A HISTO-ANATOMICAL STUDY ON SOME HALOPHYLOUS SPECIES OF THE LEPIDIUM GENUS

Marius-Nicuşor Grigore*, Constantin Toma
„Alexandru Ioan Cuza" University, Faculty of Biology, Iasi, Romania

*** Correspondence:** Grigore Marius-Nicuşor, Alexandru Ioan Cuza University, Faculty of Biology, Jassy, Carol I Bd., no. 20 A, 700506, Romania, 0766.30.77.18, mariusgrigorepsyche@yahoo.com
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ABSTRACT. Three halophyte species belonging to the Lepidium genus (Brassicaceae family) were investigated: Lepidium cartilagineum (J. Mayer) Thell. ssp. crassifolium (Waldst. & Kitt.), L. latifolium L. şi L. perfoliatum L. All the subterranean vegetative organs (root, rhizome) in the investigated taxons showed a secondary structure. The foliar limb had a bifacial, equifacial structure at L. cartilagineum ssp. crassifolium. An bifacial, equifacial, with the mesophpyll centric-heterogenous structure at L. latifolium. and a relatively compact mesophyll, with low palisadic cells at L. perfoliatum has been evidenced.

Keywords: *Lepidium*, halophytes, rhizome

INTRODUCTION

The *Lepidium* species subjected to histo-anatomical investigations are halophytes with different ecological requirements, the most important of all referring to soil salinity. Consequently, the *Lepidium cartilagineum* (J. C. Mayer) Thell. ssp. *crassifolium* (Waldst. & Kit.) Thell has been classified by Prodan (1939) as a halophyte from the „first category" (i. e., an obligatory one), by Ţopa (1954) as an obligatory halophyte, by Bucur (1957, 1960) – as euhalophyte and by Ciocârlan (2000) as an facultative halophyte.

L. perfoliatum L. has been classified by Prodan (1939) as a halophyte by the „third category", or by Ciocârlan (2000) as an facultative halophyte. *L. latifolium* L. is a halophyte from the „first category" (Prodan, 1939) or a preferant one (Topa, 1954), or euhalophyte (Bucur, 1957, 1960).

MATERIALS AND METHODS

The investigations were developed on the vegetative organs of three halophyte species of the *Lepidium* genus, namely: *L. cartilagineum* (J. C. Mayer) Thell. ssp. *crassifolium* (Waldst. & Kit.) Thell., *L. perfoliatum* L. and *L. latifolium* L., all belonging to the *Brassicaceae* family. All taxons had been collected between May and July 2007, at Valea Ilenei, the district of Jassy.

The experiments were based on the normal techniques applied for such type of investigations, described elsewhere (Grigore, Toma, 2006; Grigore, Toma, 2007).

RESULTS AND DISCUSSIONS

The subterranean vegetative organs (root, rhizome) of all taxons under investigations show a secondary structure, resulting – in either equal or not equal ratios – from the activity of the secondary meristemes: the cambium and the phelogene.

Thus, the secondary structure of the **root** of *L. cartilagineum* ssp. *crassifolium* is built up especially by the activity of the cambium. The phelogene produces some cork, with intensely radially-flattened cells. On its periphery, rests of the primary, parenchymatic-cellulosic cortex may be noticed within which numerous groups of sclerenchymatic elements (sclereids, especially) – yet less than in the cortex of the rhizome – are disseminated.

In the central cylinder, the phloemic ring is much thinner than the xylemic body; here and there, within its thickness, groups of sclerenchymatic elements may be noticed in the fundamental mass of cellulosic phloemic parenchyma.

The xylemic body is intensely parenchymatized, numerous radial – either continuous or discontinuous - vessels, with different diameters, and thick, highly - lignified walls, being observed within it (Fig.1). In the axis of the root, the vessels show shorter diameters, while the xylem parenchyma cells are absent.

In the case of *Lepidium perfoliatum,* the secondary structure results mainly from the activity of the cambium. In the central cylinder, the phloemic secondary ring consists of two distinct regions, namely: an internal, thicker one, of conductive phloem (sieve tubes, companion cells) and an external, thinner one, in which the phloemic parenchyma prevails and compact groups of phloemic fibers, with a moderately thickened, yet intensely lignified wall, are dispersed.

The central xylemic body, occupying most of the root thickness, has two distinct areas: a central, thinner one, in which the vessels are dispersed into a common mass of cellulosic parenchyma, and an external, much thicker, lignified one, in which the libriforme is prevailing, and the vessels are irregularly dispersed, either alone or in discontinuous, radial rows (Fig. 2).

