ON THE CAULINE SCLEREIDS OF THREE SPECIES OF OCHNA

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ABSTRACT

An anatomical study of Ochna wallichii Planch, O. kirkii Oliver and O. squarrosa Roxb. shows that sclereids are totally absent from O. squarrosa. Exclusively brachysclereids occur in the cortical region of the mature stem of the other two species. They occur in sub-epidermal rows and groups in the cortex. They are more abundant in the nodal regions, and form with the bast fibres a more or less continuous peripheral mechanical tissue cylinder. The adult empty sclereids which are oval or round in O. wallichii and a little squarish in O. kirkii have a thick, lignified, lamellated secondary wall traversed by pit-canals. Sclereid features are important in distinguishing the secondary woods of these species.

INTRODUCTION AND TECHNIQUE

So far as can be made out, no sclereids have been reported in the family Ochnaceae. Metcalfe and Chalk (1950) while dealing with the anatomy of this family have mentioned the presence in several genera, of peculiar cells which they designate as “cristarque cells”. The inner tangential and radial walls in these cells are heavily thickened. They occur in a sub-epidermal position as a more or less discontinuous, peripheral cylinder in the stem and also in groups in other plant parts. The presence of “spicular cells” in the leaves of some genera is reported in this family (Metcalf and Chalk, 1950).

An examination of three species of the genus Ochna, i.e., O. wallichii Planch, O. kirkii Oliver and O. squarrosa Roxb. available at Lucknow showed the presence of sclereids only in the cortex of the stem of the first two species. The sclereids occur generally as subepidermal rows in the vicinity of “cristarque cells” or scattered in groups in the ground tissue. T. A. Rao (1951) has reported the presence of branched sclerenchyma in the leaves of Ochna squarrosa arising from the sclerenchymatous sheath of the veins and veinlets.
These can easily be mistaken for sclereids. Our examination of *Ochna squarrosa* shows that sclereids are totally absent in this species.

The plant parts of *O. wallichii* and *O. squarrosa* were collected from the departmental garden and those of *O. kirkii* were obtained from National Botanic Gardens, Lucknow. Foster's techniques (1946) of clearing and staining (1949) were used. Haematoxylin Orange-G combination or alcoholic safranin by itself gave very good staining results. Hand sections, microtome sections of 6-10 μ thickness, macerations and cleared mounts were all studied.

**Distribution and Morphology of Adult Sclereids**

In *O. wallichii*, sclereids occur only in the cortex of the stem and are absent in the other vegetative and floral parts. In *O. kirkii* the floral parts were not available but so far as the vegetative parts were studied, the sclereids occur here too only in the cortex of the stem. Sclereids in *O. wallichii* form a more or less continuous row along with the other mechanical tissues (Fig. 1; Photo 1). But they also occur deep down in the cortical parenchyma (Fig. 2). In *O. kirkii*, however, the sclereids are fewer in number than *O. wallichii*, and occur diffusely scattered in the cortex (Fig. 3; Photo 2) below the row of “cristarque cells”. But in the nodal region of the stem of both the species, their number increases.

Sclereids in both the species are of only one kind, and can be classed under the category of *Brachysclereids* (Tschirch, 1889). No other type of sclereid is in evidence. The sclereids may be rounded (Fig. 4; Photo 3), oval (Figs. 5 and 6) or slightly longish (Figs. 7 and 8) in form in *O. wallichii*. In *O. kirkii* also similar shaped sclereids occur but squarish sclereids are more in number (Figs. 9 and 10; Photo 2).

The secondary wall of the adult sclereid in both the species is very thick, slightly lignified, distinctly lamellated, and traversed by branched or unbranched, closely running pit-canals (Figs. 4–10; Photos 3 and 4). The secondary walls of the adult sclereids do not stain brightly with the two specific lignin stains, phloroglucin-conc. HCl or with alcoholic safranin. From this it can be inferred that lignification is not so dense as in some other plant sclereids. It is also likely that some other substance like cellulose or hemicellulose (Esau, 1962) besides lignin enters into the substance of lamellations. Sclereid lumen is generally empty at maturity and its shape varies according to the form of sclereid. But in some sclereids, in both the species, the lumen has some deeply stainable content (Figs. 11 and 12). Sections of mature wood show both types of sclereids, some with contents
and some without contents (Photo 5). The stainable substance of the sclereid disappears during maceration in concentrated acids.

