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HISTOANATOMY OF *ECHINODORUS CORDIFOLIUS* (L.) GRISEB. *(ALISMATACEAE)*

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ABSTRACT. The article comprises investigation of the adventitious root, rhizome and leaf anatomy of an aquatic perennial herb Echinodorus cordifolius (L.) Griseb. (sin. E. radicans (Nuttall) Engel. Alisma cordifolia L.). The origin of this species is from the wetlands (marshes, swamps and ponds) in Mexico and North America, over Caribian Islands but widespread from Venezuela to Columbia. This species belongs to Alismataceae family, living mostly amphibious (roots, rhizome and leaf petiole). The leaves are emersed, rarely submersed. The flowers are 25 mm wide and have white petals. There are clustered in racemes of 3-15 flowers. The fruit is a plump. The anatomical characteristics of Echinodorus cordifolius vegetative organs has been described and discussed. In the literature a study into the anatomy of this species almost lack, excepting some systematic studies on this plant.

Keywords: anatomy, root, stem, blade, *Echinodorus cordifolium*

INTRODUCTION

Echinodorus cordifolius (L.) Griseb. belongs to the large Alismataceae family, is an aquatic plant, living mostly amphibious. It is a perennial herb found in wetlands, occasionally it may be found in the marshes, swamps and ponds (Cook, 1985; Wikipedia free encyclopedia). The leaves have petioles up to 80 cm and the middle green blades have a broad oval form and 7 to 9 veins leave the base. The submerged leaves can be spotted red-brown. *Echinodorus cordifolius* blade has a cordate base (therefore the name) and pellucid markings as short lines (Wunderlin, 1998). The flowers are clustered in racemes of 3-15 flowers, appearing in long day periods growing up to 120 cm from the base to the first whorl. Each flower is 25 mm wide and has white petals. First of all the inflorescence is growing erect, but soon lay down by his mass and then creeping above the ground. The fruit is a plump. Adventitious plants are soon appearing at the whorls and can be used for propagation. *Echinodorus cordifolium* is recommended only for large aquariums trade (Haynes and Holm-Nielsen, 1994; Muhleberg, 1982). Our purposes were to show some features of anatomical interest concerning *Echinodorus cordifolius* root, stem and the sessile leaf, in accordance with it hydrophytic habit.

MATERIALS AND METHODS

The plant was collected from the faculty laboratory aquarium. Small pieces of the adventitious root, rhizome and leaf were fixed in FAA (formalin:glaciar 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-carmine 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 advetitious root reveals the following features. Epidermis, the outermost layer is composed of simple barrel-shaped cells. Hairs are absent. The cortex is well developed and rough differentiated into 3 distinct zones. The outer cortex consist compactly arranged parenchymatous cells. The middle cortex is well developed and covers the major portion of the root. It is composed of large number of conspicuous air chambers, which are separated from each other by uniseriate partitions - trabeculae (Batanouny, 1992). The air chambers are developed schzogenously (Bavaru, Bercu, 2002; Bouman, Houtuesen, 1996) (Fig. 1A, B). The inner cortex consists of 3-4 layers of parenchymatous cells, enclosing intercellular spaces. The cells are nearly spherical in shape and regularly arranged in concentric layers. Characteristically, the endodermis is one-layered, possessing U-shaped lignified cells alternating, at places, with pericycle cells.

The stele is enclosed by a single layered pericycle. The vascular bundles are of radial type and more than four in number. The xylem shows exarch condition, metaxylem towards the centre and protoxylem facing the periphery. Phloem is well developed and present among the xylem groups (Fig. 2).

