

L. L. NARAYANA*: **A contribution to the floral anatomy and embryology of Ochnaceae**

L. L. ナラヤナ*: オクナ科の花の構造と胚発生

Saunders (1939) studied the floral anatomy of *Ochna kirkii* mainly with a view to support her theory of carpel polymorphism. Rao and Gupte (1956) described the vascular anatomy of the pistil of *Ochna squarrosa*.

The embryological work in the family has been reviewed by Davis (1966). Chiarugi and Francini (1930) reported apomixis in *Ochna serrulata*. Recently Chikkannaiah and Mahalingappa (1975) described the ovule and female gametophyte in *Ochna squarrosa*. The present paper deals with the floral anatomy and embryology of *Ochna kirkii* Oliver and *Ochna atropurpurea* DC.

Materials and methods: The FAA fixed materials for the present study were supplied by the Superintendent, Royal Botanic Gardens, Peradeniya, Ceylon. Usual methods of dehydration, infiltration and embedding were followed. Sections cut at a thickness of 8-12 microns were stained using crystal violet and erythrosin combination.

Observations

Flower: The flower is pedicellate, dichlamydeous, heterochlamydeous, bisexual, hypogynous and regular. The free 5-merous perianth shows quin-cuncial aestivation (Fig. 1 C, D, E; Fig. 2 D, E). The androecium consists of 15-30 stamens which are free (Fig. 1 E). The number of carpels varies from 7-15. Each locule bears a solitary ovule (Fig. 1 F, H; Fig. 2 I). The style is hollow and gynobasic (Fig. 1 H; Fig. 2 I). The stigmas are bifid (Fig. 1 H; Fig. 2 I).

Floral anatomy: The pedicel shows a closed ring of vascular tissue in *Ochna kirkii* (Fig. 1 A) and in *O. atropurpurea* it shows a ring of five large and five small vascular bundles alternating with one another (Fig.

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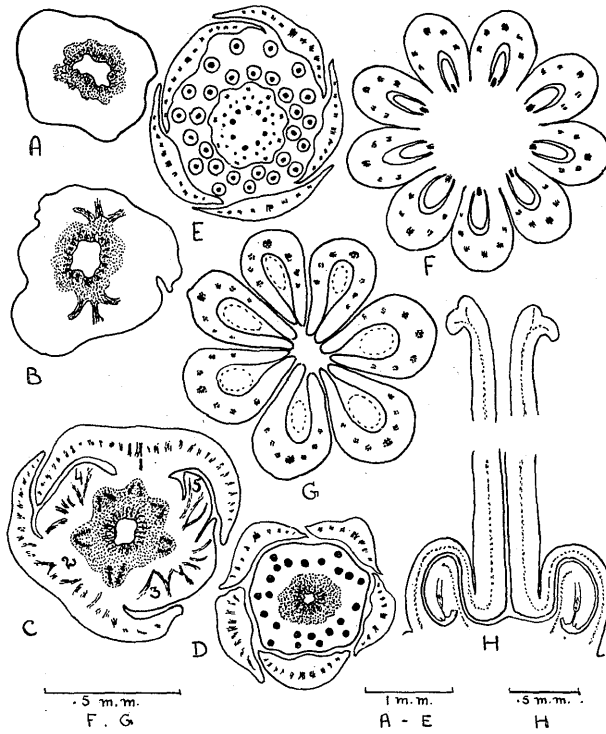


Fig. 1. A-H. *Ochna kirkii*. A-G. Serial transverse sections of flower showing the origin and distribution of vascular traces to different floral parts. H. Longitudinal section of ovary

2 A). The sepal traces in *O. kirkii* arise in the order indicated in Fig. 1 C; the lateral traces arise conjointly with the midribs. They undergo branching very early after their demarcation (Fig. 1 B, C). In *O. atropurpurea* the sepal midribs and the common sepal lateral—petal midrib traces arise in two distinct whorls (Fig. 2 B-D). In *O. kirkii* the petal traces arise independently (Fig. 1 C). The traces supplying the sepals and petals undergo repeated branching in the respective organs (Fig. 1 C-E; Fig. 2 D, E). After the demarcation of the petal traces numerous staminal traces become organized without any regular sequence in their origin (Fig. 1 D, E; Fig. 2 E, F). After the staminal supply is given off the main stele forms a closed ring of vascular tissue (Fig. 1 D; Fig. 2 E, F); from this as

