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RESEARCH ARTICLE

Petiolar Anatomy as an Aid in Taxonomy of the Genus Ixora L. (Rubiaceae)

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ABSTRACT

The present authors investigated petiolar anatomy of 12 species of the genus *Ixora* L. (Rubiaceae). The petioles (in T.S.) are horse shoe-shaped, planoconvex or circular in outline. They are usually winged and channeled adaxially. The extent of development of various tissues and their distribution, besides the cell inclusions, are observed. The vasculature is resolved into a conspicuous central arc, besides few other vascular bundles. The central arc is horse shoe-shaped, heart-shaped, circular, lunar or crescent shaped. The vascular arcs or bundles are capped abaxially by few sclerenchymatous layers, except few. The shapes of petiole, petiolar wings, features of epidermis, patterns of vascular supply and association of sclerenchyma with it, cell contents, etc. are thought systematically important. All these features are employed to prepare a key helping identification of the taxa investigated.

Keywords: *Ixora*, Petiole, Anatomy, Taxonomy.

INTRODUCTION

The genus *Ixora* L. (Rubiaceae) contains nearly 100 species (Hooker,1872-1897) and distributed in tropical Asia and Africa, America, Australia and the Pacific Island (Cooke, 1958, Hooker). They are either shrubs or small trees. The leaves are generally opposite and petiolate with interpetioler stipules. Hooker (*loc.cit.*) remarked that the species are most difficult to limit and diagnose. In such circumstances, it is worth to derive evidence from different disciplines of morphology. The present investigators, as a part of anatomy of the family Rubiaceae, extended observations on twelve species of the said genus. Anatomical observations are although fair in the family Rubiaceae, foliar anatomy and particularly petiolar anatomy is generally overlooked in past. This paper focused endomorphic features of the petiole with a view to its utility in identification *vis-a-vis* taxonomy of the genus. Important anatomical features are tabulated in Table-I.

MATERIAL AND METHODS

The plant materials were collected from different places of India like Tropical Botanic Garden and Research Institute, Palode, Thiruvanthapuram District (Kerala); Forest Research Institute, Peechi, Trichur (Kerala); Calicut University, Botanical Garden (Kerala); Malbar Botanical Garden, Kozhikode (Kerala) and Lal Bag Botanic Garden, Bangalore (Karnataka). Herbarium specimen especially of *Ixora lancceolaria* was received from Harbarium, Department of Botany, Calicut University, Calicut, Kerala. he collected leaf materials were fixed in F.A.A. solution, and then permanently preserved in (70%) alcohol. The materials were washed in water and kept ready for next stage of operation. Themiddle portion of petiole were selected for sectioning. Free hand transections of petiole were stained in safranin (1%) and fast green (1%) and mounted in D. P. X. Sketches were drawn using prismatic type of camera lucida and inked. (Plate I & II)

ABBREVIATIONS USED

Col : Collenchyma; **Cs :** Crystal sand; **Rc :** Rosette crystal; **Scl :** Sclerenchyma; **Tc :** Tannin cell.

DISCUSSION

Petiole is of considerable taxonomic importance since it is little affected by environmental change (*cf.* Metcalfe and Chalk, 1950). Metcalfe and Chalk (*loc. cit.*) although earmarked certain petiolar features of taxonomic significance, there are very few reports of their applications in systematics Ratnakumari*et al*., (2002), Shisode and Patil (2008, 2011), Thakur and Patil (2011) and Dehgan (1982) found endomorphic petiolar features of systematic value. The petiolar part of foliage has generally escaped from observations by many while studying foliar anatomy. The present authors extended anatomical observations on leaves of the family Rubiaceae as an exclusive topic of research. The present study on 12 species of the genus *Ixora* is a part of it. The endomorphic features e.g. epidermis, vascular pattern, cell inclusion like rosette crystals, association of sclerenchyma with the vascular tissue, etc. have been presented in the Table-I. All these have been employed to devise a dichotomous key which helps to identify the various species of the genus. Carlquist (1961) thought that the leaves afford characters of potential taxonomic significance, being the most varied organ of angiosprmic plants. This hold true for the observations made by the present authors. Following key appears useful to identify the species studied. (Refer Annexure I)

OBSERVATIONS

Ixora is one of the largest genus belonging to the gamopetalous family Rubiaceae. The present authors extended anatomical observations on 12 species hitherto uninvestigated. They present segment projects anatomical details of petioles of these species with respect to epidermal and hypodermal region, vasculature, conjunctive tissue, and shapes of petiole in T.S., occurrence of wings, shape of vascular arcs, number of additional vascular bundles, presence of sclerenchyma, cell inclusions, etc. All these features of each species are precisely presented in Table-I.

