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Research Article

ANATOMICAL STUDIES OF SOME COMMON MEMBERS OF MALVACEAE *S.S.* FROM WEST BENGAL

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ABSTRACT
Anatomical features are more conserve than morphological features, therefore, useful for taxonomic study. The stem, leaf and seed anatomy of some common members of Malvaceae s.s. have been studied in details. These anatomical features are used for the preparation of an identification key.

Keywords: *Anatomy, Malvaceae S.S*

INTRODUCTION
Systematic anatomy has a long history since the invention of microscope. Taxonomists found anatomical similarities among related plant groups (Cutler *et al.*, 2007). Anatomy along with plant structure and morphology always treated as the backbone of plant taxonomy and systematists elucidated the plant diversity, phylogeny and evolution following these traits (Endress *et al.*, 2000). Anatomical data are applied to improve classification schemes and it is often used for identification. Wide range of anatomical data is used by systematists including anatomy from stem, leaf, petiole, stipule, node, flower, fruit, seed etc. Often these anatomical features are correlated with environmental factors. Anatomy of a plant is more conserve than morphological data therefore useful to circumscribe taxa with wide morphological variations.

A number of anatomical studies were performed in Malvaceae on various aspects. The seed anatomy of cotton was compared with other Malvacious plants (Reeves, 1936) of the tribes Malveae and Ureneae. Klotz (1975) described the structure of the gynoecium in two species of *Bakeridesia*. Jensen (2000) showed that vascular anatomy is useful to delimit the core Malvales from other families. Floral development and androecium structure of Malvoideae (Malvaceae s.l.) was studied by Balthazar (2004). Anatomical properties of *Malva neglecta* for Turkey were studied by Akcin & Ozbucak (2006). In a latest study Garcia *et al.*, (2014) investigated the detailed leaf anatomical features of three Brazilian native species of *Theobroma* sp. (Malvaceae s.l.). The present study deals with the study of some anatomical features found in the family Malvaceae s.s. The obtained characters from anatomical study have future been utilized for making taxonomic key.

MATERIALS AND METHODS
All the plant specimens for the present study were collected from different places around Kolkata. Plants were identified following standard literatures. Table 1 shows the list of studied taxa and place of collection.

Table 1: List of Studied Taxa

Sl No.	Plant Names	Place of collection
1	*Fioria Vitifo Lia* Linn.	Barasat, W.B.
2	*Malvastrum Coromandeliamun* (L.) Garcke	Barasat, W.B.
3	*Sida Rhombifolia* Linn.	Barasat, W.B.
4	*Abutilon Indicum* G. Don	Howrah, W.B.
5	*Thespesia Populnea* Corr.	Barasat, W.B.
6	*Gossypium Herbaceum* Linn.	Kalayni, W.B.

Fresh leaf and stem samples were fixed in 70% ethanol within few hours after collection. Both hand and microtome section techniques were applied to get thin sections from stem, leaf and seed.
Johansen's double staining method was followed for staining. In some cases 1% Phluroglucinol (dissolved in 6N HCl) was used to study vessels and fibres. Anatomical pictures from both hand and microtome sections were taken under a Carl Zeiss Axio. Lab. A1 microscope with photographic attachment. Anatomical measurements were done in Axio Vision software.

