

FLORAL ANATOMY OF TREMANDRACEAE

R. SANDHYA RANI

Department of Botany Nizam College, Hyderabad - 500 001 (A.P.) India.

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The floral anatomy of *Platytheca verticillata* and *Tremandra stelligera* has been investigated. The bisexual, regular, hypogynous flowers are pentacyclic. The sepals and petals are 3-traced and the stamens are single traced. Sepal median and petal laterals arise conjointly while there is adnation between common sepal laterals and petal median in *Tremandra stelligera*. *Platytheca verticillata* exhibits adnation between common sepal laterals, petal midribs and antipetalous staminal traces. The androecium is interpreted as obdiplostemonous on anatomical basis and is suggestive of a probable geranialean affinity. A non-vascularised disc is present in *Tremandra stelligera*. The carpels are 3-traced and the placentation is interpreted as anatomically parietal. The need for more data on floral anatomy and in other disciplines is pointed out for assessing the correct taxonomic position.

Key Words : Floral anatomy, Tremandraceae, taxonomic position.

The family Tremandraceae consists of 30 species distributed in 3 genera, namely *Tremandra*, *Platytheca* and *Tetratheca* (Goldberg, 1986). Of these, *Tetratheca* is the largest genus comprising 25 species, *Tremandra* consists of 3 species and *Platytheca* comprises 2 species (Airy Shaw, 1973). The pedicellate, bisexual, regular and hypogynous flowers are axillary. The valvate sepals are free or rarely basally connate and the polypetalous corolla shows induplicate valvate aestivation. The androecium consists of 10 or 8 free stamens with short filaments and beaked anthers dehiscing by apical pores. The ovary is 2-carpellary, syncarpous, 2-locular bearing 1-3 ovules. The style is single, slender and elongate and terminates in two stigmas (Goldberg, 1986).

The floral anatomy of Tremandraceae is limited to the study of *Tetratheca thymifolia* (Saunders, 1937), *T. efoliata* (Suvantha *et al.*, 1984) and *T. affinis* (Laxmi and Narayana, 1987). The present study which deals with the floral anatomy of *Tremandra stelligera* R. Br. and *Platytheca verticillata* (Heng) Baill. has been undertaken to evaluate the bearing of the floral anatomical data in assessing the interrelationships of the taxa and affinities and systematic position of the family.