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Annexure I

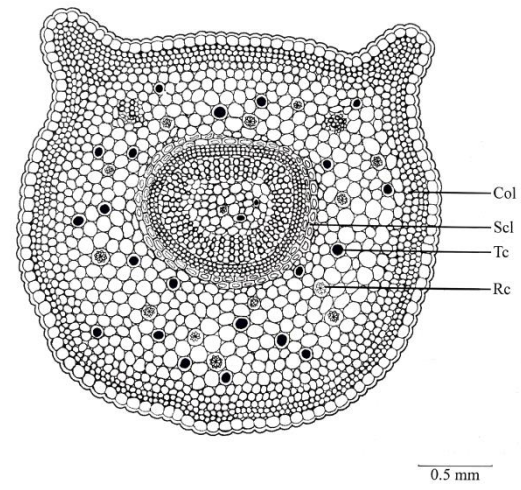
Key to the Species of the Genus *Ixora* L.

1. Petiole planoconvex in T.S. 2
1. Petiole not planoconvex in T.S. 6
    2. Central vascular arc heart-shaped .....*I. brachiata*
    2. Central vascular arc not as above 3
        3. Vascular tissue resolved into an arc and two additional vascular bundles 4
        3. Vascular tissue resolved only into an arc ..... *I. thwaitsii*
            4. Petiole deeply winged adaxilly .....*I. alba*
            4. Petiole not as per above 5
                5. Rosette crystals present in ground tissue .....*I. finlaynsoniana*
                5. Rosette crystals absent in ground tissue ..... *I. nigricans*
                    6. Vascular tissue resolved into an arc and two additional vascular bundles 7
                    6. Vascular tissue resolved into an arc and 3-4 additional vascular bundles 8
                        7. Vascular arc associated with continuous layers of sclerenchyma abaxially ..... *I. jawanica*
                        7. Vascular arc associated with patches of sclerenchyma abaxially .....*I. malabarica*
                            8. Central vascular tissue resolved as a continuous cylinder 9
                            8. Central vascular tissue resolved not as above 11
                                9. Petiole prominently winged ..... *I. johnsonii*
                                9. Petiole not as above 10
                                    10. Epidermal cellsbarrel-shaped and collenchymatous hypodermis 3-4 layered ..... *I. monticola*
                                    10. Epidermal cells barrel-shaped and collenchymatous hypodermis 3-4 layered ..... *I. singaporensis*
                                        11. Petiole prominently Winged ..... *I. lanceolaria*
                                        11. Petiole not as above ..... *I. polyantha*

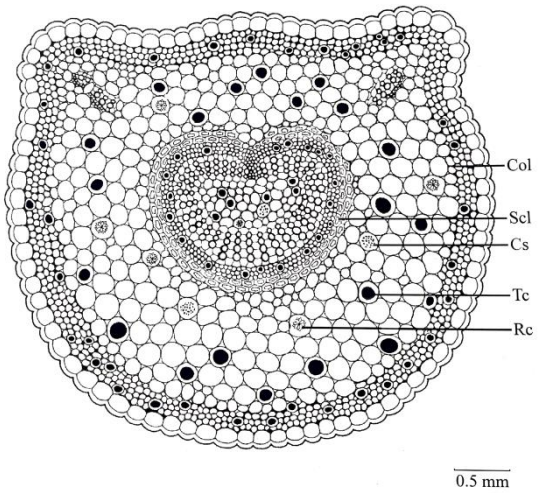
Table I : Anatomical Observations

Sr. No.	Plant Species Studied	Shape of Epidermal cells	No. of Hypodermal layers	Wings present/ absent	Shape of central vascular arc	No. of additional bundles	Shape of cells in conjunctive tissue cells	Rosette crystals	Tannin	Vascular tissue caped by sclerenchyma
1	*Ixora alba* L.	Squarish	2-3	Present	Circular	02	Rounded	Present	Present	2-Layer
2	*Ixora brachiata* Roxb. ex DC.	Squarish	4-5	Present	Heart-Shaped	04	Rounded	Present	Present	2-Layer
3	*Ixora finlaysoniana* Wall. ex Don	Beaded	3-4	Absent	Circular	02	Rounded	Present	Present	Patches
4	*Ixora javanica* D C.	Squarish	4-5	Present	Circular	02	Rounded	Absent	Present	2-Layer
5	*Ixora johnsoni* Hook. *f.*	Squarish	3-4	Present	Circular	04	Rounded	Present	Present	1-Layer
6	*Ixora lanceolaria* Colebr.	Squarish	3-4	Present	Lunar-Shaped	04	Rounded	Present	Present	2-Layer
7	*Ixora malabarica* (Dennst.) Mabberley	Beaded	3-4	Present	Lunar-Shaped	02	Rounded	Present	Present	Patches
8	*Ixora monticola* Gamble	Barrel-shaped	3-4	Present	Circular	04	Rounded	Present	Absent	2-Layer
9	*Ixora nigricans* R. Br.ex Wight & Arn.	Squarish	3-4	Present	Circular	02	Rounded	Absent	Present	Patches
10	*Ixora polyantha* Wight	Squarish	2-3	Absent	Lunar-Shaped	04	Rounded	Present	Present	2-Layer
11	*Ixora singaporensis* Linn.	Squarish	1-2	Present	Circular	03	Rounded	Present	Present	Absent
12	*Ixora thwaitesii* Hook. *f.*	Squarish	2-3	Present	Circular	Absent	Rounded	Present	Absent	1-Layer

