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Wood anatomy of Cuban species of *Leptocereus* (*Cactaceae*)

Abstract

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Leptocereus, a genus with its centre of diversity in Cuba, has about five different assemblages of species based on floral features. However, flowers are not always available when identifying plants. Considering wood as a conservative tissue and its previous contributions to the taxonomy and systematics of flowering plants, the wood anatomy of *L. arboreus* and *L. scopulophilus* is described and compared with other species of the genus. In wood anatomy, *L. arboreus*, from central Cuba, differs from the western species by the presence of scalariform intervessel pits, a feature also reported for *L. quadricostatus*, a species of Puerto Rico and the British Virgin Islands. This fact might indicate that *L. arboreus* is probably more similar to the eastern species of the genus. *Leptocereus scopulophilus* is characterized by the predominance of septate fibres and solitary vessels. All the studied Cuban species of *Leptocereus* have druses in ray cells, a distinct characteristic in *Cactoideae*.

Additional key words: cacti, druses, paedomorfic rays, Caribbean, West Indies

Introduction

Leptocereus (Berger) Britton & Rose comprises about a dozen allopatric and rather distinct species, whose combined distribution extends in an arc from Cuba through Hispaniola to Puerto Rico and Culebra (Areces-Mallea 1993a). Cuba is the centre of diversity of this genus with 11 species recorded (Alain 1953; Areces-Mallea 1992, 1993a, b). Outside Cuba only four species have been described (Anderson 2001).

Even though these species have some differences in their vegetative organs, their identification has been based mostly on reproductive structures in the identification keys of Alain (1953) and Areces-Mallea (1992). Additionally, floral characters support no less than five different assemblages of allopatric species within the range of the genus in the West Indies according to Areces-Mallea (1993a). One of them is formed by *Leptocereus assurgens* (C. Wright & Griseb.) Britton & Rose, *L. ekmanii* (Werderm.) F. M. Knuth and *L. prostratus* Britton & Rose, species of W Cuba (Pinar del Río) characterized by bright yellow flowers (Areces-Mallea 1993a). Another group of related species in NW Cuba is formed by *L. leonii* Britton & Rose, *L. scopulophilus* Areces and *L. wrightii* León, with pinkish flowers. Nevertheless, it should be taken into account that flowers are not always available in the field, especially for this genus where variations in the extent and abundance of the flowering season have been observed. Therefore, it is important to include vegetative organs in an identification key for *Leptocereus* species.

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Table 1. Vessel element features of *Leptocereus* species.

	L. arboreus	***L. assurgens***	***L. leonii***	***L. quadricostatus***	***L. scopulophilus***	***L. wrightii***
Vessel element length average [µm]	303	117	244	316	237	268
Longest vessel element [µm]	390	305	305	–	290	360
Vessel diameter average [µm]	43	53	70	45	38	58
Widest vessel [µm]	54	71	96	–	50	79
Ray width range [number of cells]	5–9	4–17	6–13	8–10	5–8	3–11
Geographic distribution	C Cuba	W Cuba	W Cuba	Puerto Rico and British Virgin Islands	W Cuba	W Cuba
Habitats	coastal thickets	limestone hills	limestone hills	coastal thickets	limestone hills	coastal thickets

On the other hand, wood has long been viewed as a conservative tissue (Metcalfe & Chalk 1988) and a potential source of systematically informative characters (Herendeen & al. 1999). In the present study, the wood anatomy of *Leptocereus arboreus*, from central Cuba, and *L. scopulophilus* is described and compared with similar data for *L. assurgens*, *L. leonii* and *L. wrightii* (Gibson 1973) as well as data for the non-Cuban species *L. quadricostatus* (Mauseth & Ross 1988). The value of wood anatomy in *Leptocereus* for grouping species and its contribution to their identification is also analysed.

Material and methods

Wood samples of more than 2 cm long and 1.5 cm in diameter were taken from a mature branch of an individual of *Leptocereus arboreus* near to the Yaguanabo river estuary, Cienfuegos, and from a dead trunk of an individual of *L. scopulophilus* at the Pan de Matanzas. Sampling was limited by the fact that the two species are Endangered EN B1ab(iii) and Critically Endangered CR B1a b(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v), respectively, with reduced populations (Taylor & al. 2013), so the present study considered mainly wood anatomical qualitative features.

Samples were processed by standard techniques in anatomy (Peña & Saralegui 1982; Montenegro & Gómez 1997). Semi-permanent preparations stained with safranine 1 % were made for both species. Descriptions of qualitative anatomical characters were made according to the nomenclature of the IAWA Committee (1989). Vessel element length and vessel diameter were measured with a light microscope graduated lens. Anatomical characters with diagnostic value were selected. Photomicrographs were taken using a digital camera attached to the microscope.

The anatomical comparison with other species of the genus included data of the wood anatomy of *Leptocereus assurgens*, *L. leonii* and *L. wrightii* taken from Gibson (1973) and of *L. quadricostatus* taken from Mauseth & Ross (1988).

