Comparative morphology and taxonomic value of foliar sclereids in *Garrya* Dougl. ex Lindley (Garryaceae)

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Abstract. A topographic survey of the laminae of *Garrya* has revealed that sclereids are present only in 14 taxa and they conform to polymorphic groupings. The usefulness of sclereids in the provisional identification, nomenclatural changes and taxonomic status has been discussed.

Keywords. Foliar sclereids; typology; *Garrya*.

1. Introduction

Garryaceae is a monogeneric family with 17 species (Eyde 1963) distributed in North America, island of Jamaica and eastern portions of Cuba.

According to Metcalfe and Chalk (1950) the mesophyll has multiple palisade layers, and sclerenchymatous idioblasts of varying shape and wall-thickness in different species. Recently Paliwal and Kakkar (1970) have reported three types of leaf sclereids in 5 species of *Garrya*. Further the endomorphic features of many species of *Garrya* are summarised by Dahling (1978), recently. However, the data published so far on sclereids appear inadequate to determine the taxonomic range of this character within this genus notwithstanding the enumeration of several distinct characters for maintaining the family status (Dahling 1978).

2. Materials examined

The materials for this investigation were procured from the following herbaria (symbols according to the recent edition of the Index Herbariorum, Holmgren and Keuken 1974) : Herbarium of the Komarov Botanical Institute of the USSR Academy of Sciences, Leningrad (LE); Central National Herbarium (CAL), Botanical Survey of India, Howrah, India; The Gray Herbarium and the Arnold Arboretum of Harvard University (GH), Cambridge, Mass, U.S.A.; Dudley Herbarium, Natural History Museum, Stanford University (DS), Stanford, California, USA.
The names of the taxa studied are arranged in alphabetical order. An asterisk preceding the plant name indicates that it is a re-examination of the same plant, but not necessarily the same specimen already investigated by earlier authors.

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3. Observations


In the clear lamina the sclereids are either present or absent. When present, they exhibit diffuse distribution; in a few cases they occur close to the vein-endings. The seemingly terminal or sub-terminal appearance of sclereids needs confirmation from ontogenic studies, as already stressed by Rao (1951). The varied types of sclereids observed, have been classified after Rao and Bhupal (1973).

3.1. Typology

Sclereids in the majority of the taxa conform to a central rod-like axis branching at one end or both the ends, giving rise to rhizosclereids or raniform sclereids of varied sizes and base forms. They have narrow lumina and a thick striated cell wall. They have short branches with rounded ends. The following features are recorded from the lamina of:

(i) G. ovata Benth. (Pringle 131, LE) T-shaped or ramiform sclereids branching at adaxial pole, vertical in disposition, interspersed in palisade tissue in the form of idioblasts (figures 1, 2).

(ii) G. elliptica Doug.l. (Douglas 18833, LE). Ramiform T-shaped sclereid vertically disposed in the palisade tissue. Branching is profuse at the adaxial end while the abaxial end is drawn out considerably. The arms have irregularly convoluted outline and the resulting body appears to be very peculiar (figures 3, 4).
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Figures 3–4. 3. Transection of *G. elliptica* Dougl. (Douglas 18833, LE) showing T-shaped sclereids. 4. Macerated portion of the lamina showing profusely convoluted outline of short arms of sclereids.
Figures 5–6. 5. Transection of lamina of *G. veatchii* Kell. var. *palmeri* (Abrams 2805, LE) sclereids disposed in the palisade region. 6. Sclereids from the lamina showing crookedly curved or with convoluted knobs of peculiar shape.
(iii) *G. veatchii* Kell. (McGregor 1076, DS) and *G. veatchii* Kell. var. *palmeri* (Abrams 2805, LE) (figures 5, 6). Rhizosclereids and ramiform sclereids dominate in the palisade region. Sclereids are relatively thick and very conspicuous. A few sclereids of twisted rod-like body with convoluted outline have also been noted. The thick cell wall is striated and the lumen is of irregular width. Paliwal and Kakkar (1970), however, grouped sclereids of *G. veatchii* Kell. under stellate-polymorphic type. The presence of terminal or sub-terminal sclereids in the cleared lamina is probably of chance occurrence in the vicinity of vein-endings. However, this needs ontogenic study.

(iv) *G. rigida* Eastwood (Baker 3168, LE). Ramiform sclereids fork at the poles. The main axis often shows a small protuberances. Sclereids occupy the major part of the palisade region but sometimes extend their branches into the spongy region. They are mostly disposed perpendicular to the laminar surface (figures 7, 12).

(v) *G. fremontii* Torr. (Copeland 667, LE). Ramiform sclereids varying from T-shaped to twisted, rod-like or fusoid base forms in the palisade and spongy parenchyma. In the former region the ramiform sclereids are more or less T-shaped; the rhizosclereids fork frequently at the abaxial end. Sclereids in the spongy region show convoluted axis and horizontal orientation (figures 9, 10).