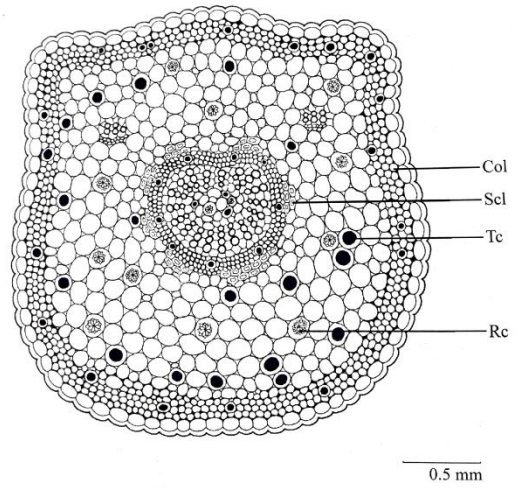
PLATE I



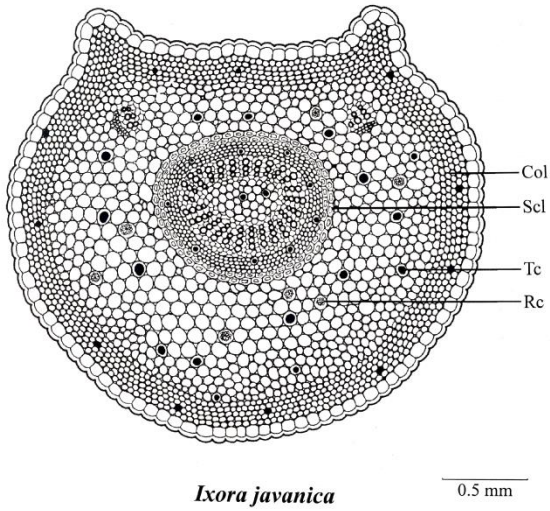
Ixora alba



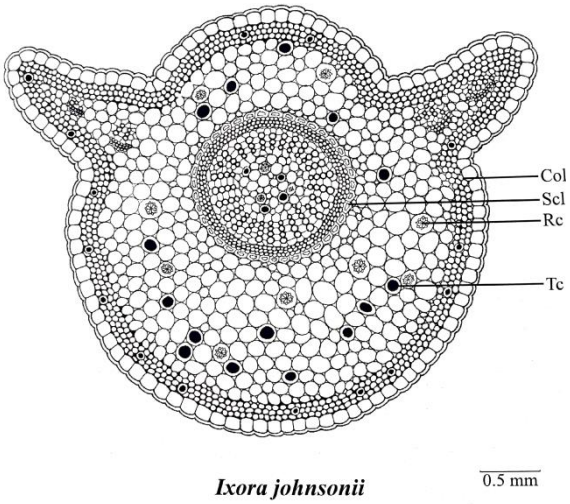
Ixora brachiata



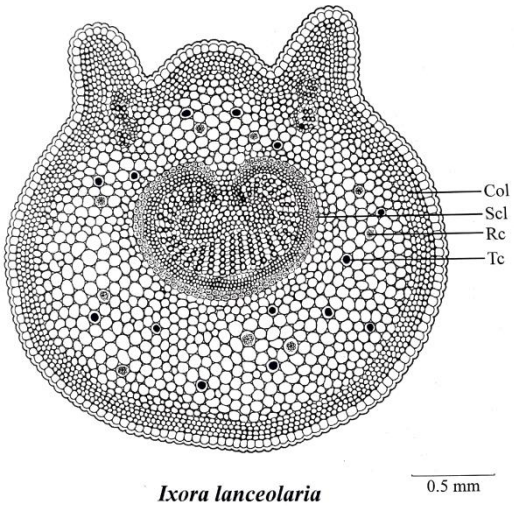
Ixora finlaysoniana



Ixora javanica

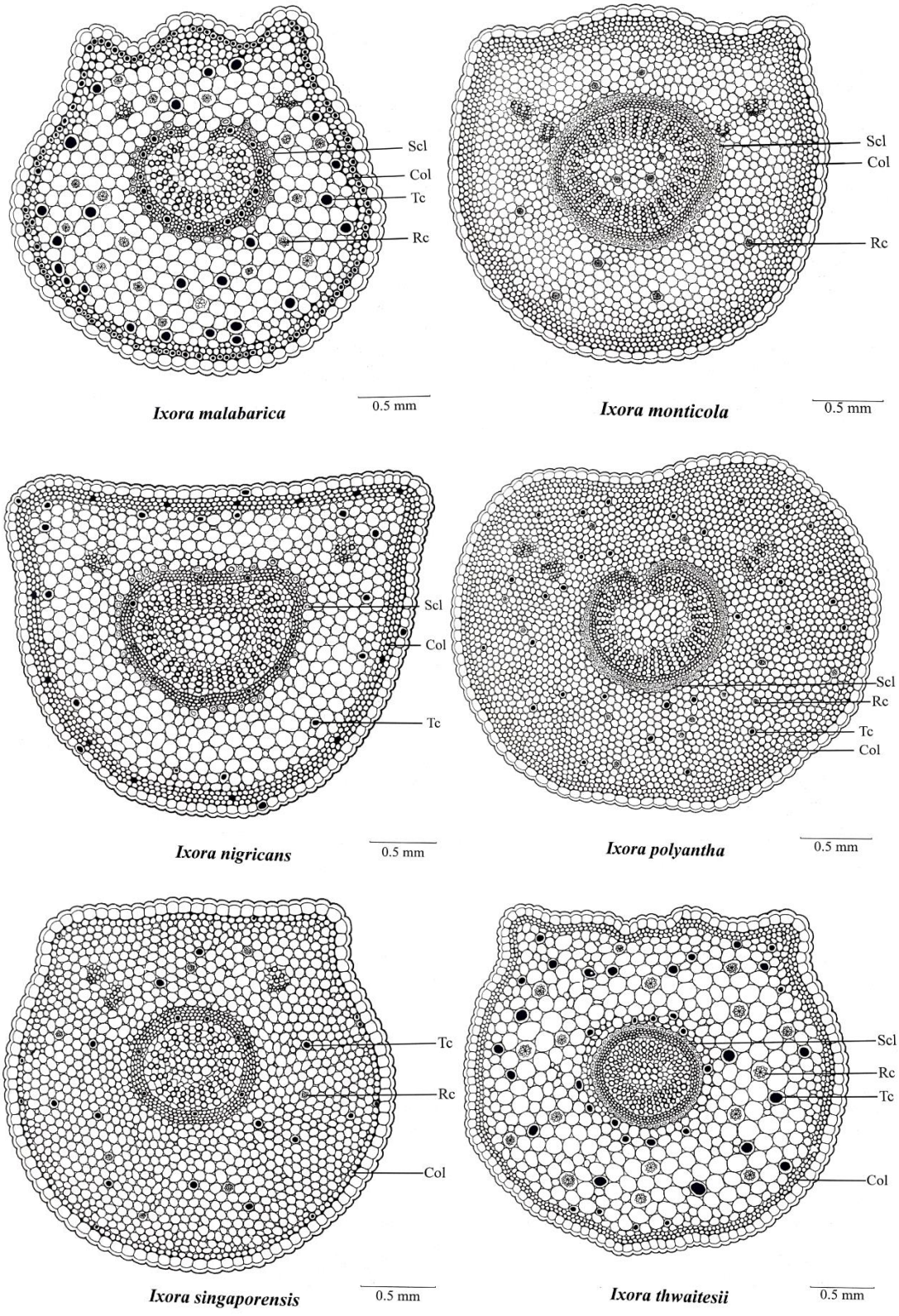


Ixora johnsonii



Ixora lanceolaria

PLATE II


Scl
Col
Tc
Rc
0.5 mm
Ixora malabarica
Scl
Col
Rc
0.5 mm
Ixora monticola
Scl
Col
Tc
0.5 mm
Ixora nigricans
Scl
Rc
Tc
Col
0.5 mm
Ixora polyantha
Tc
Rc
Col
0.5 mm
Ixora singaporensis
Scl
Rc
Tc
Col
0.5 mm
Ixora thwaitesii