

HISTOANATOMY OF *BACOPA CAROLONIANA* (WALT.) ROBINS (SCROPHULARIACEAE)

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INTRODUCTION

Bacopa caroliniana (Walt.) Robins. (syn. *B. ampexicaulis* (Pursch.) Wettst., *Moniera ampexicaulis* Michx., *Obolari caroliniana* Walter), known as blue water hyssop, belongs to the Scrophulariaceae family, living mostly in bog or semi-submersed conditions, adapting well if flooded and fully submerged. Its ability to grow in water makes it a popular aquarium plant (Haynes & Holm-Nielsen, 1994; Muhleberg, 1982). The leaves of this plant are succulent, smell of lemon if crushed, and relatively thick. Leaves are oblanceolate and are arranged oppositely on the stem. It grows up to 50-100 cm. The flowers are blue, with five petals (Cook, 1985; Wikipedia free encyclopedia). Our purposes were to show some features of anatomical interest concerning *Echinodorus cordifolius* root, stem and the sessile leaf, in accordance with its hydrophytic habit.



Bacopa caroliniana (Walt.) Robins

MATERIAL AND METHODS

The plant was collected from the faculty laboratory aquarium. Small pieces of the root, stem and leaf were fixed in FAA (formalin:glacial acetic acid: alcohol 5:5:90). Cross sections of the vegetative organs were performed using the classical technique used in vegetal histology (Bercu & Jianu, 2003). The samples were stained with alum-carmin and iodine green. Histological observations and micrographs were performed with a BIOROM – T bright field microscope, equipped with a TOPICA 6001A video camera. The microphotographs were obtained from the video camera through a computer.

RESULTS AND DISCUSSIONS

Cross section of the root reveals that the outermost layer of cells – rhizodermis – is composed of simple radial barrel-shaped cells. Hairs are absent. The cortex is well developed and covers the major portion of the root. It is composed of a large number of conspicuous large air chambers, which are separated from each other by uniseriate partitions, named by Batanouny (1992) trabeculae. The air chambers are developed schizogenously (Bavaru & Bercu, 2002; Bouman, Houtuesen, 1996). However, around the stele, compactly arranged parenchymatous cells, regularly arranged in concentric layers, are present (fig. 1, A). Characteristically, the endodermis is one-layered, possessing Casparian strips, alternating, at places, with pericycle cells. The stele is enclosed by a one-layered pericycle. The vascular bundles are of radial type and four in number. The xylem elements show exarch condition, metaxylem towards the centre and protoxylem, facing the periphery. Phloem is well developed and present among the xylem groups (fig. 1, B). The undulate-outline stem, in cross section, reveals an epidermis, a cortex and the stele.

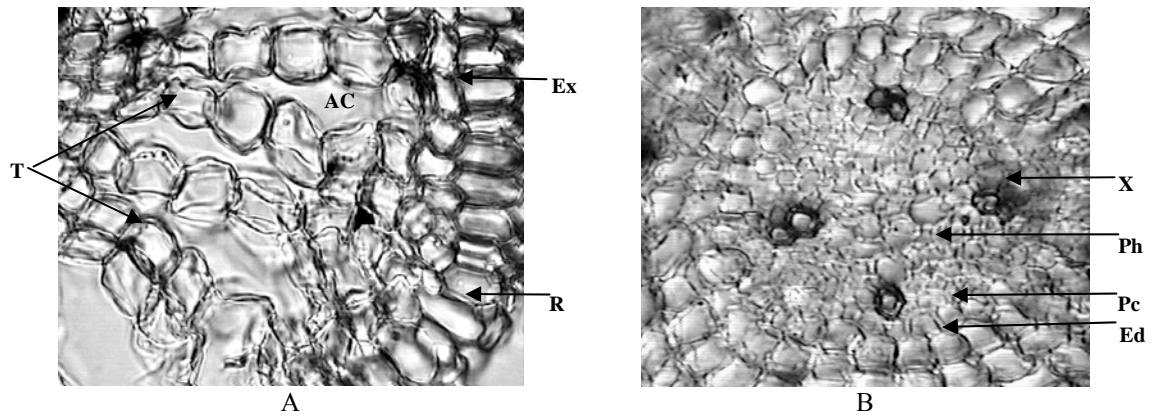


Fig. 1. Cross section of the root. Portion with rhizodermis and cortex (A). Detail of the stele (B). X 500: AC- air chamber, Ed- endodermis, Ex- exodermis, Pc- pericycle, Ph- phloem, R- rhizodermis, T- trabeculae, X- xylem (orig.)

The epidermis is one-layered with large thin-walled cells. The cortex lies beneath the epidermis and is made up of symmetrically arranged air spaces separated by thin partitions made up of a single layer of thin-walled cells (fig. 2 A, B).

Such as other aquatic plants, rests of diaphragmatic tissue may be present (Bercu, 2007). Epidermis and cortex contain abundant chloroplasts and stomata (fig. 2, C).