MATERIALS AND METHODS

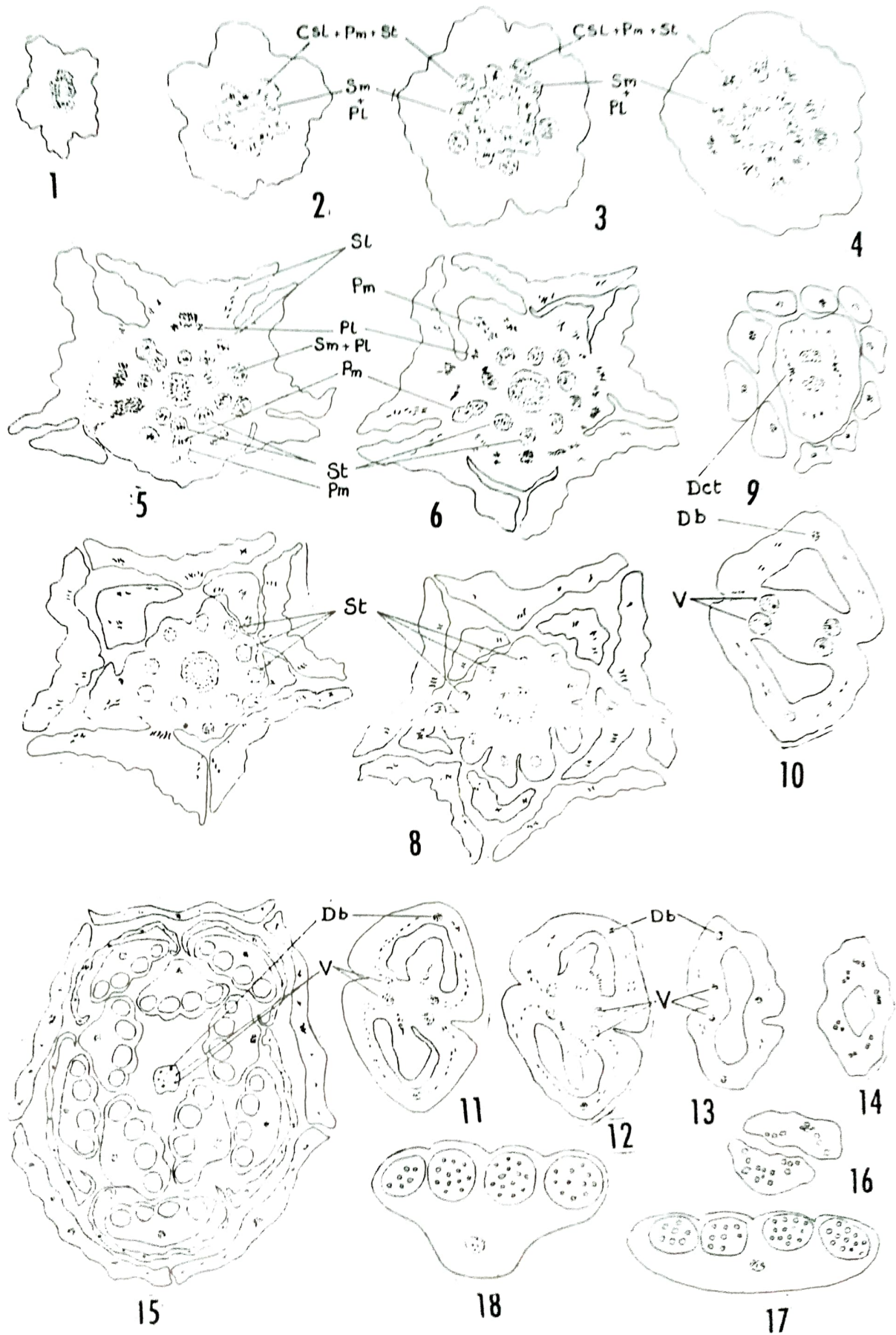
Both herbarium and FAA fixed materials have been used in the study. The herbarium materials have been processed following the procedure described by Narayana (1964) and conventional methods have been

followed for processing the pickled materials. Sections cut at a thickness of 8 to 12 microns, have been stained using crystal violet and erythrosin combination.

OBSERVATIONS

A common description is given for the flower and for convenience, the floral anatomy has been described separately for the two species.

Flower : The flower is pedicellate (Figs. 1, 19), bisexual, regular, hypogynous, pentacyclic and pentamerous (Figs. 15, 24, 29) except the gynoecium which is bimerous (Figs. 11, 30). The sepals are free and show valvate aestivation (Figs. 6-8). The petals are free and show induplicate valvate aestivation (Figs. 15, 29). The androecium consists of 10 free stamens arranged in two whorls of 5 each (Figs. 15, 29). The anthers are tetrasporangiate and the sporangia are arranged in one plane on the adaxial side in *Platytheca verticillata* (Figs. 15, 17, 18). In *Tremandra stelligera* the anthers are four lobed and the sporangia are arranged in two lateral pairs (Fig. 29). The distal part of the anther is sterile and prolonged into a beak like extension. Hypogynous disc is absent in *Platytheca verticillata*. In *Tremandra stelligera* an extra staminal 5 lobed disc is present and the disc lobes are antipetalous. At the level of separation of the staminal filaments, the disc lobes divide forming ten lobes which alternate with the staminal filaments (Figs. 24-27). The gynoecium is bicarpellary, syncarpous, bilocular and each locule bears a solitary subapical ovule in *Platytheca verticillata* (Figs. 11, 12) and two ovules in each loculus in



Figures 1-18 *Platytheca verticillata*. Serial transverse sections of flower buds showing the origin and distribution of the traces to the different floral parts.