RESULTS AND DISCUSSION

The measurements of various anatomical features are given in details in Table 2. The cuticle thickness is highest in *Gossypium* and lowest in *Malvastrum*. The bast fibers are larger in *Fioria*, *Gossypium* and *Thespesia*. *Thespesia* is characterized by the absence of stem and leaf trichomes. In all other species the stem and leaf trichomes are present. The largest trichome is observed in *Gossypium*. Longest palisade parenchyma cells are found in *Gossypium* and *Thespesia*, whereas the spongy mesophyll cell diameters are more or less equal in all studied taxa. Cambium layer (number of cell layers) is thicker in *Thespesia* indicates its high cambium activity.
The most interesting observation was the diverse shape difference of bast fibres (phloem fibers) in the stem section (Figure 1). *Abutilon* and *Sida* show more or less similar kind of bast fiber. In case of *Abutilon* bast fibers are found in separate patches whereas continuous bast fibres around vascular bundle are observed in *Sida*. *Malvastrum* shows thick bust fibers in patches. Morphologically the bast fibers are more or less similar in *Thespesia* and *Gossypium* and found in patches.
Leaf anatomically all the specimens (Figure 2) show typical dorsiventral type of leaves, the dorsal layer of elongated palisad cells and ventral layer of round spongy cells. The quantitative differences between these two types of cells and culticale thickness are presented in Table 1. Trichomes are frequent on the upper epidermis. *Gossypium* shows the largest trichomes and *Thespesia* leaves are trichome less.
A common feature is observed in all these specimens which are the cystolith like structures in mesophyll tissues (Figure 3). A comparative seed anatomy was presented in Figure 4. *Fioria* seed coat is thicker than *Sida*. Endothelium layer is prominent and thicker in *Fioria* whereas it is indistinct and present in small patches in *Sida*. In *Fioria* the endosperm is distributed throughout the embryo whereas in case of *Sida* the endosperm is confined at the apical part of the embryo. This clear-cut distinction between these two species indicates the seed anatomy would be a useful character for taxonomic treatment of the members of Malvaceae.

Conclusion

The anatomical characters of the studied taxa are varied considerably. So these characters are useful to delimit the taxa. An identification key to the genera is given below considering the studies anatomical features.

(1) Bast fibres appear as continuous band …… ... (2)

(1) Bast fibres appear as small patches ……..…… … (3)

(2) Trichomes densely present over the stem surface, lumen diameter of bast fibre cell is < 6 µ and bast fibre cells are more or less round shaped ……. *Abutilon*
(2) Trichomes spearsly present over the stem surface, lumen diameter of bast fibre cell is > 6 µ and bast fibre cells are elongated shaped ……..……... *Sida*
(3) Trichomes completely absent ……..…… …. *Thespesia*

(3) Trichomes present ……...……..... (4)
(4) Trichomes unicellular with pointed tip and lumen diameter of bast fibre cell is < 15 µ ……..……..…. (5)

(4) Trichomes unicellular with obtuse tip, bast fibre cells are hexagonal or pentagonal and large lumen diameter of bast fibre cell is > 15 µ …….. *Fioria*

(5) Largest trichomes (ca.1350 µ long), bast fibre cells are elongated shaped with (20x13 µ) size ……..….. *Gossypium*

(5) Trichomes small (ca.966 µ long), bast fibre cells are more or less round shaped with (15x10 µ) size …… *Malvastrum*