Results and Discussion

Leptocereus arboreus Britton & Rose

Growth rings indistinct. Wood diffuse-porous. Vessels in radial pattern, 50 % solitary, in radial multiples (Fig. 1A) of 2 vessels (up to 4 vessels) and clusters of 4 vessels. Simple perforation plate. Alternate to mostly pseudoscalariform intervessel pits, elliptic to oblong, frequently elongate oblong. Pseudoscalariform to scalariform vessel-ray pits, elliptic to elongate oblong, with much-reduced borders to apparently simple, similar to the intervessel ones. Scalariform vessel-parenchyma pits (Fig. 2A), elongate oblong, with distinct borders, in general similar to the intervessel ones. Axial parenchyma scanty paratracheal, up to 4 cells per parenchyma strand; apotracheal parenchyma diffuse. Nonseptate fibres present (Fig. 1B), occasionally septate fibres, with simple to minutely bordered pits; pits common in both radial and tangential walls. Multiseriate rays of 5–9 cells wide (Table 1), up to 57 cells high; all ray cells upright and square (Fig. 1C). (Pith was lost during histological procedures.)

Leptocereus scopulophilus Areces

Growth rings indistinct. Wood diffuse-porous. Vessels in radial pattern, 74 % solitary (Fig. 1D), occasionally in radial multiples of 2 or 3 vessels and clusters of 3–5 vessels. Simple perforation plate. Alternate to pseudoscalariform intervessel pits, elliptic to oblong. Alternate vessel-ray pits, elliptic to mostly elongate oblong, with distinct borders, different to the intervessel ones. Scalariform vessel-parenchyma pits, elongate oblong, with distinct borders, different to the intervessel ones. Axial parenchyma scanty paratracheal, up to 5 cells per parenchyma strand; apotracheal parenchyma diffuse. Septate fibres