Tremandra stelligera (Fig. 33). The ovary becomes unilocular above the ovule bearing region (Fig. 13). The long, solitary style shows a distinct canal without transmitting tissue (Figs. 15, 16) and terminates in two crescent shaped stigmas (Figs. 16, 33).

Floral anatomy

Platytheca verticillata: The pedicel shows a ring of vascular tissue (Fig. 1). The stele expands and becomes pentangular in the thalamus region. Five traces become organized from these angles and these represent the conjoint sepal lateral, petal median and staminal traces (Figs. 2,3). As these traces emerge outwards and reach the periphery of the thalamus, divide tangentially forming a row of three bundles. The outermost of these function as the common sepal laterals which divide radially demarcating the lateral traces of adjacent sepals (Figs. 5, 6). The bundles inner to the common sepal laterals function as petal median and the innermost constitute the supply for the stamens (Figs. 5,6). The first set of common traces are closely followed by another set of five traces which function as the combined sepal median and petal lateral traces (Figs. 2-4). These conjoint traces cut off two traces to the inside and the outer bundles enter the bases of the sepals. The inner petal lateral traces swing to the sides (Fig. 5) and come to lie on either side of the petal medians (Fig. 6). The common petal lateral and sepal median traces are closely followed by the antisepalous staminal traces (Figs. 5,6). At the level of separation of the petals, the ten staminal traces stand in a ring at the periphery and finally enter the staminal filaments (Figs. 7-10). At this level the main stele is in the form of a closed ring of vascular tissue (Fig. 7). At the level of separation of the stamens, the main stele breaks into four bands, two median and two lateral (Fig. 8). The median traces which function as dorsal carpellary traces give off branches which traverse the ovary wall and terminate towards the top (Figs. 9-14). Two pairs of heterocarpellary ventrals are organized from the lateral bands (Figs. 8,10-12). The ovular supply is derived from these bundles (Fig. 11).

Adnation between the common sepal laterals, petal median and antipetalous staminal traces, results in early demarcation of the antipetalous staminal traces, making the androecium obdiplostemonous (Fig. 15).

Besides supplying the ovules, the ventral bundles give off branches into the ovary wall (Figs. 11,12). These branches and those derived from the branching

