STUDIES ON THE DISTRIBUTION, STRUCTURE AND ONTOGENY OF THE FLORAL SCLEREIDS IN FAGRAEA*

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Received April 5, 1967
(Communicated by Dr. V. Puri, F.A.SC.)

ABSTRACT

The present study deals with the distribution and structure of floral sclereids in Fagraea fragrans Roxb., F. ridleyii K. & G. and F. ceilanica Thunb. and their ontogeny in F. fragrans. The sclereids are diffuse, branched, with thick and stratified walls, showing pits, pit canals and spicules. On the basis of form, four types of sclereids have been recognised. The development of sclereids, both in the pedicel and ovary of F. fragrans, is similar. Distribution and structure of sclereids in sepals seem to provide a distinct and sharp demarcating character for all the three species.

INTRODUCTION

ALTHOUGH sclereids are known to occur in every part of the plant body (Esau, 1960), only foliar sclereids have been studied in detail so far, and those in the floral parts have received very scanty attention.

The present study deals with sclereids in the pedicels and floral parts of the three species of Fagraea (Loganiaceae), viz., F. fragrans Roxb., F. ceilanica Thunb. and F. ridleyii K. & G.

F.A.A. preserved material of F. fragrans Roxb. and F. ridleyii K. & G. was very kindly supplied to me by the Curator, Botanical Gardens, Singapore, and that of F. ceilanica Thunb. (F. obovata Wall) by the Curator, Botanical Gardens, Ootachmund.

Various plant parts possessing sclereids were macerated, following Tomlinson’s technique (1959). However, glycerine jelly was preferred for mounting, to glycerine as prescribed, and cover-glasses were sealed with wax. The studies were also supplemented with the observations, from

* Research contribution No. 86 from the School of Plant Morphology, Meerut College, Meerut.
clearings of the plant parts, using Foster's method (1955), as also from paraffin sections cut from 10-12 μ. Different staining combinations were used.

Observations

Distribution of sclereids.—The sclereids are found to occur in pedicel (Fig. 1) and sepals (Fig. 2) in all the three species, while in *F. fragrans* they are also found in the ovary (Fig. 2). In the pedicel they are diffuse, distributed irregularly throughout the tissue of the pith and inner cortex, being absent from 8-10 hypodermal layers. They increase in number gradually towards the receptacle, being absent here only from one or two hypodermal layers. The arms of sclereids generally do not penetrate the epidermis, but may reach it. The sclereids form large and many aggregates in *F. ridleyii*, while they are small and fewer in *F. fragrans*, but rare in *F. ceilanica*.

In the sepals, sclereids are irregularly scattered, showing gradual decrease upwards and lacking from the tip. In all the three species they are abundant near the adaxial epidermis. In *F. fragrans* and *F. ceilanica*, however, they are restricted to the sub-hypodermal region of the adaxial epidermis, in the upper region of the sepal (Fig. 41). The arms of sclereids may approach the epidermis, but do not penetrate it. They occur in aggregates as in pedicel of corresponding species and do not show any relation to the vascular tissue.

Only *F. fragrans* has sclereids in the ovary, especially in the vicinity of vascular tissue at the base. These gradually decrease as the locules are approached and around them they are restricted only to the peripheral region of the ovary and are absent from the style and stigma (Fig. 54). In young ovaries, however, they are seen only in its basal part. They are mostly isolated from one another, but a few may form aggregates.

Structure of sclereids.—The sclereids in all the three species studied are branched, the branches spreading in all directions and ending bluntly (e.g., in the sepals of *F. fragrans*, Figs. 45-48) or in sharp points (e.g., in the pedicel of *F. ceilanica*, Figs. 3-4). The tips of branches are sometimes forked (Figs. 3-5 and 40). The sclereid cell retains its cytoplasm and nucleus up to a comparatively late stage of maturation (Figs. 19, 25, 26 and 44). The lumen is variable showing pits that may be simple, mostly pore-like or elliptical (Fig. 43), and pit canals which may again be simple or ramified (Figs. 26 and 44). In *F. ridleyii* some “spicule”-like structures were observed on the body of the sclereids (Figs. 31, 33, 35). The thickness of the secondary wall, that is stratified (Figs. 19, 25, 26, 42-44) is variable at different places. It also shows irregularly developed bulgings in *F. ridleyii* (Figs. 29 and 35).
Crystals are also seen in the lumen of sclereids from the ovary wall of *F. fragrans* (Figs. 56-57).

The sclereids can preferably be grouped under following categories, based on shape, size, structure and nature of the branching. This division is mostly for convenience of description; otherwise, there are numerous intermediate forms.

*Type I.*—Here the sclereid cells are small with small branches, which are mostly in the form of lobes. The sclereids in *F. fragrans* are lobed (Figs. 45–47) while in *F. ridleyii* the lobes are somewhat more elongated. Fusoid sclereids showing both lobes and small branches are found in *F. ceilanica* (Figs. 35–37).

