TYPOLOGY OF FOLIAR SCLEREIDS IN VARIOUS TAXA OF HAMAMELIDACEAE

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ABSTRACT

Sclereids of one type or the other in various combinations within the mesophyll of the several taxa of Hamamelidaceae are described in this paper. Furthermore the study suggests that the typology of sclereids in a few taxa segregated under taxonomic sub-division could be utilised for evaluating the systematic value either for singling out a species or group of species within a genus and may also prove to be taxonomically significant in solving problems of synonymy.

INTRODUCTION

Harms (1930) has drawn attention to the fact that the taxonomic subdivisions of the family exhibit corresponding anatomical differences. This applies particularly to the type of crystal in the mesophyll and to the distribution of sclerenchyma around the vascular bundles of the veins (Metcalfe and Chalk, 1950). Further, from the records available that ‘sclerenchymatous idioblasts’ of various types are reported in the mesophyll of Bucklandia (Exbucklandia), Rhodoleia, Eustigma, Hamamelis, Dicoryphe, Distylium, Loropetalum and Sycopsis (Reinsch, 1890; Niedenzu, 1891; Solereder, 1908; Metcalfe and Chalk, 1950). Reinsch (1890, p. 360) was the first worker to report the intimate relationship between ‘Spicular cells’ and the veinlets in the leaf of Distylium and Loropetalum of this family. Foster (1947) has briefly mentioned the occurrence of terminal sclereids in Exbucklandia populnea (R. Br. ex Griffith) R. W. Brown, Eustigma oblongifolium Gard. and Champ. and Rhodoleia teysmanni Miq. Rao (1953, 1968) and Mody (1958) have confirmed the occurrence of terminal foliar sclereids in Exbucklandia populnea (R. Br. ex Griffith) R. W. Brown, Bhupal and Kundu
(1969) and Rao (1973) have reported the intimate relationship of the sclereids and veinlets in the mesophyll of a few species of *Rhodoleia*. In the present study the following herbarium specimens have been examined to find out the types of sclereids in various taxa of the family and their utility in taxonomic sub-divisions.

**Materials**

Typology of Foliar Sclereids in Various Taxa of Hamamelidaceae


Following the synoptic classificatory system of Hamamelidaceae by Harms (l.c.), a brief account on the position and combination of foliar sclereids in the lamina of varied taxa is given below.

Sub-family: DISANTHOIDEAE

Genus: Disanthus

In the leaf clearings of Disanthus cercidifolium Maxim. terminal or sub-terminal sclereids have been observed (Fig. 4). In transections they are oriented in the mid-mesophyll region with their arrested branches protrud- ing among palisade and spongy cells (Fig. 3.) The sclereids type usually conform to fusiform type. From such a simple type, a gradual series can be built to ‘Y’ or ‘T’-shaped forms. Polymorphic sclereids conform to symmetrical astrosclereids or asymmetrical polyramous type sensu Rao and Bhupal (1973). Structurally, both the forms of sclereids have a smooth outline except for the presence of a few spicules.

Sub-family: HAMAMELIDOIDEAE

Tribe: Hamamelideae

Genus: Hamamelis

Cleared leaves of H. mollis Oliv., H. virginiana L. and H. japonica Sieb et Zuce with its varieties and forms: H. japonica f: Yoshiden
Figs. 1-4. Figs. 1 and 2. Sclereids of *Hamamelis mollis*. Figs. 3 and 4. Sclereids of *Disanthus cercidifolium*.
Hiyama, *H. japonica* var. *bitchnensia* (Makino) Ohwi, *H. japonica* var. *discolor* Hiyama f. *Incarnata* Ohwi, *H. japonica* var. *discolor* Hiyama f. *obtusata* Hiyama and *H. japonica* var. *flavopurpurescens* Rheder have been investigated. No sclereids have been observed in any of them except *H. mollis*. The absence of sclereids in *H. virginiana* is puzzling because polymorphic terminal sclereids of varied size and form have been reported in the same species by many authors.