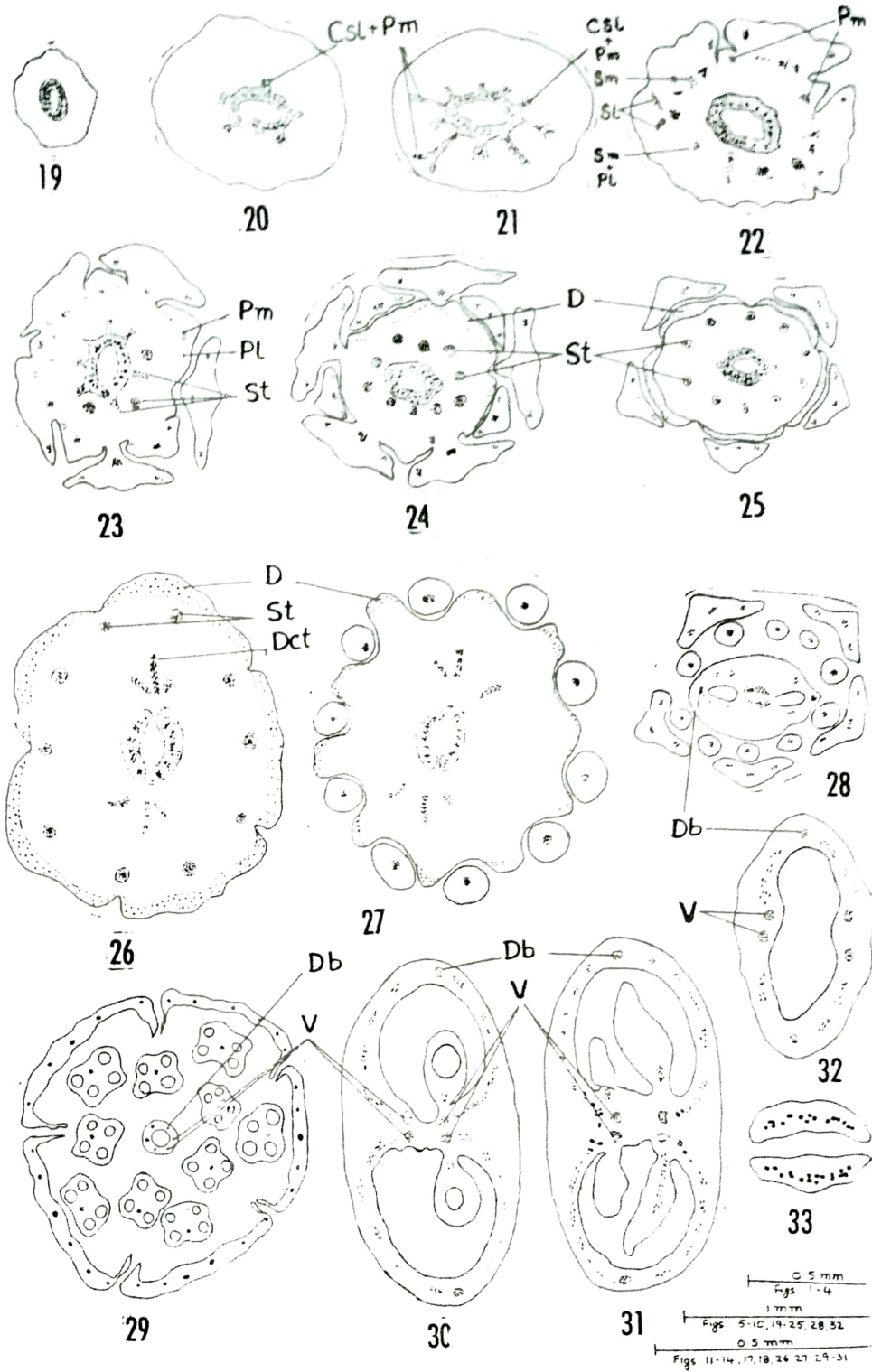
of the dorsals, traverse the ovary wall and terminates towards the top of the ovary. The hollow style is vascularised by the dorsals and ventral bundles (Fig. 15) which divide and form two arcs of vascular tissue in the crescent shaped stigmas (Fig. 16).

Tremandra stelligera: The pedicel shows a closed ring of vascular tissue (Fig. 19). The conjoint common sepal lateral and petal median and sepal median and petal lateral arise in two closely alternating whorls (Fig. 20,21). The common sepal laterals and sepal median and petal median and petal laterals become demarcated to the outside and inside respectively, as a result of tangential division of the conjoint traces (Fig. 27). After the emergence of the conjoint perianth traces, ten staminal traces arise in two alternating whorls independently from the main stele. The antipetalous staminal traces are demarcated earlier than the antisepalous ones, making the androecium obdiplostemonous (Figs. 23, 24). After the organization of the dorsal carpellary traces at the level of separation of petals, the main stele splits into two lateral bands of vascular tissue (Figs. 25-27). The dorsal bundles undergo branching and the branches traverse the ovary wall (Figs. 26-28). Two pairs of heterocarpellary ventrals are formed from the lateral bands of vascular tissue. Besides supplying the ovules, the ventrals give off branches into the ovary wall (Figs. 30-32). Above the ovule bearing region, the ovary becomes unilocular (Fig. 32). The stylar supply is constituted by the dorsal and heterocarpellary ventral bundles (Fig. 29). The stylar bundles divide forming arcs of vascular tissue in the stigmas (Fig. 33). The extrastaminal disc is devoid of vascular supply.

DISCUSSION

The floral anatomy of *Tremandra stelligera* and *Platytheca verticillata* shows that these taxa resemble *Tetratheca* (Laxmi and Narayana, 1987; Suvartha *et al.*, 1984; Saunders, 1937) in essential floral anatomical characters but exhibit certain distinctive features.