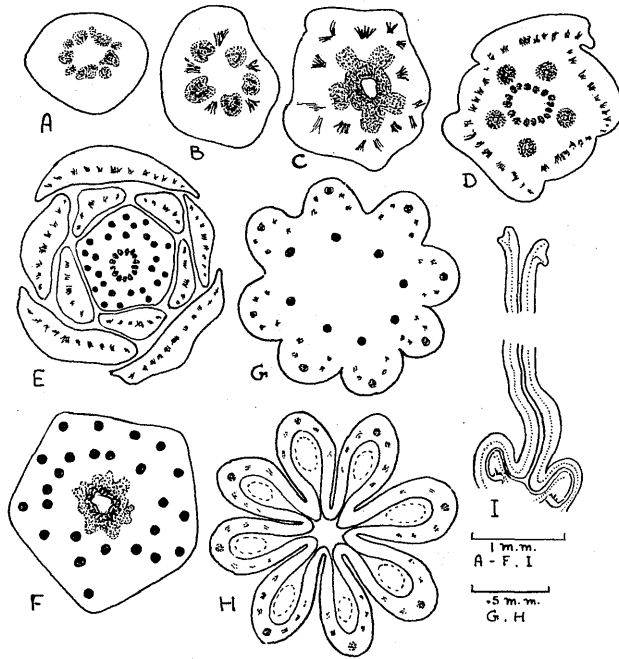


Fig. 2. A-I. *Ochna atropurpurea*. A-H. Serial transverse sections of flower showing the origin and distribution of vascular traces to the different floral parts. I. Longitudinal section of ovary.

many dorsal carpellary traces as there are carpels are organized (Fig. 1 E; Fig. 2 G). At the very base each dorsal carpellary trace gives off two lateral branches which divide further (Fig. 1 F, G; Fig. 2 G, H). The remaining stele organizes into as many ventral bundles as there are carpels and they lie on the radii of the dorsal bundles (Fig. 1 F; Fig. 2 G). Each ventral bundle supplies the solitary ovule in each locule (Fig. 1 H; Fig. 2 I). The dorsal carpellary bundles travel upwards, follow the contour of the ovary and reach the base of the style and extend towards the top (Fig. 1 H; Fig. 2 I); there they undergo bifurcation and these terminate in the bifurcated stigmas (Fig. 1 H; Fig. 2 I). Above the ovule-bearing region the ventral margins of the carpels do not show fusion (Fig. 1 G; Fig. 2 H).

Microsporogenesis and male gametophyte: The fully developed anther shows an epidermis and four wall layers in *Ochna kirkii* (Fig. 3 A) and three wall layers in *O. atropurpurea* (Fig. 4 A). The innermost wall layer functions as the tapetum which is of the secretory type. The tapetal cells ultimately become binucleate (Fig. 4 A). By the time the pollen grains are formed in the anthers the tapetum becomes absorbed (Fig. 3 B; Fig. 4 B). The cells of the hypodermal wall layer develop fibrous thickenings only at the top of the anthers (Fig. 3 B; Fig. 4 B).

Division of the pollen mother cells is simultaneous and cytokinesis takes place by furrowing (Fig. 3 C; Fig. 4 C). Pollen tetrads show tetrahedral arrangement (Fig. 3 D; Fig. 4 D). The pollen is 3-celled in *O. kirkii* and 2-celled in *O. atropurpurea* (Fig. 4 E) at the shedding stage. The pollen grains are 3-colporate (Fig. 3 E; Fig. 4 E). Starch is present in the cytoplasm of the pollen grains.

Ovule: The ovule is tenuinucellate, bitegmic and anatropous. The ovule primordium arises from the ventral margin at the base of the locule (Fig. 3 F). During development the ovule undergoes downward curvature so that the micropyle in the mature ovule points towards the base of the loculus (Fig. 1 H; Fig. 2 I; Fig. 3 F-H; Fig. 4 F). The integumentary primordium arises by the time the archesporium is differentiated in the ovule (Fig. 3 F). By the time the megaspore mother cell is full-grown, the integument encloses the nucellus and shows slight lobing at the apex suggestive of the fusion of the two integuments (Fig. 3 G, H; Fig. 4 F). The micropyle is formed by the inner integument (Fig. 3 G, H; Fig. 4 F). The innermost layer of the inner integument develops into the endothelium, the cells of which are uninucleate (Fig. 3 L; Fig. 4 F, I). The nucellus is narrow and elongated (Fig. 3 H; Fig. 4 F). The funicular vascular bundle terminates below the nucellus.

Megasporogenesis and female gametophyte: The female archesporium is single-celled and hypodermal (Fig. 4 G). The archesporial cell directly functions as the megaspore mother cell without cutting off a primary parietal cell (Fig. 3 I). The megaspore mother cell undergoes meiosis and gives rise to a linear tetrad of megaspores (Fig. 4 H). Occasionally 'T' shaped megaspore tetrads have been observed in *Ochna kirkii* (Fig. 3 K). In one instance enlargement of the micropylar megaspore has been

observed in the same species (Fig. 3 J). The chalazal megaspore is functional (Fig. 4 H) and gives rise to an 8-nucleate embryo sac as a result of three successive free nuclear divisions (Fig. 3 L; Fig. 4 I, J). Thus the embryo sac development follows the *Polygonum* type and shows the usual organization. The egg apparatus consists of two hooked synergids which show filiform apparatus and an egg (Fig. 3 L; Fig. 4 J).