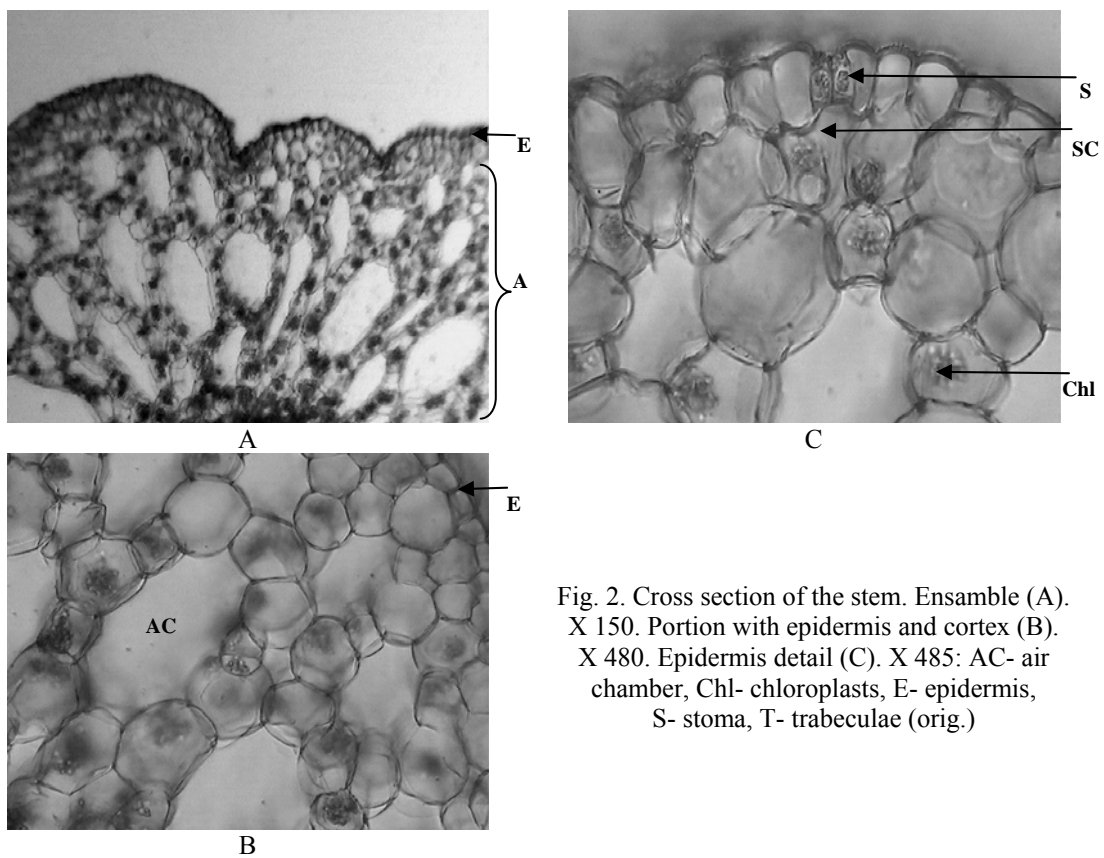


Fig. 2. Cross section of the stem. Ensemble (A). X 150. Portion with epidermis and cortex (B). X 480. Epidermis detail (C). X 485: AC- air chamber, Chl- chloroplasts, E- epidermis, S- stoma, T- trabeculae (orig.)

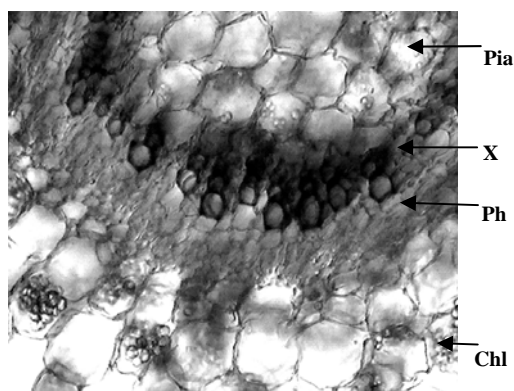


Fig. 3. Portion of the petiole stele in cross section. X 480: Chl- chloroplasts, Ph- phloem, Pi- pith, X- xylem (orig.)



Fig. 5. Paradermal section of the epidermis. X 530: EC- epidermal cell, SC- subsidiary cell, StC- stoma cell (orig.).