(vi) *G. flavescens* Wats. (Cloaky 8449 LE). Ramiform sclereids have elongated rod-like axis showing number of tubercles and sometimes forking at the poles to form T-shaped or rhizosclereids with attenuated branches (figures 8, 11).

(vii) *G. laurifolia* Hartw. (Mueller 131, LE). Small sclereids, rod-shaped with drawn-out ends or like palosclereids with flat ends. They have sclerosed striated cell wall with abundant pits. The cleared lamina shows very few sclereids which are horizontally disposed without any relation to veinlet endings.

(viii) *G. fadyenii* Hook. (Coulter, s. n. CAL). Small palo- or rhizosclereids disposed vertically in the surface section. The cell wall is striated with pits.

(ix) *G. orientalis* L. (Sinterus 1303, CAL). Short filiform sclereids in abundance along with the main veins and also freely disposed in the mesophyll. They are unbranched and display undulating outline.

4. Taxonomic value

The taxonomic status of *Garrya* Douglas ex Lindley has been a matter of dispute since long. One school believes that it is a monotypic genus in the family Garryaceae which is allied to Cornaceae (Moseley and Becks 1955). The second school emphasises the feature of ovary as superior or inferior, a moot point that still is in the dispute despite the attention of several researchers.

The previous detailed information available on foliar sclereids of *Garrya* in mostly in respect of *G. veatchii* only. Following the taxonomic classifications of Eastwood (1903), Wangerin (1910) and Dahling (1978) an attempt is made to study the typology of foliar sclereids of varied taxa to evaluate their taxonomic or diagnostic value.

*Garrya veatchii* Kell. var. *undulata* Eastwood is synonymous with *G. veatchii* Kell. The present work has revealed that sclereids are absent in the varietal form whereas in *G. veatchii* the polyramous type of sclereids are conspicuous in
Figures 7-8. 7. Transection of the lamina of *G. rigida* Eastwood (Baker 3168, LE) showing ramiform sclereids with small-sized protuberances. 8. Transections of the lamina of *G. flavescens* Wats (Clokey 8449, LE) showing T-shaped and rhizo-sclereids.
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Figures 9-10. 9. Transection of the lamina of *G. fremontii* Torr. (Copeland, 667, LE) showing T-shaped, fusoid or ramiform sclereids disposed in the mesophyll. 10. Sclereids with pilàr-like axis having convoluted knob-like protuberances.
the lamina. In the absence of sclereids, the varietal form stands distinct and casts doubt on the attempted synonymy. However, other morphological features are to be examined before coming to any conclusion about their synonymy or taxonomic status. It is interesting that sclereid types are similar in *G. veatchii* Kell. var. *palmeri* (Wats.) Eastwood, and *G. veatchii*.

*Garrya laurifolia* Benth. ssp. *macrophylla* (Benth.) Dahling is synonymous with *G. macrophylla* Benth. The typology of sclereids supports their synonymy. *Garrya flavescens* Wats. ssp. *congdonii* (Eastwood) Dahling is synonymous with *G. congdonii* Eastwood. The sclereidal features support their synonymy.

*Garrya flavescens* Wats. ssp. *pallida* (Eastwood) Dahling is considered as synonymous with *G. pallida* Eastwood by Dahling (1978). But for the differences in their relative size the sclereids are similar in both the taxa.

From Dahling's work (1978) the following nomenclatural changes in *Garrya laurifolia* Hartw. are examined in the light of varied typology of sclereids as recorded in the present study.

In the 4 subspecies of *G. laurifolia* Hartw., namely, ssp. *laurifolia*, *racemosa*, *quichensis* and *macrophylla* the sclereids conform to Ramiform base form with minor yet significant differences in their shape and outline. In ssp. *laurifolia* sclereids are napiform with convoluted or small protruding lobes at the head region, in ssp. *macrophylla* they are T-shaped, in ssp. *quichensis* they are sparingly present and T-shaped, and in ssp. *racemosa*, they are spheroidal to ramiform sclereids.

*Garrya rigida* Eastwood—This taxon is considered different from *G. remontii* Torr. in habit, pubescens, inflorescence and fruit morphology, but Wangerin (1910) considers the two synonymous. The sclereidal features and their orientation inside the mesophyll do not support their synonymy. However, this needs critical study after verifying the type of *G. rigida*.

*Garrya salicifolia* Eastwood is an exception in the sclereid-bearing genus *Garrya*. It is said to be related and nearest to *G. laurifolia*, has larger leaves and differently shaped berries. The absence of sclereids in *G. salicifolia* and its abundance in *G. laurifolia* and its ssp. does not support their alliance. Further *G. salicifolia* is considered as nearest to *G. longifolia* Rose, from which it differs in pubescens, foliage and habit. However, in the absence of sclereids in both the taxa, their alliance outweighs points of external differences.

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