindeman 5702 (Uw 3914). – *F. glau-*

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cescens (Liebm.) Miq. Guyana: For. Dept. 4538 (Uw 984). – *F. glumosa* Delile. Angola: Dechamps et al. 1098 (Uw 23512), 1167 (Uw 23416). – *F. insipida* Willd. Venezuela: J. de Bruijn 1666 (Uw 22633); Brazil, Paraná: Lindeman & de Haas 2131 (Uw 13523). – *F. maxima* P. Miller. Brazil, Amazonas: Krukoff 6413 (Uw 7706); Surinam: Lanjouw & Lindeman 1468 (Uw 1498). – *F. natalensis* Hochst. South Africa: H. Baijnath s.n. (Uw 25512, 25513). – *F. nodosa* Teijsm. & Binn. Indonesia, Irian Jaya: BW 11827 (Uw 18152). – *F. nymphaeafolia* P. Miller. Brazil, Amazonas: Maguire et al. 48182 (Uw 16929), Prance & Berg 18443 (Uw 20909); Surinam: Lindeman 5612 (Uw 3880). – *F. platyphylla* Delile. Togo: Kersting 25 (Uw 25819). – *F. racemosa* L. Pakistan: Matundar & Islam 72 (Uw 24226), US Nat. Herb. 24513 (Uw 18041). – *F. retusa* L. Sri Lanka: For. Dept. s.n. (Uw 24059). – *F. septica* Burm. f. Indonesia, Sumatra: Krukoff 4084 (Uw 25821). – *F. sur* Forssk. Togo: Kersting 48 (Uw 25816); Angola: Dechamps 1185 (Uw 23447), 1520 (Uw 23511). – *F. sycomorus* L. South Africa: Bosnavorsingsinst. Pretoria IND 2257 (Uw 22022); Angola: Dechamps 1471 (Uw 23480). – *F. thonningii* Bl. South Africa: H. Baijnath s.n. (Uw 25502, 25503, 25504). – *F. variegata* Bl. Philippines, Quezon: Justo P. Rojo 227 (Uw 24227). – *F. werckleana* Rossberg. Costa Rica: Ilca CCO-32 (Uw 20669).

General features. Growth rings faint or absent; heartwood absent or indistinguishable from the cream to light brown coloured sapwood. Texture medium to coarse; grain straight or interlocked. Specific gravity 250–760 N per cubic metre.

Microscopical features. Vessels diffuse, solitary (10–80%) and in short radial multiples and irregular clusters of 2–4, 2–12 per sq.mm, round and oval, diameter 85–265 μm, average vessel member length 275–580 μm. Perforations simple, end walls almost transverse. Intervascular pits alternate; round, oval to polygonal, 6–12 μm. Vessel-ray and vessel-parenchyma pits larger and irregularly shaped, sometimes tending to scalariform, half-bordered or with much reduced borders, especially in weakly procumbent to upright cross-fields, sometimes unilaterally compound. Tyloses, if present, thin-walled. Fibres non-septate except for two samples of *F. natalensis* and two samples of *F. sur*, in which species part of the fibres is septate; pits small, restricted to the radial walls; walls 2–4 μm, lumina 10–25 μm; length 945–1760 μm; F/V-ratio 2.5–4.7. Gelatinous fibres in varying amounts present in all subgenera. Rays uniseriate and multiseriate, 3–7 per mm. Uniseriate rays 3–30%, composed of few rows of procumbent and many rows of upright cells. Height 2–9 cells (140–455 μm). Multiseriate rays composed of procumbent cells, except for the uniseriate margins of 1–2 (9) rows of square and/or upright cells and few sheath cells in some of the rays; 3–9 (12) cells wide, up to 315–890 μm high. Parenchyma abundant; apotracheal in regular concentric bands of 3–15 cells wide, 1–3 bands per mm; paratracheal in narrow rings of vasicentric parenchyma. Strands of 4–6 (10) cells, the cells often more or less square as seen in radial and tangential section. Rhombic crystals are of variable occurrence in ray margins and axial parenchyma, rarely in regular vertical rows. Radial latex tubes mostly present but commonly very few; the diameter as seen in tangential section varying from equal to that of the surrounding ray cells, to nearly as wide as the (multiseriate) ray.