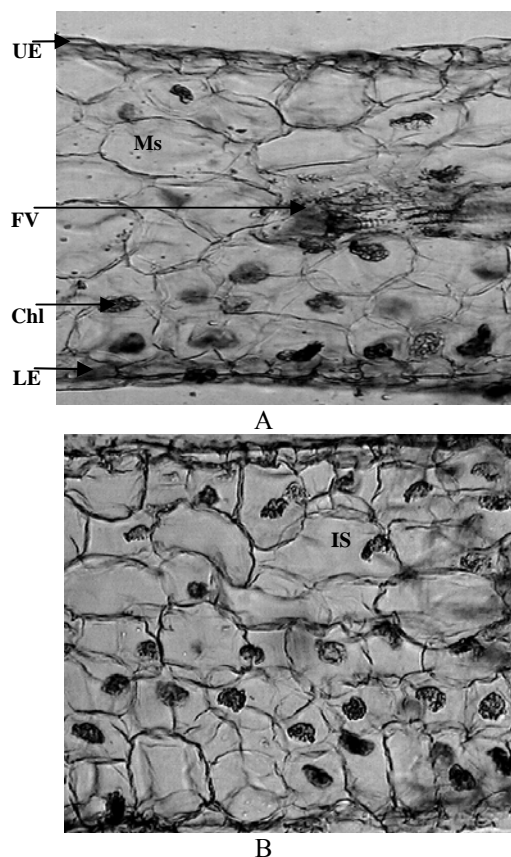


Fig. 4. Cross sections of the blade. Marginal portion with a vein vascular bundle (A). Portion with mesophyll (B). X 100: AC- air chamber, BS- bundle sheath, LE- lower epidermis, Ms- mesophyll, Ph- phloem, UE- upper epidermis, V- small vein, VB- vascular bundle, X- xylem (orig)

The centrally located stele is represented by xylem and phloem elements arranged on two concentric circles. The central vascular bundle consists of metaxylem vessels and a protoxylem lacuna. Phloem possesses sieve vessels, companion cells and few phloem parenchyma. The endodermis and pericycle are slightly differentiated. The pith is composed of large parenchymatous cells such as the cortical cells (fig. 3).

A transversal section through the blade exhibits the usual succession of tissues. The upper epidermis, such as the lower one, forms a single layer of elongated thin-walled cells.

The lower epidermis forms a slightly prominence. The epidermis continuity is interrupted by the presence of stomata.

The mesophyll is undifferentiated and consists of large thin-walled cells, enclosing intercellular spaces with abundant chloroplasts (fig. 4, A, B).

The vascular system of the veins is represented by poorly developed collateral bundles and consists of few xylem and phloem vessels.

Xylem is placed to the upper epidermis and phloem to the lower one. Each vascular bundle is unprotected by parenchymatous sheaths (fig. 4, A).

Paradermal section discloses large epidermal cells with undulate anticline walls. Here and there anomocytic stomata are present (Dilcher, 1974) (fig. 5.)

CONCLUSIONS

Results revealed that the root of *Bacopa caroliniana* possesses a typical primary structure. However, the cortex is well-developed, containing a large number of air chambers and the stele is characteristic to the dicots root.

The stem primary structure is characteristic to aquatic plants with large intercellular spaces – air chambers – in the cortex. Remarkable is the centrally located stele and the concentric arrangement of xylem and floem elements.

The mesophyll of the sessile leaf is homogenous with abundant chloroplasts. The epidermis continuity is interrupted by the presence of anomocytic stomata.

ABSTRACT

The article is a part of a complex study on the anatomy of aquarium plants and comprises investigation of the root, stem and leaf anatomy of a perennial creeping herb *Bacopa caroliniana* (Walt.) Robins. The anatomical characteristics of *Echinodorus cordifolius* vegetative organs has been described and discussed. The root has a typical primary structure. The stem cortex is an aerenchyma and the centrally located vascular system is poor developed related to the cortex. The sessile semi-submersed leaves epidermis possess stomata. The mesophyll is represented by a spongy tissue. In the mesophyll are embedded few poor developed vascular bundles. In the literature a study into the anatomy of this species almost lack, excepting some systematic studies.

REFERENCES

1. BAVARU A., BERCU R., 2002 – Morfologia si anatomia plantelor, Ed. Ex Ponto, Constanta
2. BATANOUNY K.H., 1992 – Plant Anatomy. University Press, Cairo.
3. BERCU R., JIANU D.L., 2003 - Practicum de Morfologie și anatomia plantelor. „Ovidius” University Press, Constanta
4. BERCU R., 2007 - Morfologia si anatomia cormofitelor acvaticе, Ed. Ex Ponto, Constanta
5. BOUMAN F, HOUTUESEN J., 1996 - Strukturele botanie. 2. Weefsels, CD-ROM Versie, SEP, Hugo de Vries laboratorium
6. COOK C.D.K., 1985 - Range Extensions of Aquatic Vascular Plant Species. J. of Aquatic Plant Managemen, 23: 1-6
7. DILCHER D.L., 1974 - Approaches to the identification Angiosperm leaf remains. Bot. Rev., New York, 40: 24-25, 42-47, 86-103
8. HAYNES R.R, HOLM-NIELSEN L.B, 1994 - The Alismataceae, Flora Neotropica, New York Botanical Garden, New York
9. MUNHLEBERG H, 1982 - The Complete Guide to Water Plants, EP Publishing Ltd., Germany
10. WUNDERLIN R.P, 1998, Guide to the Vascular Plants of Florida. University Press of Florida
11. Wikipedia free encyclopedia
http://en.wikipedia.org/wiki/Bacopa_caroliniana

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