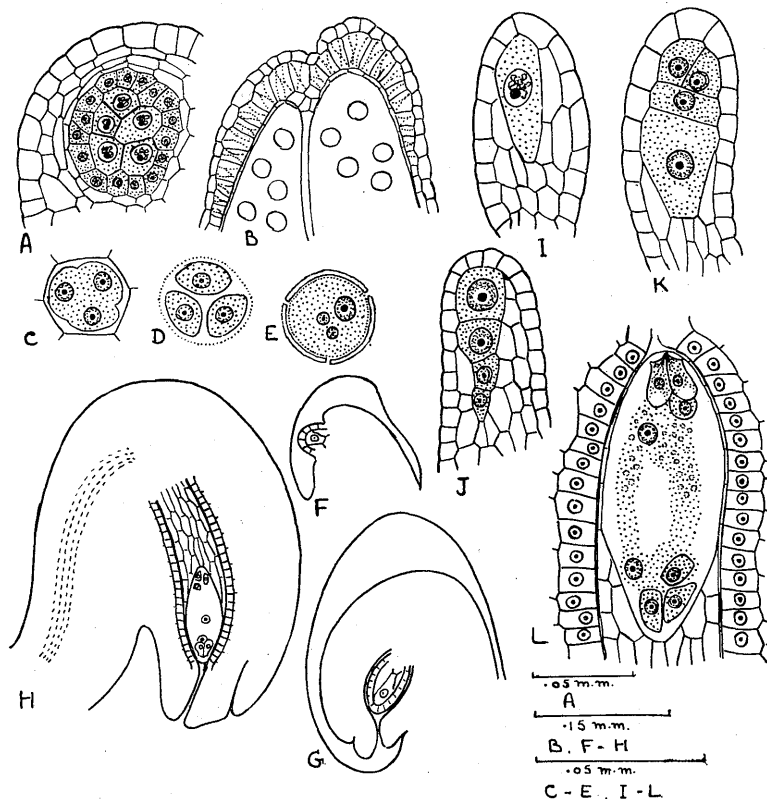


Fig. 3. A-L. *Ochna kirkii*. A. Transection of anther lobe showing sporogenous tissue, tapetum and 3 wall layers. B. Fibrous endothecium in the apical part of the anther. C. Pollen mother cell showing cytokinesis. D. Tetrahedral pollen tetrad. E. Mature pollen grain. F & G. Stages in the development of ovule. H. Longisection of mature ovule. I. Longisection of ovule showing megaspore mother cell. J. Linear megaspore tetrad with enlarging micropylar megaspore. K. 'T' shaped megaspore tetrad. L. Fully formed embryo sac.

The polar nuclei fuse before fertilization. The antipodals are organized as distinct cells (Fig. 3 L; Fig. 4 J). In *O. kirkii* they remain small (Fig. 3 L) while in *O. atropurpurea* they become hypertrophied and appear glandular (Fig. 4 J). During development the embryo sac enlarges and crushes the nucellar cells on the sides and above and some of the nucellar cells below (Fig. 3 H, L; Fig. 4 F, I). The mature embryo sac shows starch grains especially around the secondary nucleus (Fig. 4 J).

Discussion: The sepals are 3-traced. The origin of sepal traces at different heights in *Ochna kirkii* may be reminiscent of ancestral spiral arrangement. In *O. kirkii* the lateral traces of sepals arise conjointly with the midribs. In *O. atropurpurea* the common sepal lateral traces show adnation with the petal midribs and in *O. kirkii* they arise independently.