Discussion

It is evident from the description given here, that the wood anatomy of the many samples studied is surprisingly homogeneous, taken into account the wide variation in habit and habitat, and the large number of species. If compared with the variability within other moraceous genera, no features with an exceptional or unlikely variation were found. On the contrary, most characters vary within narrow limits. An attempt to relate the present variation in vessel characters, F/V-ratio, pit-size, ray width, and number and width of parenchyma bands to the generic subdivision, lead to the conclusion that the variation in all characters is neatly distributed over the four subgenera. In the same way it proved to be impossible to correlate character variation and geographical distribution.

The data on the vegetation types of the localities of our specimens are very scanty. Thus an elaborate comparison with respect to altitude and moisture condition is not possible. However, most specimens were collected in tropical lowland areas. The specimen of *Ficus calimana* was collected in the extremely wet Chocó, Colombia (with an annual rainfall app. 8000 mm), and completely fits within the generic description. If we consider, in contrast, the data provided by Baas et al. (1983) (see Table 1) on the vessel characters of *F. pseudo-sycomorus* and *F. sycomorus* found in the dry areas of the Middle East, we see that their data given for *F. sycomorus* are more or less similar to our data for this species. For *F. pseudo-sycomorus*, they found vessel member lengths comparable with the shortest values found by us within the genus (see the generic description). The diameter of the narrowest vessels (40 μm) is considerably lower and the frequency higher (25