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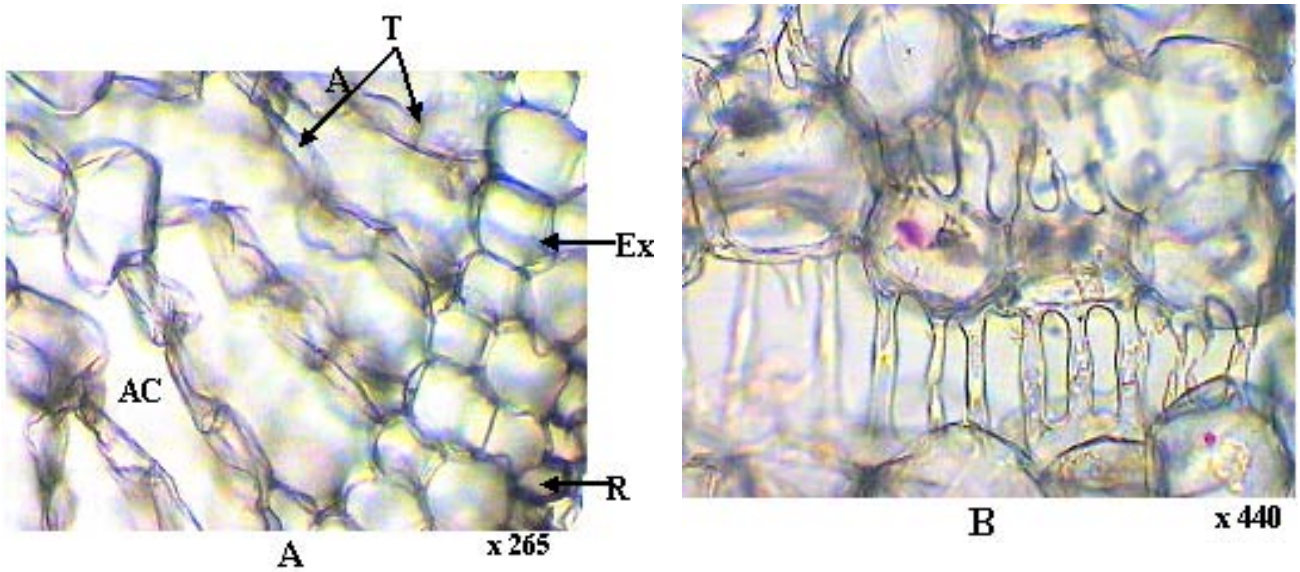

Fig. 1 Cross section of the root. Portion with epidermis and acernchyma (A). The schizogenous formation of an air chamber (B): AC- air chamber, Ex- exodermis, R- rhizodermis, T- trabeculae (orig.)

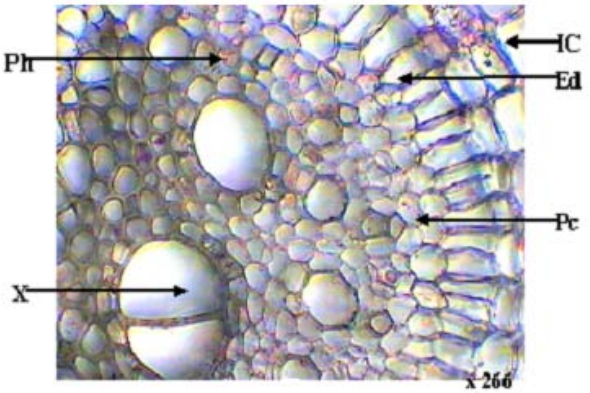

Fig. 2 Portion of the root's stele: Ed- endodermis, Ex- exodermis, IC- inner cortex, Pc- pericycle, Ph- phloem, X- xylem (orig.)

Cross section of the petiole reveals the following anatomical characteristics. Epidermis is one-layered with thin-walled cells. The cortex lies beneath the epidermis and is differentiated in two distinct zones. The sub-epidermal region (hypodermis) is composed of thin walled compactly arranged parenchymatous cells, whereas the inner region is made up of symmetrically arranged air spaces separated by thin partitions made up of a single layer of thin-walled cells. Rare small insignificant vascular bundles occur (Fig. 3; 4, A). Such as other aquatic plants, rests of diaphragmatic tissue are present (Bercu, 2004). Epidermis and hypodermis contain abundant chloroplasts (Fig. 4, B).

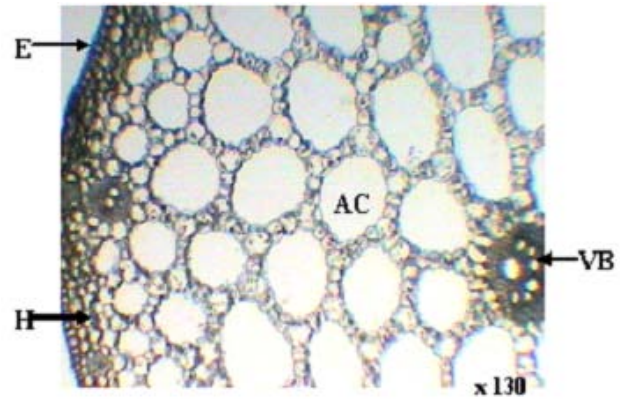

Fig. 3 Cross section of the petiole. Portion of aerenchyma and vascular bundles: AC- air chamber, E- epidermis, H- hypodermis, VB- vascular bundle (orig.)