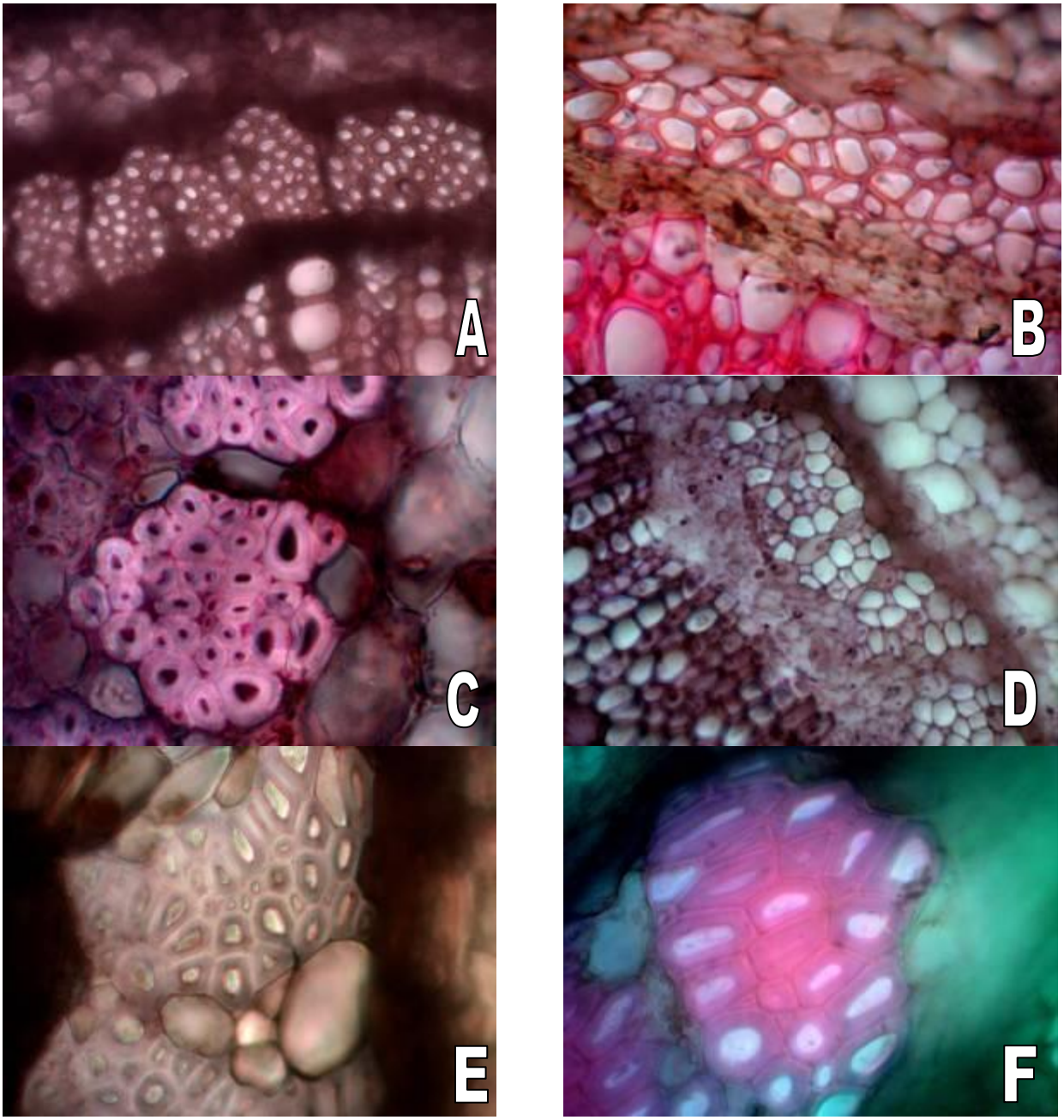


Figure 1: Bast Fiber Anatomy. A- *Abutilon Indicum*; B- *Sida Rhombifolia*; C- *Malvastrum Coromandeliamun;* D- *Fioria Vitifolia*; E- *Thespesia Populnea* and F- *Gossypium Herbaceum*. A and D in 40X magnifications and B, C, E and F in 100X Magnifications

Table 2: Detailed Anatomical Measurements and Trichome Characters of Studied Taxa

Sl No.	Characters		*Fioria*	*Malvastrum*	*Sida*	*Abutilon*	*Thespesia*	*Gossypium*
1	Size of Epidermal Cell in Stem	Length	13.612 ± 2.43	16.932 ± 1.62	10.956 ± 1.32	16.268 ± 1.24	9.960 ± 1.81	14.608 ± 3.04
		Breadth	17.928 ± 4.45	2.347 ± 24.9	14.608 ± 4.60	13.28 ± 1.17	15.272 ± 2.72	16.932 ± 2.16
2	Cuticle Thickness		3.498 ± 0.30	1.892 ± 0.22	2.224 ± 0.70	3.692 ± 1.16	6.129 ± 1.92	10.175 ± 3.20
3	Size of Epidermal Cell in Leaf	Length	15.604 ± 2.77	17.264 ± 1.48	10.956 ± 3.99	12.084 ± 3.70	19.588 ± 0.74	17.928 ± 3.19
		Breadth	25.232 ± 4.29	26.892 ± 4.13	20.584 ± 3.99	20.916 ± 3.01	22.576 ± 5.06	17.596 ± 3.44
4	Cuticle Thickness in Leaf		1.792±0.18	1.494.0.16	2.025±0.378	1.626±0.074	3.253±0.09	1.726±0.148
5	Size of Bast Fiber	Length	20.916±4.78	14.608±1.38	14.94±1.66	13.114±2.37	19.256±1.89	19.92±2.03