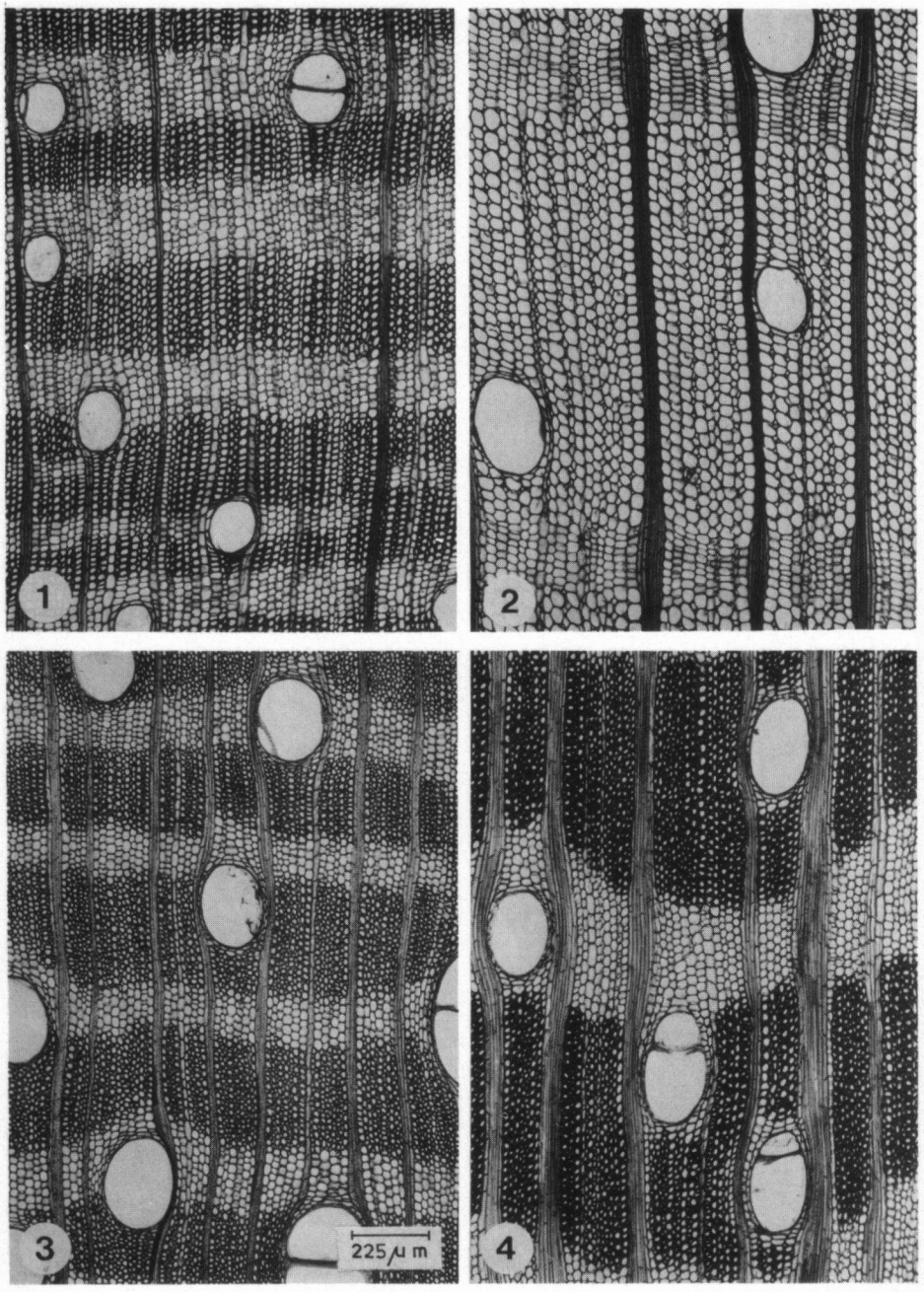

Fig. 1. *Ficus maxima*, Uw 1498. — Fig. 2. *F. nodosa*, Uw 18152. — Fig. 3. *F. clusiaefolia*, Uw 3768. — Fig. 4. *F. sur*, Uw 23447.