*Type II.*—Here the body of the sclereid gives out few to many branches, diverged in all directions, but the extent of growth of their branches is variable. Variously shaped, stellately branched sclereids are common in *F. ceilanica* and *F. ridleyii* (Figs. 30–33, 38 and 40). In *F. fragrans* sclereids usually possess long pointed branches on one side, and small, blunt ones on the other (Fig. 50).

*Type III.*—The sclereids of this category are fusiform, bearing irregular branches, that may at times be very much elongated (Figs. 20–23). Such types of sclereids are of most common occurrence in all the three species studied.

*Type IV.*—Here, the sclereids are considerably elongated and bear a few inconspicuous lateral lobes (Figs. 6, 13, 14 and 39). These occur in all the three species.

**Ontogeny of sclereids.**—The development of sclereids in *F. fragrans* follows the same pattern in both, pedicel and ovary. The sclereid is seem to develop from any parenchymatous cell. Few initials may lie close to intercellular spaces (Fig. 59). In pedicel sclereid initials are evident by the large size of their nucleus (Fig. 59), while in the ovary, initials show many conspicuous nucleoli. A binucleate cell was also observed, but it remains to be seen whether unequal division as indicated by Bloch (1946) resulting into sclereid initial, follow this binucleate condition. The initial grows in size, sending small protuberances in all directions and these later on develop into thin, slender, branches which may occupy nearby intercellular spaces if any. Secondary wall of variable thickness is laid down. This deposition seems to establish stratified walls, pits and pit canals. Protoplasm and nucleus is still retained (Fig. 72).
DISCUSSION

All the species lack "terminal sclereids", developed at the free vein endings. However, occasionally in surface view, a few sclereids were seen to occupy such a position. It, therefore appears, in view of the absence of developmental stages, that such a terminal position may have been attained because of the chance transformation of a cell in the neighbourhood of the
vein ending or the initial cell might have grown more towards the free vein end.

Solereder (1908), Foster (1946, 1955, 1956), Rao (1951, 1957) and Bailey (1961) emphasize the need of study of wider range of material and also the use of sclereids in systematic work. Morley (1953) attaches some taxonomic significance to this character by taking advantage of foliar and floral sclereids to recognise a new genus *Coryphadenia* (Melastomaceae). In Loganiaceae also, the presence of sclereids can be of some help in strengthening the inter-relationships between *Anthocleista*, *Fagraea* and *Potalia* [which have already been grouped together by Solereder (1895), Hutchinson (1959), Leenhouts (1962), etc., due to varied grounds], because of the presence of foliar sclereids, in only these three genera of Loganiaceae (Solereder, 1908). Studies of floral sclereids of these three genera will be more revealing in this respect.

The sclereids can be useful as a character at the species level (Solereder, 1908) which can be illustrated by the three species, in which the distribution and structure of sclereids in the sepals provide sharp and distinct characters.

(a) *F. ceilanica.*—Shows many sclereids, diffuse, and usually form no aggregates. Sclereids are mostly isolated and scattered. They appear branched in surface view, branches being long and pointed.

(b) *F. fragrans.*—Shows many sclereids, diffuse and forming aggregates, which are not dense. Sclereids appear sparingly branched in surface view. Branches are small and stubby.

(c) *F. ridleyii.*—Shows many sclereids, diffuse and forming aggregates which are very dense. Sclereids appear well branched in surface view, branches being long and pointed.

**Acknowledgements**

The author is indebted to Professor V. Puri for his invaluable suggestions and critical reading of the manuscript. My grateful thanks are due to Dr. V. Singh for his keen interest and constant encouragement and to Dr. R. Shiam for his generous help. I am also thankful to Dr. Y. S. Murty for providing all the facilities.

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Bloch, R.


Esau, K.


Foster, A. S.


Hutchinson, J.


Leenhouts, P. W.


Morley, T.


Rao, T. A.


Solereder, H.


Tomlinson, P. B.


**EXPLANATION OF FIGURES**

Figs. 1–53. Fig. 1. Transverse section of pedicel of *F. fragrans* Roxb. to show distribution of sclereids. Fig. 2. Transverse section of the base of flower of *F. fragrans* Roxb. showing distribution of sclereids in the sepals and ovary. Figs. 3–6. Variously shaped sclereids in the pedicel of *F. ridleyi* K. and G. Figs. 7–11. Sclereids of different shapes in the pedicel of *F. ceilanica* Thunb. Figs. 18. Sclereid with pits. Fig. 19. Part of mature sclereid showing cytoplasm and nucleus. Note the stratified wall. Figs. 25–33. Variously shaped sclereids from the sepals of *F. ridleyi* K. and G. Figs. 25–26. Parts of mature sclereids showing stratified wall, pit canals, cytoplasm and nucleus. Figs. 34–40. Sclereids of different shapes from the sepal of *F. ceilanica* Thunb. Fig. 41. Transverse section of sepal of *F. fragrans* Roxb. to show restriction of sclereids in the sub-hypodermal region of the adaxial epiidermis in the upper part. Figs. 42–53. Sclereid type in the sepal of *F. fragrans* Roxb. Figs. 42–44. Parts of mature sclereids showing thick wall, pits, pit canals and cytoplasmic contents.

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