Bisexual, regular, hypogynous flowers, 3-traced valvate sepals, adnation between sepal median and petal laterals, 3-traced induplicate valvate petals, single traced stamens and 2-carpellary, 2-locular ovary are features shared by all the three taxa. However, in the 5-cyclic flowers, *Platytheca* and *Tremandra* (present study) differ from *Tetratheca* where they are tetracyclic owing to the suppression of the antisepalous staminal whorl for which there is no external or anatomical



Figures 19-33 *Tremandra stelligera*. Serial transverse sections of flower buds showing the origin and distribution of the traces to the different floral parts.

(Sm - Sepal median; Sl - Sepal lateral; Csl - Common sepal lateral; Pm - Petal median; pl - Petal lateral; St - Saminal trace; D - Disc; Dct - Dorsal carpillary trace; V - Ventral bundle; Db - Dorsal bundle; Sm+Pl - Conjoint sepal median and petal lateral traces; Csl+Pm+St - Conjoint sepal laterals, petal median and staminal traces)

evidence (Laxmi and Narayana, 1987; Suvartha *et al.*, 1984; Saunders, 1937). Though there is no external fusion between sepals, petals and stamens, their traces exhibit varying degrees of adnation. Adnation between the common sepal laterals, petal medians and antipetalous staminal traces, such as reported in *Tetralthea thymifolia* (Saunders, 1937) is present in *Platythea verticillata*, whereas *Tremandra stelligera* exhibits adnation between petal medians and common sepal laterals as was also reported in *Tetralthea affinis* (Laxmi and Narayana, 1987). In *Tetralthea efoliata* (Suvartha *et al.*, 1984), however the common sepal laterals and petal medians arise independently.

There is so far no record of obdiplostemony in Tremandraceae. The present study clearly brings to light this condition in *Platythea verticillata* and *Tremandra stelligera*, where the traces for the antipetalous stamens are demarcated earlier than the antisepalous ones.

The carpels are 3—traced and judging from the pairing of heterocarpellary ventrals and derivation of the ovular supply the placentation is interpreted as anatomically parietal in *Platythea verticillata* and *Tremandra stelligera* (Present study) and *Tetralthea affinis* (Laxmi and Narayana, 1987). However, Suvartha *et al.* (1984) reported 5-traced carpels and axile placentation in *Tetralthea efoliata*.

The stylar vasculature consists of dorsals and hetero-carpellary ventrals in *Platythea verticillata* and *Tremandra stelligera* (present study) and *Tetralthea affinis* (Laxmi and Narayana, 1987), whereas in *Tetralthea efoliata* (Suvartha *et al.*, 1984) only the dorsals extend into the style.

The family Tremandraceae has been variously treated under Polygalinae (Bentham and Hooker, 1862-1883; Cronquist, 1981; Melchior, 1964; Rouleau, 1981; Stebbins, 1974; Young, 1981), Pittosporales (Dahlgren, 1983; Hutchinson, 1973; Takhtajan, 1980; Thorne, 1983) and Teribinthales (Emberger, 1960).