		Breadth	14.94±2.34	9.29±0.90	9.29±1.89	6.97±1.38	13.94±0.90	12.616±2.77
6	Lumen Diameter of Bast Fibre		15.272±3.96	7.968±1.38	10.292±1.81	5.312±1.38	17.596±3.01	8.3±2.62
7	Size of Hairs in Stem	Length	129.48±12.25	962.8±40.66	93.624±7.29	70.716±3.23	-	1344.6±74.23
		Breadth	10.292±2.16	35.192±3.96	6.108±0.89	3.71±0.41	-	31.872±2.72
8	Size of Palisade Parenchyma Cell	Length	36.52±6.21	34.196±7.10	27.224±3.82	31.872±4.60	55.444±13.207	52.456±3.44
		Breadth	11.288±2.16	12.616±2.51	9.96±1.17	8.46±0.90	9.296±1.48	9.628±1.38
9	Spongy Cell Diameter		15.272±2.46	18.592±2.16	11.952±2.46	15.936±2.51	14.94±1.17	12.284±1.48
10	Number of Cell Layer in Cambium in Stem		4 to 6	3 to 4	6	4 to 5	12 to 15	6
11	Xylem Layer Thickness in Stem (no. of Layer)		4 to 5	5 to 8	4 to 6	6 to 8	5 to 7	7 to 11
12	Hypodermis Thickness (i.e no. of Cell Layer)		5	5 to 6	-	3 to 4	7 to 8	1 to 18
13	Trichome Type		Stellate, Unicellular, Obtuse Tip	Stellate, Unicellular, Pointed Tip	Stellate, Unicellular, More	Stellate, Unicellular, Pointed Tip	Smooth Surface, No Hair Found	Stellate, Unicellular, Very Thin Pointed Tip