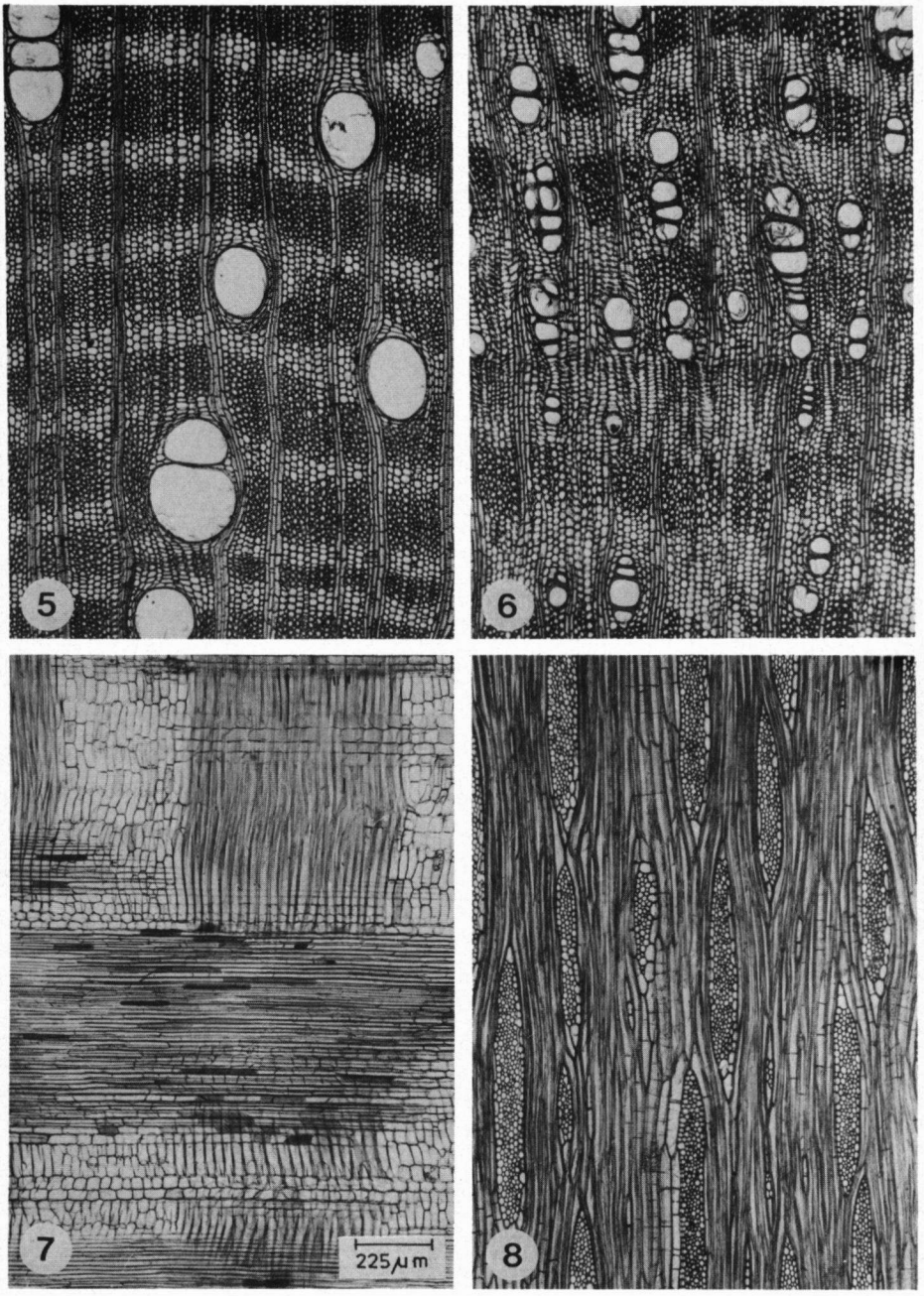

Fig. 1. *Ficus albert-smithii*, Uw 20878. — Fig. 6. *F. carica*, Uw 10200 (cult.; juvenile sample). — Fig. 7 & 8. *F. sur*, Uw 23447.

Table 1. Some vessel characters in selected species of *Ficus*.

	Vessel diameter (μm) average	min.	max.	Vessel frequency (sq.mm)	Vessel member length (μm) average
Ficus					
(material studied for this paper)		85	265	2–12	275–580
F. calimana					
(Colombia, very mesic locality)	180	145	215	3	390
F. carica					
(U.S.A., cult.*)	115	85	145	7–10	275
F. sycomorus					
Angola	170	145	205	3	395
Israel**		95	240	5	490
F. pseudo-sycomorus					
Israel**		40	200	25	270

*: probably from fairly dry localities; **: data from xeric species taken from Baas et al. (1983).

per sq.mm) if compared with our data for mature samples, but the maximum value for vessel diameter, again, fits within our generic descriptions. On the other hand, quantitative data for *F. pseudo-sycomorus* fit well with those for the more or less juvenile specimen of *F. carica*, pictured in Fig. 6 (vessel diameter 45–90 μm). Relevant here is the discussion by Baas et al. (1983) on 'the lack of any provisions for extra safety in the tropical species growing in the desert'. These three examples suggest that within the genus *Ficus* the wood anatomical structure is hardly influenced by ecological conditions, contrary to some trends concerning element length, diameter end frequency, found repeatedly in other families (see, for instance, Baas 1982, and many references given there).

The features by which *Ficus* is characterised wood anatomically within the Moraceae are:

- few and large vessels;
- (nearly) exclusively non-septate, libriform fibres;
- rays heterogeneous Kribs type III, sometimes tending towards heterogeneous Kribs type II or homogeneous;
- parenchyma in long, continuous, 3–15 cells wide, apotracheal bands; the individual cells rather short in axial direction, sometimes tending towards an isodiametric shape;
- rhombic crystals often present, often in marginal ray cells and axial parenchyma.

In particular the parenchyma bands, often taking up 25–50% of the transverse section, are conspicuous. They are rarely found elsewhere in the Moraceae. Up till now, we found comparable bands in samples of *Batocarpus* and *Streblus* only. We will return to this point in one of the forthcoming papers. For the time being, we support the isolated position of the genus as indicated by the recognition of the tribe Ficeae (Corner, 1962; Berg, 1975, 1983).

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