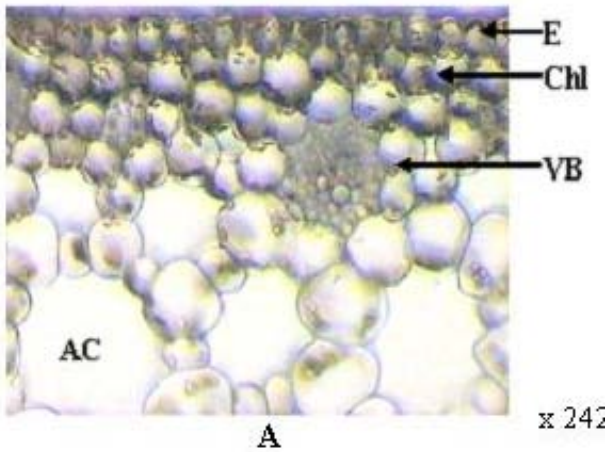

Fig. 4. Cross sections of the petiole. Portion with epidermis and cortex (A). AC- air chamber, BS- bundle sheath, Chl- chloroplasts, DT- diaphragmatic tissue, Mx- metaxylem, Ph- phloem, PxL- protoxylem lacuna (orig.)

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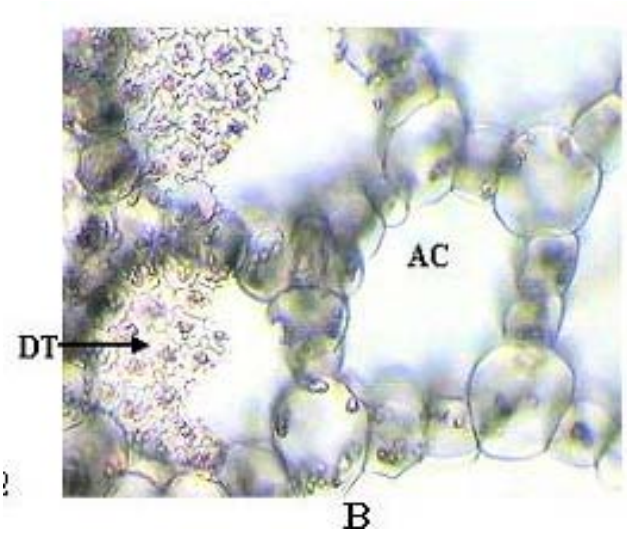

Fig. 4. Cross sections of the petiole. Aerenchyma with diaphragmatic tissue (B). AC- air chamber, BS- bundle sheath, Chl- chloroplasts, DT- diaphragmatic tissue, Mx- metaxylem, Ph- phloem, PxL- protoxylem lacuna (orig.)

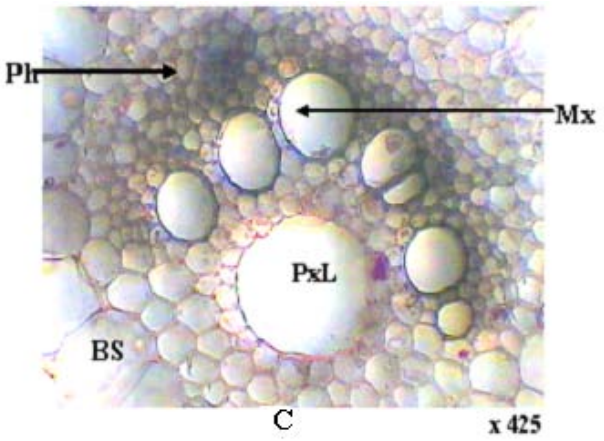

Fig. 4. Cross sections of the petiole. A large vascular bundle (C): AC- air chamber, BS- bundle sheath, Chl- chloroplasts, DT- diaphragmatic tissue, Mx- metaxylem, Ph- phloem, PxL- protoxylem lacuna (orig.)

The stele is represented by a centrally located large vascular bundle with few xylem and phloem elements. The central vascular bundle consists of metaxylem vessels and a protoxylem lacuna. Phloem possesses sieve vessels, companion cells and few phloem parenchymas (Fig. 4, C). The endodermis and pericycle are absent and the protection of the vascular tissue is afforded by a parenchymatous cells surrounding them (Fig. 4, A, C).

A transversal section through the blade exhibits the usually succession of tissues. The upper epidermis such as the lower one forms a single layer of thin-walled cells. The upper epidermis forms a crest below the large veins. The mesophyll is undifferentiated consisting large thin walled-cells interrupted by two large air chambers placed both sides of each large vein and homogenous to the margins (Fig. 5 A and C). However the cells, placed just below the upper epidermis remember a palisade tissue, consisting abundant chloroplasts whereas the rest layers of cells few.

The vascular system of a large vein is represented by xylem and phloem. Remarkable are the vascular bundles of the vein with primary structure forming a crest to the lower epidermis. Xylem is placed to the upper epidermis and phloem to the lower one. Each vascular bundle is protected by a parenchymatous sheath (Fig. 5 B and C).