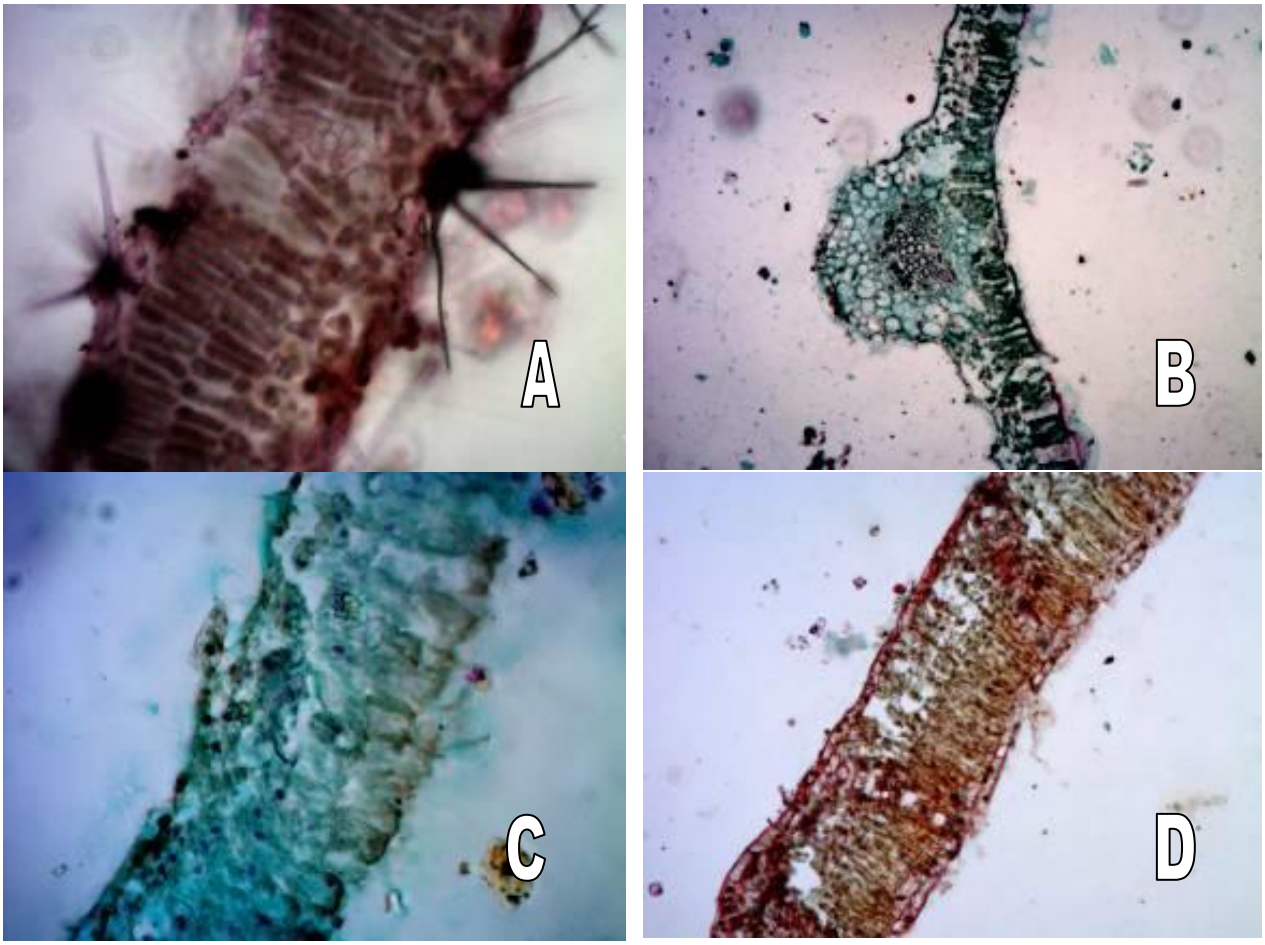
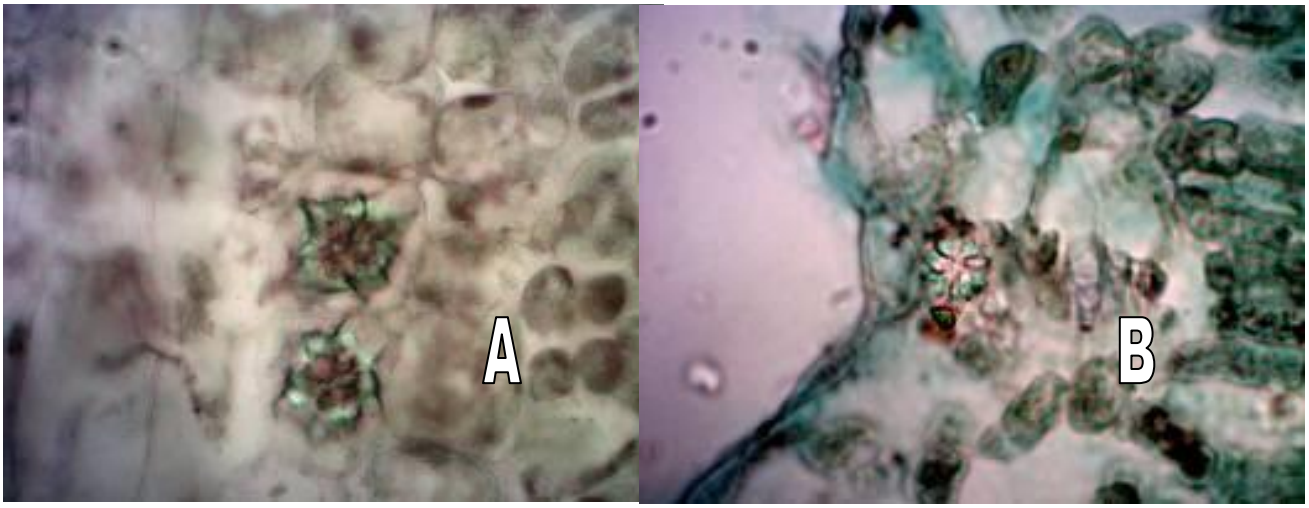


