XYLEM ANATOMY OF DIEGODENDRON HUMBERTII

by

William C. Dickison

Department of Biology, University of North Carolina, Chapel Hill, N.C. 27599, U.S.A.

Summary

The first description of the wood of the monotypic Madagascan genus Diegodendron is provided. The xylem of D. humbertii is characterised by short, solitary vessel elements with alternate lateral wall pitting and simple perforation plates, imperforate tracheary elements of the libriform fibre type, nearly all biseriate, imperfectly storied, homogenous rays composed of procumbent cells only, and diffuse and diffuse-in-aggregates axial parenchyma. The specialised wood anatomy of Diegodendron supports a close alliance with both Sphaerosepalaceae and Malvales.

Key words: Diegodendron, wood anatomy, Sphaerosepalaceae, Malvales.

Introduction

The genus Diegodendron was initially described and recognised as a distinct family by Capuron in 1963, and is represented by a single species (D. humbertii R. Capuron). The monospecific Diegodendraceae are confined to Madagascar, where plants are either shrubs or small trees, having simple, alternate leaves and intrapetiolar stipules that surround the terminal bud. Bisexual flowers are borne in terminal panicles and have numerous stamens, a 2- or 3-carpellate gynoecium with a gynobasic style, and two ascending ovules in each locule. As described by Capuron (1965), the fruit is composed of 1–3 dry, coriaceous mericarps. Although the genus is widely regarded as having general ochnalean or thealean affinities, little has been written about the taxonomy and morphology and anatomy is almost totally unknown. The xylem has not been described.

Hutchinson (1973) placed the Diegodendraceae in the Ochnales, along with the Ochnaceae, Lophiraceae, Sauvagesiaceae, Strasburgeriaceae, Quinaceae and Scytopetalaceae. Goldberg (1986) classified the Diegodendraceae between the Strasburgeriaceae and Sphaerosepalaceae in the Theales. Cronquist (1981) preferred to merge the genus within a broad concept of the Ochnaceae (also including the Lophiraceae, Luxemburgiaceae, Strasburgeriaceae, Sauvagesiaceae, and Malvaceae). Straka and Albers (1978) concluded from a study of pollen morphology that a position near Ochnaceae cannot be negated. Thorne (1983) believed that available evidence suggested treatment as a monotypic subfamily Diegodendroideae in Sphaerosepalaceae. In commenting on the genus, Airy Shaw (in Willis 1973) remarked, “Probably related to Sphaerosepalaceae, differing from them in the glandular-punctate leaves, pentamery, and outward-facing micropyle of the ovules. The conspicuous development of the disk in Rhopalocarpus constitutes another part of difference. The aspect of the twigs, leaves, stipules, and stipular scars is strongly reminiscent of Irvingia and its immediate allies.”

This study was undertaken in order to provide another approach toward assessing the relationships of the genus.

Materials and Methods

The specimen described here represents a piece of mature wood of Diegodendron humbertii R. Capuron obtained from the Centre Technique Forestier Tropical (CTFT 14338) with accompanying herbarium voucher SF 18964. This specimen was collected in the Arkarana forest in the vicinity of Diego Suarez, Madagascar. The sample was boiled in water and cut on a sledge microtome at a
thickness of 20 µm. Resulting sections were stained with saffranin. Data relating to wood cell length were obtained by making 50 measurements from macerations prepared using Jeffrey’s fluid. Cell diameters were measured from transverse sections and include walls.

Generic wood anatomical description

Wood hard, very dense. Growth rings are weakly differentiated by a narrow zone of closely spaced, uniseriate tangential lines of axial parenchyma at the boundary of a growth increment (Fig. 1). Vessels are diffuse and exclusively solitary, often filled with solid, amorphous deposits (Fig. 1). Average pore density is 86 per sq.mm. Pores are rounded in outline and tangential pore diameters are mostly very small, ranging from 17–45 µm, with an average of 35 µm. Mean vessel wall thickness is about 3 µm. Vessel elements are mostly short, ranging from 192–293 µm in length, with a mean of 237 µm. Perforations are exclusively simple in slightly inclined to transverse end walls.

Intervascular pitting is noncrowded and predominantly alternate. Lateral wall pits are less than 3 µm in diameter. Vessel-ray pitting is the same. Ground tissue is composed of thick-walled to very thick-walled imperforate tracheary elements with minute pits that are either simple or provided with inconspicuous borders. Elements are, for all practical purposes, of the libriform fibre type. Pitting is present on both radial and tangential walls. Fibres are short to medium-sized, ranging in length from 525–1292 µm, with an average of 975 µm. Mean wall thickness is 4.5 µm. Axial parenchyma is aprotachal diffuse and diffuse-in-aggregates, occurring as isolated elements and in short to long, discontinuous or continuous, irregularly spaced, wavy aggregations from ray to ray (Fig. 2). Parenchyma lines sometimes interconnect as seen in cross section and contact the pores. Axial parenchyma cells are filled with dark staining deposits. Rays are nearly all biseriate, with exclusively uniseriate rays scarce. Rays are homogeneous and imperfectly storied as seen on the tangential surface (Fig. 3). Rays are composed of moderately thick-walled cells that are exclusively procumbent. Elongate marginal extensions are absent. Mean height of biseriate rays is 13 cells. Ray parenchyma is filled with dark-staining deposits. Solitary prismatic crystals are frequently present in ray cells.