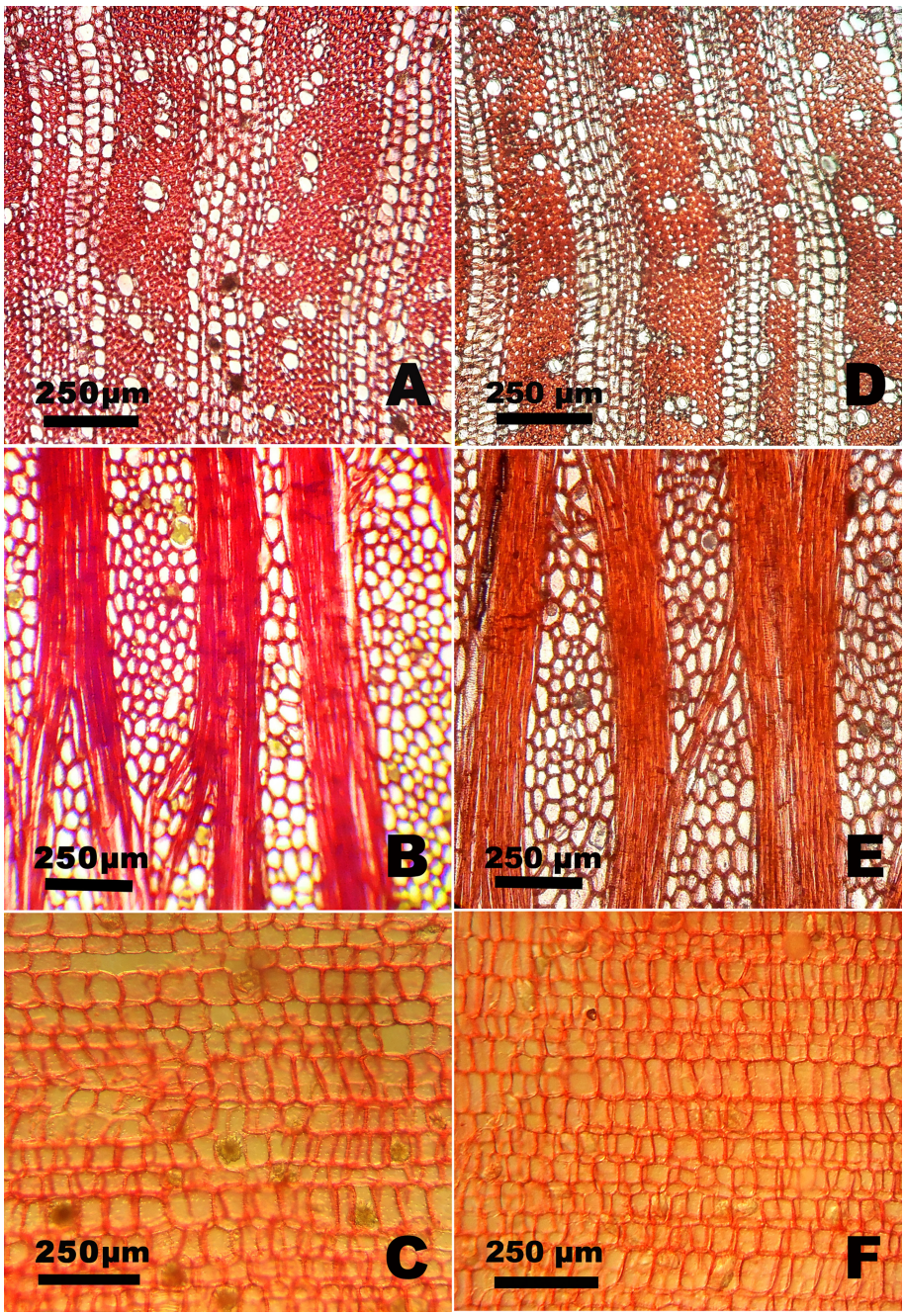

Fig. 1. Wood sections of *Leptocereus arboreus* (A–C) and *L. scopulophilus* (D–F). – A, D: cross-section; B, E: tangential section; C, F: radial section.

present (Fig. 2B), with simple to minutely bordered pits; pits common in both radial and tangential walls. Multiseriate rays of 5–8 cells wide (Fig. 1E), up to 48 cells high; all ray cells upright and square (Fig. 1F). (Pith was lost during histological procedures.)

These species of *Leptocereus* are very similar in wood anatomy (Table 1), which agrees with Gibson (1973). Nevertheless, some features allowing the identification of species can be pointed out, such as the predominance of septate fibres in *L. scopulophilus* and the predominance of scalariform intervessel pits in *L. arboreus* and *L. quadricostatus* (see Mauseth & Ross 1988), while in the rest of the species the transitional to alternate intervessel pitting pattern predominates, except for *L. wrightii* where it is exclusively alternate according to Gibson (1973).

There are also preliminary quantitative differences in the wood anatomy of the genus. For the Cuban species, *Leptocereus arboreus* showed the longest vessel elements, as opposed to *L. assurgens* with the shortest ones, with average lengths of 303 µm and 117 µm, respectively (Table 1). It should be remarked that the length of the vessel elements supports the group with pinkish flowers formed by *L. leonii*, *L. scopulophilus* and *L. wrightii*, with average lengths ranging from 237–268 µm (Table 1). Vessel diameter shows extreme values in *L. leonii* and *L. scopulophilus*, with averages of 70 µm and 38 µm, respectively (Table 1). This feature has been regarded as closely related to the environment (Baas 1982; Metcalfe & Chalk 1988); however, both species grow on limestone hills with similar environmental conditions, and nevertheless the vessels of *L. leonii* have almost twice the width of those of *L. scopulophilus*. The rest of the species have intermediate values. Despite these differences, further studies are needed involving a greater number of individuals per species in order to re-evaluate the diagnostic value of these quantitative characters.

Druses were abundant in the ray cells of all Cuban species studied (Fig 1B, C, E). The presence of these crystals is distinctive within *Cactoideae* according to Gibson (1973), as well as the presence of paedomorphic rays (Fig. 1C, F).

In general, *Leptocereus arboreus* differs from the western species by the presence of scalariform intervessel pits, which are also present in the species of Puerto Rico and the British Virgin Islands, *L. quadricostatus*, according to Mauseth & Ross (1988). This suggests that

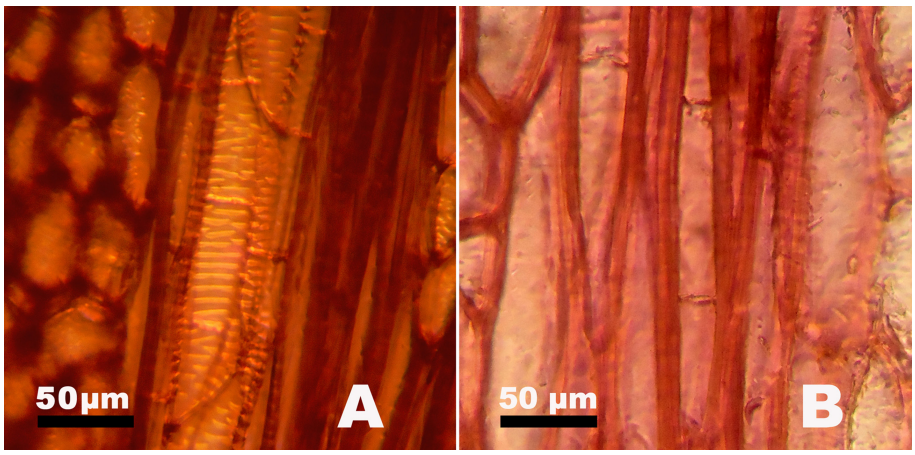

Fig. 2. Tangential sections with scalariform vessel-parenchyma pits of *Leptocereus arboreus* (A) and septate fibres of *L. scopulophilus* (B).

L. arboreus is probably more related to the eastern species of the genus. Further studies on this topic should be able to evaluate this hypothesis.

Conclusions

Wood anatomical features could be used for grouping species of *Leptocereus*.

Preliminarily such features for the identification of the Cuban species of the genus are: the type of intervessel, vessel-ray pits and type of fibres.

Acknowledgements

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