Figure 2: General Leaf Anatomy. A- *Abutilon Indicum*; B- *Sida Rhombifolia*; C- *Malvastrum Coromandeliamun* and D- *Thespesia Populnea*. A, C and D in 10X Magnifications; B in 5X Magnification



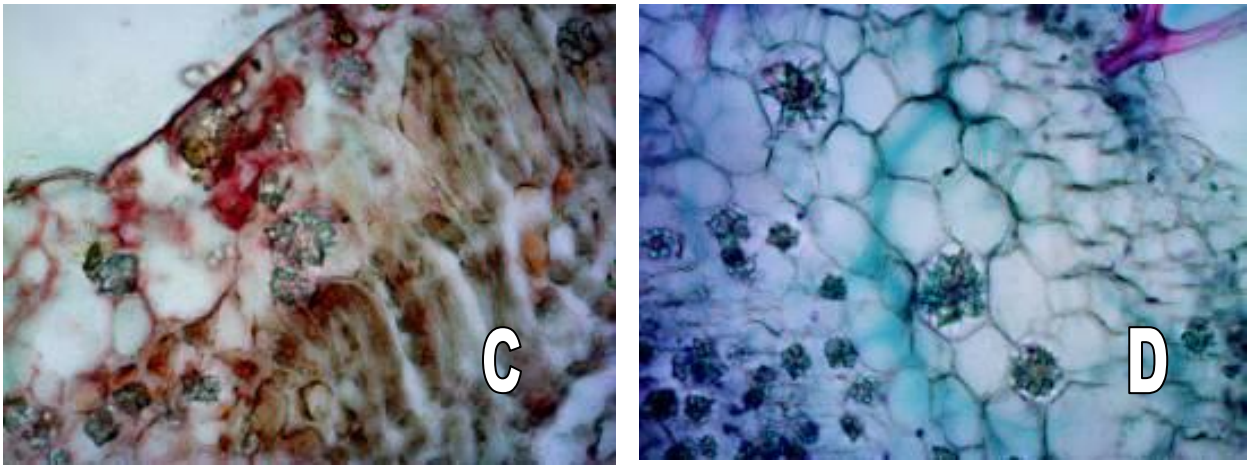


Figure 3: Cystolith Like Structures in Leaf Mesophyll. A- *Abutilon Indicum*; B- *Sida Rhombifolia*; C- *Thespesia Populnea* and D- *Fioria Vitifolia*. Magnifications- 40X

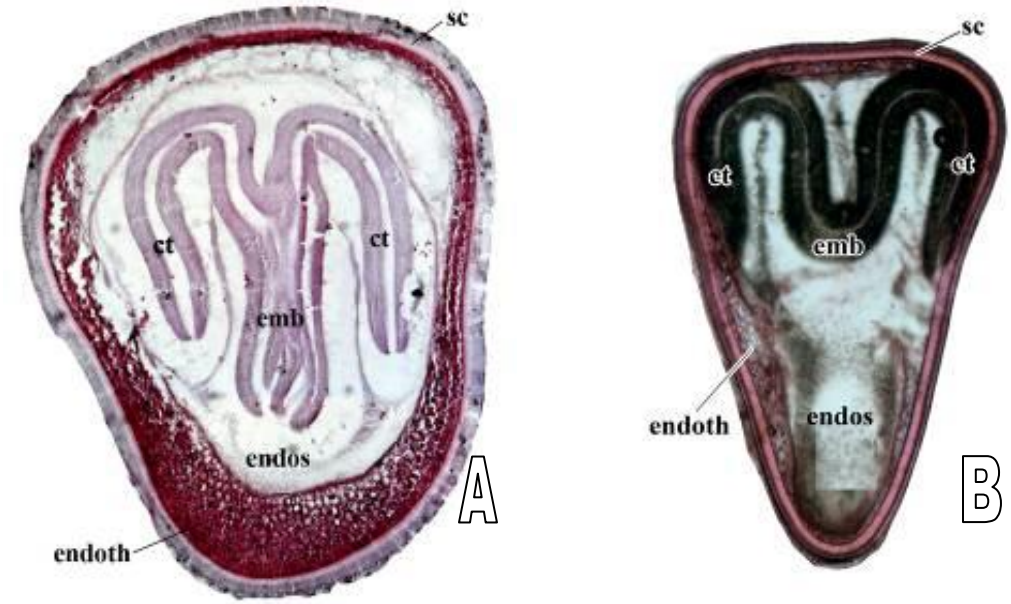


Figure 4: Seed Anatomy. A- *Fioria Vitifolia*; B- *Sida Rhombifolia*
Sc- Seed Coat, Ct- Cotyledon, Emb- Embryo, Endos- Endodermis and Endoth- Endorhelial Layer Magnifications- 40X

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