Sclereids of *H. mollis* conform to three main base forms: osteosclereids, fusiform sclereids *sensu* Rao (1953) and rhizosclereids *sensu* Richter (1920) with many intermediary stages (Fig. 1). In the leaf clearing they are sparingly distributed and in transections the form conspicuous idioblasts in the mesophyll (Fig. 2). Some of them are ‘Y’ or ‘T’-shaped with striated cell wall, rarely spiculated and possess lumina of irregular width.

**Genus: Loropetalum**

The cleared leaf preparations as well as transections the leaves in *L. chinense* revealed the presence of sclereids of a peculiar kind. They resemble vascular fibres and are disposed close to the minor veins and veinlets. They constitute extraxylary idiofibrosclereids (Rao and Bhupal, 1971). In leaf clearings, they appear as fibres leaving their main path and traversing into adjacent tissues of the leaf expanse. In transections, they are obliquely oriented and sometimes branches run parallel to epidermal layers. Morphologically, they resemble vascular fibres but could be easily distinguished from them by their bizarre ends, bigger transsectional area, uneven wall thickening and lumen of irregular width.

**Genus: Trichocladus**

In the two species examined, *viz.*, *T. ellipticus* E. et K. and *T. crinatus* Pres. foliar sclereids were absent in *T. ellipticus* but extraxylary idiofibrosclereids were present in *T. crinatus* which in general appearance show the same features as described in *Loropetalum chinense*.

**Genus: Maingaya**

One species of this genus *M. malayana* Oliv. was examined. The cleared leaf preparations as well as transections revealed that no sclereids were present in any part of the leaf expanse.
Tribe: EUSTIGMATEAE

Genus: Eustigma

Cleared lamina of this monotypic genera *E. oblongifolium* Garden et Champ. shows the presence of terminal or sub-terminal sclereids (Fig. 7). In transections they are more or less vertically oriented and occasionally touch the epidermal layers (Fig. 8). Foliar sclereids conform to osteosclereid type. From this base form it is not uncommon to find rhizosclereids (Figs. 7 and 8) showing crookedly branching ends facing the spongy area.
Structurally, sclereids have thick striated cell wall and possess lumina of irregular width.

Figs. 7 and 8. Sclereids of *Eustigma oblongifolium*.

**Tribe: Corylopsideae**

**Genus: Corylopsis**

In cleared laminae of the two species examined, *viz., C. himalayana* Griff. and *C. manipurensis* Harms sclereids were not noticed in the mesophyll tissue.

**Tribe: Forthergillieae**

**Genus: Forthergilla**

In cleared laminae of both the species, *viz., F. alnifolia* L. f. and *L. major* (Sims.) Loddiges, sclereids were not observed in the mesophyll tissue.
Tribe: **Distyleae**

Genus: *Distylium*

*Distylium indicum* Benth. was examined for the presence of foliar sclereids in the mesophyll tissue. The cleared leaf preparations revealed the presence of extraxylary idiofibrosclereids along the main secondary veins. They often exhibit criss-cross pattern and in transections they appear as idioblastic sclereids. Structurally, they conform to the descriptions already described.

Genus: *Sycopsis*

The leaf clearings of *Sycopsis griffithiana* Oliv. was examined. The presence of extra xylaryidiofibrosclereids in abundance along the major and minor veins as well as at the terminus of veinlets were found throughout the leaf expanse.

Sub-family: **Rhodoleioideae**

Genus: *Rhodoleia*

Recently the genus has been examined by Bhupal and Kundu (1969). The leaf clearings as well as transections of the leaves of four species examined, namely, *R. championi* Hook. f., *R. ovalifolia* Ridl., *R. subcordata*, Exell and *R. teysmannii* Miq., terminal or subterminal sclereids were present in the mesophyll tissue. The simple type chiefly conforms to Osteosclereids, rhizosclereids, ‘I’-shaped sclereids and its modifications. The polymorphic type is represented mainly by polyramous sclereids (Rao and Bhupal, 1973). All types of sclereids have been seen in one and the same leaf.