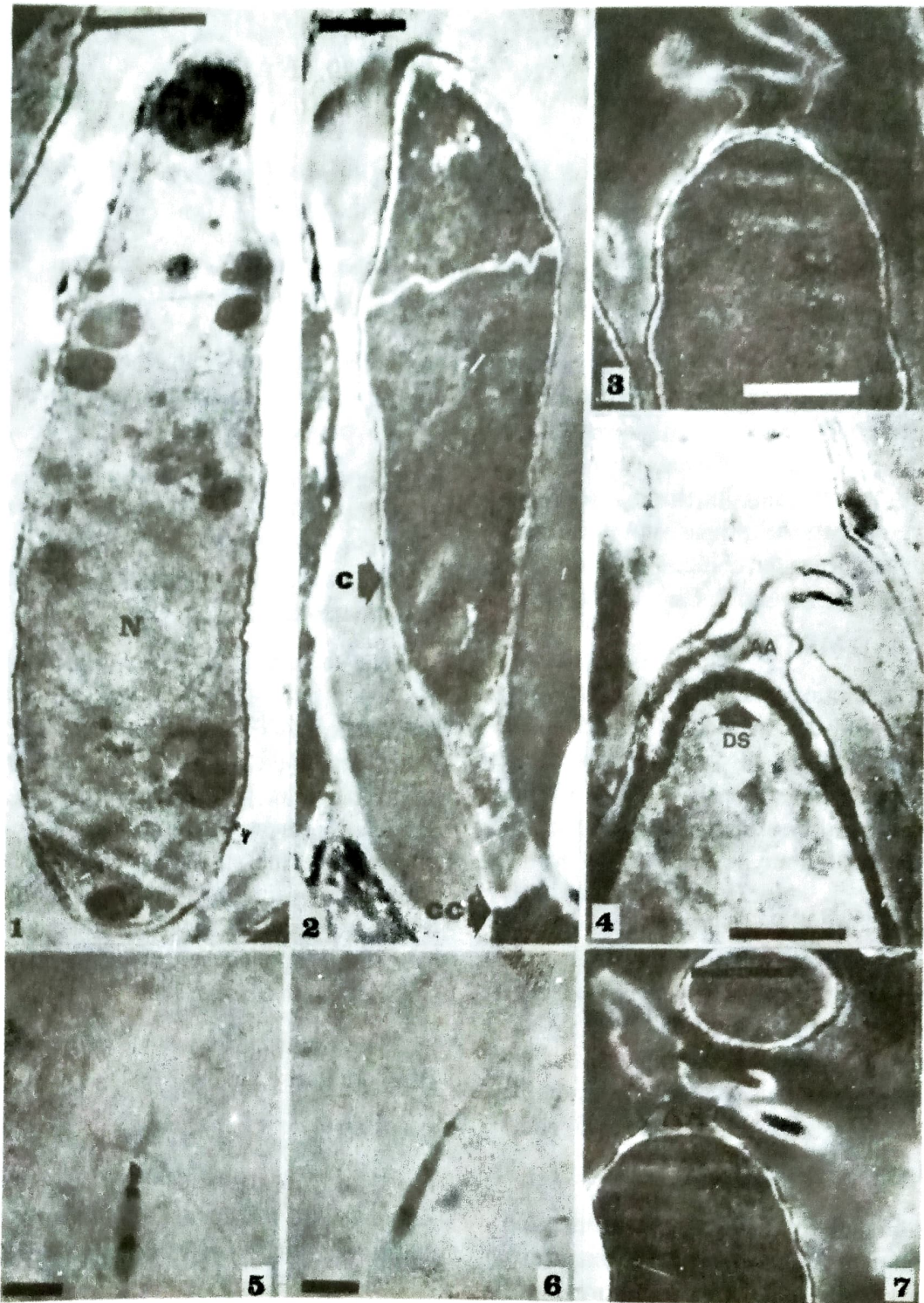
The available data on the floral anatomy of Tremandraceae do not support any relationships with the families included under the above mentioned orders. The 5-cyclic flowers and obdiplostemony seem to suggest a probable geranioid affinity. Goldberg (1986) also found this taxon to be included under the category "Incertae sedis". However, more work on the floral

anatomy and also in other collateral disciplines of botany is necessary to be able to arrive at more meaningful conclusion.

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Figures 1-7. Fig. 1. Vertical section of the conidium showing the nucleus (N) and lipid bodies (L) (Bar = 1 μ m), Fig. 2. Section of the conidium (C) showing detachment from the conidiogenous cell (CC) (Bar = 2 μ m), Figs 3,4. Vertical sections of conidia showing the extension of the conidial wall into the apical appendage (AA). Note the delimiting septum (DS) in between the conidium and the appendage (Bars = 1 μ m), Figs. 5, 6. Light photo micrographs of HCl - Giemsa stained conidia of *Robillarda depazeoides*, Fig. 5. Vertical section of conidium showing the migration of nucleus into the bulbous region of conidial appendage (Bar = 10 μ m), Fig. 6. Binucleate conidium with nucleate appendage (Bar = 10 μ m). Fig. 7. Section of the conidium showing the presence of protoplasm in the apical appendage (AA) (Bar = 1 μ m).

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