Discussion

There is wide concensus, based upon available evidence, that *Diegodendron* has theoid affinities, although the question of whether the genus deserves familial status, and if not, to which existing family it should be assigned, is unsettled. Wood anatomy offers additional points of comparison.

The wood of *Diegodendron*, when compared with thealean families, is seen as structurally rather specialised. The combination of short, nearly all biseriate, homogeneous and imperfectly storied rays, libriform fibres, and mostly short vessel elements with alternate intervacular pitting and simple perforation plates represent a suite of advanced characters that are exceptional for the Theales. As noted by Carlquist (1988), however, differences in perforation plate type among theoid taxa may not be significant in assessing relationships, as this feature is undoubtedly related to the physiology of conductance. By way of comparison, the monotypic family *Strasburgeria*-ceae from New Caledonia are distinguished by a decidedly less advanced xylem structure. *Strasburgeria* possesses mostly solitary, long and angular vessel elements with a high number of scalariform bars. Intervascular pits are opposite. Ground tissue is composed of long fibre-tracheids with prominent bordered pits. Ray tissue is distinctly heterogeneous with both uniseriate and multiseriate rays present. Crystals are absent (Dickison 1981).

As broadly circumscribed, the Ochnaceae are wood anatomically rather diverse, being characterised by extremely small to rather large pores that are solitary, or distributed in pore clusters, or radial, or tangential pore multiples. Pores range from angular to circular in transsectional outline and individual vessel elements range in length between very short and extremely long. Perforation plates are simple in most genera, however, both simple and scalariform plates occur in some taxa. Intervascular pitting is alternate. Imperforate tracheary elements are fibre-tracheids, often septate. Fibres range in length between
very short and long. Rays are heterogeneous, of either the I or IIA types of Kribs (1935), or, infrequently homogeneous. Crystals are often present in ray parenchyma. Axial parenchyma varies from vasicentric and diffuse, diffuse-in-aggregates, or reticulate, sometimes metatracheal in distribution (Metcalf & Chalk 1950; Decker 1966). Although many xylem features of Diegodendron fall within the range of variation of Ochnaceae, as a member of the family the genus is structurally somewhat discordant. Homogeneous rays are unusual in ochnaceous plants, occurring only in Lophira and Tyleria, and the storied ray condition represents a distinct specialisation apparently unknown for the family (Decker 1966). Furthermore, Diegodendron combines characteristics of the two ochnaceous subfamilies. The genus lacks vestured pits like subfamily Albuminosoideae, but possesses nonseptate fibres and vessel-ray pitting similar to intervascular pitting like subfamily Exalbuminosoideae.

It can now be confirmed that the wood anatomy of Diegodendron closely approximates that of the Madagascan family Sphaerosepalaceae. The two taxa form a homogenous structural group that share the following features: short, solitary vessel elements with minute lateral wall pits and simple perforation plates, an identical distribution of axial parenchyma, and often short rays of similar histology. There is little difference in vessel element length (Keating 1968). Rays of the Sphaerosepalaceae range from narrow to very wide and are frequently transitional between heterogeneous and homogeneous with a tendency toward storying. Homogeneous rays are composed of procumbent cells. Huard (1965) described a phylogenetic and ontogenetic progression in ray structure among species of Sphaerosepalaceae from heterogeneous to homogeneous, that is also accompanied by the elimination of uniseriate rays. The occurrence of nearly entirely biseriate, homogeneous, and storied rays in Diegodendron can be viewed as the culmination of this trend. The two taxa are held apart by the relatively minor characters of imperfect tracheary elements being fibre-tracheids in Rhopalocarpus as opposed to what are essentially libriform fibres in Diegodendron, and the fact that rhombohedral crystals are present in the axial parenchyma of Rhopalocarpus whereas crystals are restricted to the ray parenchyma in Diegodendron.

The data from wood anatomy lend additional support to the interpretation that Diegodendron (and Sphaerosepalaceae) are closely related and perhaps transitional to the Malvalves (Cronquist 1981). The presence of storied rays is an unknown feature within the Theales, whereas this character state is found in a number of advanced members of the Malvaceae and other malvalean families. Both groups have imperforate tracheary elements with simple pits or inconspicuous borders.

In summary, wood anatomy strengthens the generic distinctiveness of Diegodendron. Until more evidence becomes available from other parts of the plant it seems most prudent to assign Diegodendron to a position in or very near the Sphaerosepalaceae.

Acknowledgements

I am grateful to M. Pierre Détienne, Chief of the Division of Wood Anatomy, Centre Technique Forestier Tropical, Nogent-sur-Marne, France for kindly providing me with the wood specimen used in this study.

References