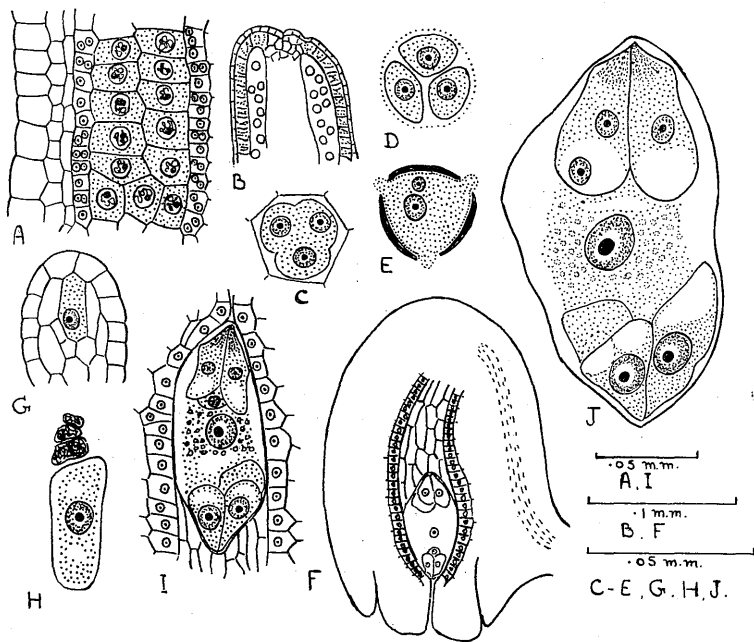


Fig. 4. A-J. *Ochna atropurpurea*. A. Longisection of part of anther showing sporogenous tissue, tapetum and 2 wall layers B. Fibrous endothecium in the apical part of anther. C. Pollen mother cell showing cytokinesis. D. Tetrahedral pollen tetrad. E. Mature pollen grain. F. Longisection of mature ovule. G. Female archesporium. H. Enlarging functional megaspore with degenerating megaspores. I & J. Mature embryo sacs.

The petals are single traced.

The multistaminate condition of the androecium and the multicarpellate condition of the gynoecium may also be reminiscent of the ancestral condition. There is no rhythm in the organisation of the staminal traces.

The carpels are 3-traced. Judging from the position of the ventral bundles the placentation can be described as axile. The style is vascularized by the dorsal bundles which undergo bifurcation towards the top.

In the secretory anther tapetum, simultaneous type of division of the pollen mother cells, furrowing method of cytokinesis and the 2-celled condition of the pollen at the shedding stage (except in *O. kirkkii*) the species under the present study resemble the other investigated taxa of the family (Davis, 1966; Chikkannaiah and Mahalingappa, 1975). Development of fibrous thickenings in the cells of the hypodermal layer at the top of the anther appears to bear relation to the poricidal dehiscence.

Ovules are tenuinucellate, bitegmic and anatropous as also reported by earlier workers. The integuments are fused throughout their length except for a short distance at the apex—a feature reported in Balsaminaceae (Venkateswarlu and Lakshminarayana, 1957; Narayana and Sayeeduddin, 1959; Narayana, 1963, 1965). The micropyle is formed by the inner integument alone while in *Ochna squarrosa* (Chikkannaiah and Mahalingappa, 1975) both integuments are reported to take part in the formation of the micropyle. Endothelium is differentiated from the innermost layer of the fused integument. However, Chikkannaiah and Mahalingappa (1975) reported in *O. squarrosa* the differentiation of a false endothelium from the epidermal cells of the nucellus enclosing the embryo sac and hypostase. No hypostase has been noticed in the species under the present study. Parietal tissue is absent.

A multicellular archesporium reported by Ghosh (1964) in *O. atropurpurea*, has not been observed. The embryo sac develops according to the Polygonum type. The antipodal cells in *O. atropurpurea* are very much hypertrophied as also reported in *O. squarrosa* (Chikkannaiah and Mahalingappa, 1975).

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オクナ科の 2 種類について花の維管束配列, 花粉形成, 胚嚢形成を記述した。

〇ツバキとサザンカの雑種の新品 (津山 尚・山崎富佐子) Takasi TUYAMA & Fusako YAMAZAKI: A new cultivar of presumable hybrid between *Camellia japonica* and *C. Sasanqua*

1975年2月25日に浜松市の前田勝宏氏がツバキとサザンカの雑種と思われる数種の開花中の生標本を同定のため著者ら双方に送って来た。氏は先にも浜松市近郊でハルサザンカ品種群に属する2園芸品種を発見した(山崎富佐子, 1972) ツバキ類の研究者である。上記で発表した2品種の原樹は天竜川下流西岸の二軒の旧家にそれぞれ別々にあったが、今回のものはその東岸、磐田郡豊田町の旧家、伊藤一二氏邸に栽植されている。本年3月5日、著者らは現地を訪れて現物を調査し採集したのでここに研究の結果を報告する。同家にはツバキとサザンカの雑種と推定される5品種5株が開花中であつたが、その中の1品種について述べる。

天竜紅 (テンリュウコウ) 新園芸品種

花は淡赤色, (海棠色, Begonia Rose 標準色鑑一興林会), (R.H.S. 番号 52A-57C; H.C.C. 22, Crimson 25/1, Rose Bengal) 一重平咲で弁間にすぎ間があり, 筒芯で, 花弁数は5~6個, 外花弁(外部の小形の附加的な花弁で, 雄ずい筒と直接癒合してい