CONCLUSIONS

Results revealed that the root of *Echinodorus cordifolius* possesses a typical primary structure. However, the cortex is well-developed, containing a large number of air chambers and the stele is characteristic to monocots roots. The leaf petiole epidermis is thin-walled, lacking cuticle. The cortex possesses air chambers and a number of small close collateral vascular bundles embedded in the aquatic parenchyma tissue. Phloem is prominent and located in the outer region of the bundle, whereas xylem frequently consists a large protoxylem lacuna. Few air chambers consists rests of diaphragmatic tissue. The mesophyll possesses air chambers near by the large veins and poor developed vascular bundles. Among the veins and to the margins, the mesophyll is homogenous. Mechanical tissues are absent. The histo-anatomical features of the plant organs are in accordance with it hydrophytic nature.

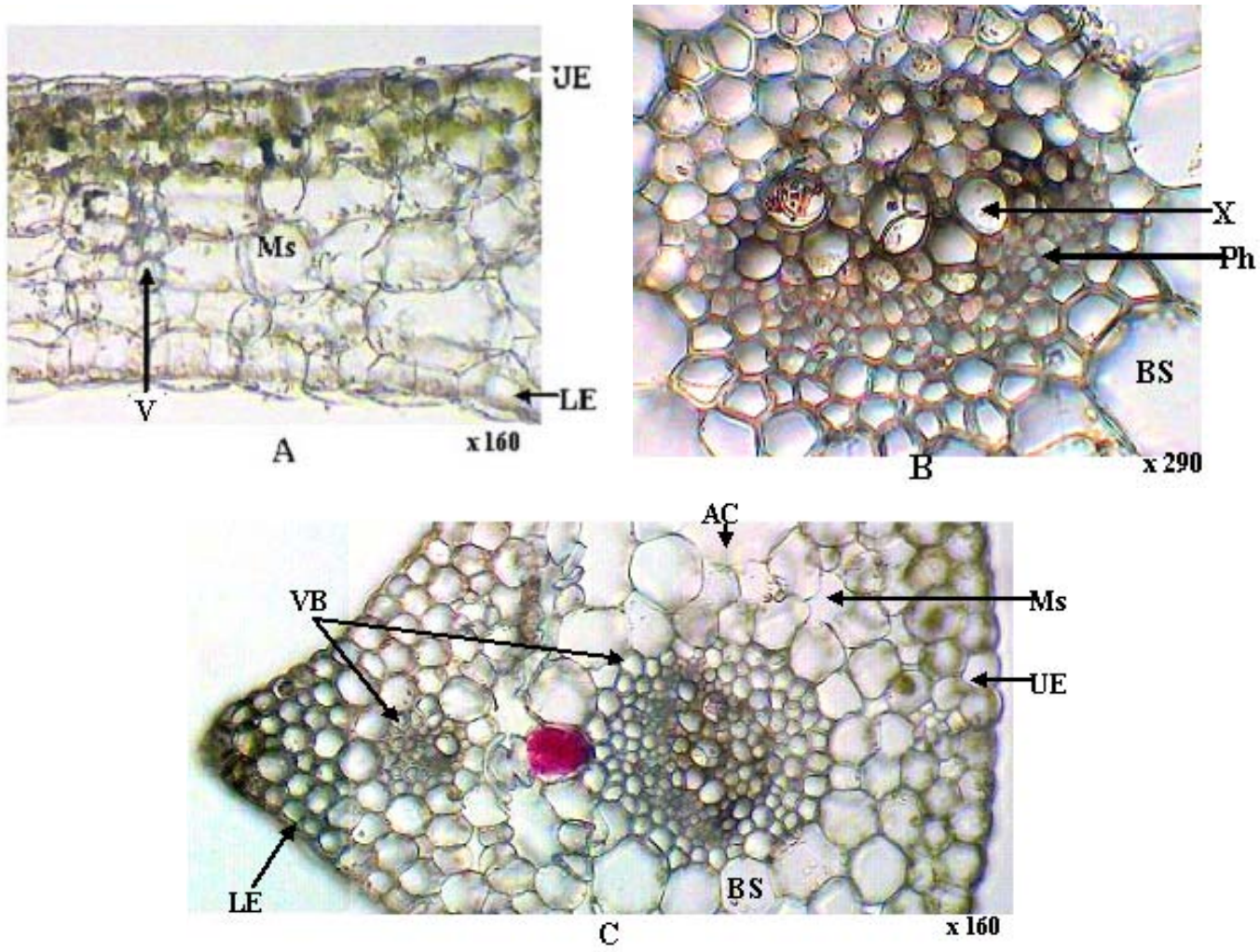

Fig. 5 Cross section of the blade. Portion of the mesophyll (A). A vein's small vascular bundle (B). The vascular bundle of a large vein (C): AC- air chamber, BS- bindle sheath, LE- lower epidermis, Ms- mesophyll, Ph- phloem, UE- upper epidermis, V- small vein, VB- vascular bundle, X- xylem (orig)

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