Sub-family: **Bucklandiodeae**

Genus: *Bucklandia*

The leaf clearings as well as transections of the leaves of *Exbucklandia populnea* (R. Br. ex Griffith) R. W. Brown show terminal polymorphic sclereids belonging to the categories of astrosclereids and polyramous sclereids (Fig. 9). Richter (1920), Foster (1947), Rao (1955, 1968) and Mody (1958) have reported the occurrence of terminal sclereids in the mesophyll of this species.
The present work supports the detailed observations of Rao (1968). Structurally the sclereids have smooth outline, striated secondary wall and luminae of irregular width. They often exhibit branching leading to symmetrical astrosclereids or asymmetrical polyramous sclereids (Figs. 9 and 10).

**Figs. 9 and 10. Sclereids of *Exbucklandia populnea*.**
Sub-family: LIQUIDAMBAROIDEAE

Genus: Liquidamber

In the four species, namely, L. chinensis Champ., L. formosana Hance, L. styraciflua L. and L. tricuspis Miq. examined, terminal polymorphic sclereids of the category of polyramous sclereids are encountered only in the mesophyll tissue of L. tricuspis Miq. (Fig. 6). In the other species, no sclereids were observed.

The sclereids of L. tricuspis are peculiar cell forms. Mostly they are asymmetrical forms due to repeated irregular short branches (Fig. 5). The sclereids have thick, striated cell wall, short arrested branches and lumina of irregular width.

Genus: Altingia

In the species examined, viz., A. excelsa Nor. no sclereids were found to be present.

CONCLUSION

The present study suggests that the typology of sclereids in a few taxa segregated under taxonomic sub-division could be utilised as a promising source of systematically valuable criteria. Of the several taxa re-examined sclereids of one type or the other in various combinations within the mesophyll are recorded in the following taxa: fusiform to polyramous sclereids in Disanthus of Disanthoideae, fusiform, osteo and rhizosclereids in Hamamelis, osteo and rhizosclereids in Eustigma, idiofibrosclereids in Loro, petalum, Trichocladus, Distylium and Sycopsis of Hamamelidoideae, osteo and polyramous sclereids in Rhodoleria of Rhodoleioidae and astro and polyramous sclereids in Exbucklandia of Bucklandioideae. The detailed study has shown that the typology of sclereids are useful in singling out a species or group of species with a genus. However their absence in Maingaya, Corylopsis, Forthergilla of Hamamelidoideae and in all the species of Liquidamberoideae leads to the conclusion that there may be some justification for the removal of Liquidamber and Altingia from Hamamelidaceae to an independent family Altingaceae. Similar reasoning may be thought of for removing Maingaya, Corylopsis and Fothergilla from the subfamily Hamamelidoideae if adequate other characters are elucidated in the future studies in the systematics of this sub-family.
Clarke (1858) and Vink (1957) have considered *Liquidamber tricuspis* Miq. as synonymous with *Exbucklandia populnea* (R. Br. ex Griff.) R. W. Brown. Further, Clarke is of the opinion that Malayan *Liquidamber tricuspis* does not differ in the smallest point from Himalayan specimens of *Exbucklandia populnea* some of which have tricuspidate leaves and sericeous petioles. The sclereid morphology clearly indicates that in *Exbucklandia populnea* sclereids are asterosclereids and polyramous sclereids with terminal or sub-terminal disposition with reference to their veinlet endings. Often they are found clustering round the minor and major veins forming more or less a loose protective covering. As a contrast to this orientation, the cleared laminae and transections of *Liquidamber tricuspis* show polyramous sclereids, relatively bigger than that of *Exbucklandia populnea* and form distinct idioblasts inside the mid-mesophyll region. At no stage they have close juxtaposition with the main veins and veinlets, but appear in twos or threes at the veinlet endings. In view of the characteristic sclereid orientation in the leaf of *Liquidamber tricuspis*, Clarke's attempt to consider this species as synonym of *Exbucklandia populnea* needs critical study. The sclereid pattern supplemented by the histology of leaf and stem may be useful in re-examining the real status of these taxa.

It is of interest to remember that no sclereids have been reported in the genus *Liquidamber*. Of the two species of *Altingia* only *A. excelsa* Nor. was examined. It was found that the leaf expanse in this species was completely devoid of sclereids. The absence of foliar sclereids are very characteristic of the genus *Liquidamber* and Clarke's treatment of *Liquidamber altingia* Bl. as synonymous with *Altingia excelsa* Nor. in all probability seems to be correct.

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