**ONTGENY OF SCLEREIDS**

The ontogeny of the sclereids is similar in both the species, *i.e.*, *O. wallichii* and *O. kirkii*. Sclereid initials are differentiated as densely protoplasmic, distinctly nucleate cells from the parenchyma cells of the cortex (Figs. 13 and 14), which are produced by the secondary activity of the vascular cambium. The development of brachysclereids does not involve many morphological changes. The initials increase in size and the protoplasm accumulates in the centre of the cell (Fig. 15) followed by “secondary sclerosis” of the wall which becomes gradually thickened by the deposition of the wall substance (Figs. 16–19). The nucleus which moves towards the periphery of the cell (Figs. 16–19) ultimately disorganises along with the protoplast. The adult sclereid is therefore empty at maturity. Two (Fig. 20) or more sclereid initials may also differentiate side by side, deep down in the cortex. All the sclereids do not mature simultaneously (Fig. 19). In fully mature stems (Fig. 1) the sclereids along with the other mechanical tissues, like the fibres, etc., form a discontinuous, peripheral mechanical tissue cylinder.

**DISCUSSION**

Three species of *Ochna* have been investigated in this paper. *O. wallichii* and *O. kirkii* have exclusively cauline brachysclereids and sclereids are totally absent in *O. squarrosa* in all the parts of the plant. In *O. wallichii*, sclereids occur in large numbers and in more or less continuation with the other mechanical tissues. In *O. kirkii* however the cauline sclereids are fewer in number and occur not in rows or groups but are scattered in the cortex. Further, in this species bast fibres are very much more abundant than sclereids. This is not so in *O. wallichii*. The structure of sclereids is more or less similar in the two species, except that in *O. kirkii*, sclereids are more squarish in form. These differences, in the distribution and form of the adult sclereids help in distinguishing the stems of these species from one another.

According to Metcalfe and Chalk (1950) other Ochnaceous genera like, *Blastemanthus*, *Cespedesia*, *Elvasia*, *Hilairella*, *Luxemburgia*, *Poecilandra*, *Trichovaselia* and *Vaselia*, etc., have “spicular cells” or “sclerenchymatous dioblasts” occurring in rows below upper leaf epidermis. In the leaves of the species of *Ochna* described in this paper, no such cells are present.
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Although "cristarque cells" are abundant. This feature helps to separate the three species of Ochna, i.e., O. wallichii, O. kirkii and O. squarrosa from the genera referred to above. The other members of the family heed further investigation.

The juxta position of the sclereids with fibres in the peripheral part of the stem builds up a more or less interrupted mechanical tissue cylinder. This feature has been noticed in numerous dicotyledonous stems (Haberlandt, 1914; Foster, 1949; Malaviya, 1963, 1967a, b). In the nodal regions where branching is initiated, there is an excessive development of sclereids. These facts suggest that the functions of the sclereids may probably be to impart rigidity to the stem and also to render it capable of withstanding the strain of branching. Thus the nature and distribution of sclereids in plants seems to have some definite significance not only in physiological plant anatomy but also in systematic botany.

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REFERENCES


EXPLANATION OF FIGURES

FIGS. 1-20. Fig. 1. Diagrammatic sketch of T.S. of stem showing distribution of sclereids in *O. wallichii*, ×23. Figs. 2 and 3. Parts of transections of stems of *O. wallichii* and *O. kirkii* respectively showing sclereids, ×137. Figs. 4-8. Sclereids of *O. wallichii*, ×212. Figs. 9 and 10. Sclereids of *O. kirkii*, ×212. Figs. 11 and 12. Sclereids with contents, ×212. Figs. 13-20. Stages in the ontogeny of sclereids in the stem of *O. wallichii*, ×137.

(c, cortex; cc, cristaque cells; ct, cell content; epi, epidermis; f, fibre; i, initial; l, lumen; n, nucleus; pc, pit-canal; pt, protoplast; sc, sclerenchyma; scl, sclereid; sph, secondary phloem; sw, secondary wall; sx, secondary xylem.)

EXPLANATION OF PLATE III

PHOTO 1. Part of L.S. of stem of *Ochna wallichii* showing two groups of sclereids, ×250.

PHOTO 2. Part of L.S. of *O. kirkii* showing a group of squarish sclereids, ×382.

PHOTO 3. Two sclereids magnified to show the lamellated secondary wall, ×1,356.

PHOTO 4. Sclereids with pit-canals in secondary wall and contents in lumen, ×608.

PHOTO 5. L.S. of stem showing two types of sclereids, some with contents and some without contents, ×210.

(cc, cristaque cells; ct, cell content; pc, pit-canal; scl, sclereid; sw, secondary wall.)