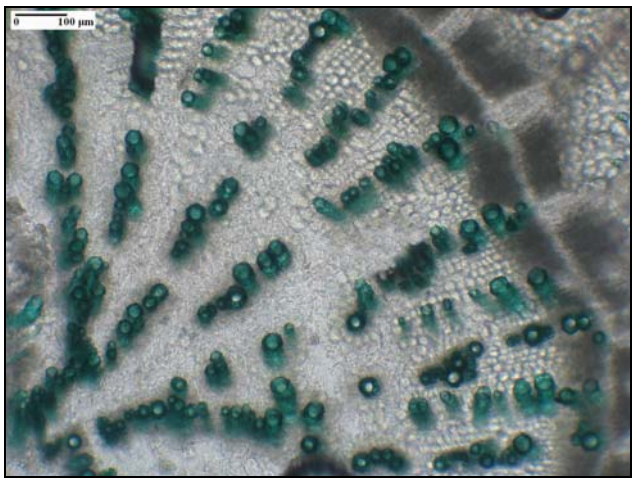

Fig. 1 Cross section through the root of *Lepidium cartilagineum* ssp. crassifolium

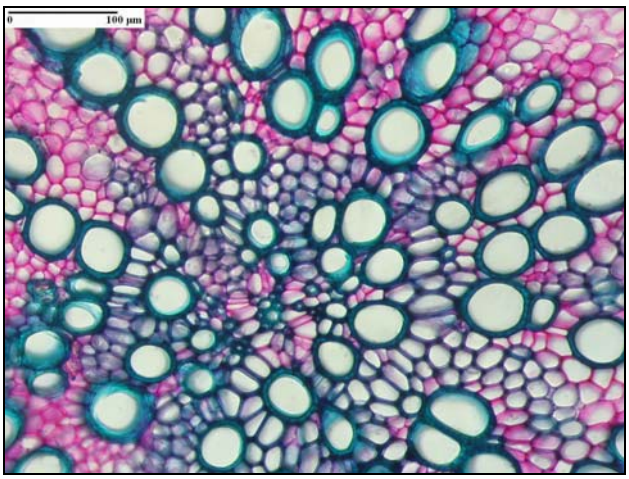

Fig. 2 Cross section through the root of *Lepidium perfoliatum*

In the *L. cartilagineum* ssp. *crassifolium* **rhizome**, the conducting tissues form two concentric rings of similar thickness, both resulting from the cambial activity.

The phloemic ring is formed of a conducting area (sieve tubes and companion cells), in the vicinity of the xylem, and of a thick, external, parenchymatic area, in which numerous islands are dispersed (sclerenchymatic fibers, of different size, fibers with extremely thick, yet non – lignified walls).

The xylemic ring includes a circular area, from which deep, radial blades penetrate the pith, and an external, parenchymatic area, in which vessel blades are disseminated. In both categories of xylemic vessels, the libriform (intensely lignified fibers, with thick walls), in which the vessels are irregularly arranged, is prevailing (Fig.3).

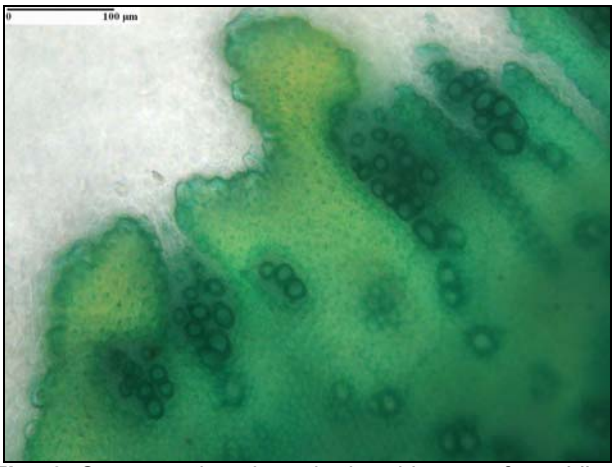

Fig. 3 Cross section through the rhizome of *Lepidium cartilagineum* ssp. *crassifolium*

Fig. 4 Cross section through the rhizome of *Lepidium latifolium*

In *L. latifolium* rhizome, numerous groups of sclerenchymatic elements, with extremely thick, highly lignified walls (Fig. 4) are dispersed in the thickness of the cortical parenchyma of cellulosic and meatic type; rarely, these mechanical elements are solitary, disorderly dispersed. The activity of the cambium resulted in a relatively thin ring of secondary phloem, contacting the most inner groups of sclerenchymatic groups.

In the secondary phloemic rings, radial areas of conducting elements (some of them with cholenchymatized walls) may be observed, separated by long, parenchymatically – cellulosic medullary rays, the cells of which show a strictly radial arrangement; all phloemic areas occur in front of the internal groups of sclerenchymatic elements.

The cambium forms a continuous area, which generated, towards the inner side, a thick ring of secondary xylem, in which the rays are either solitary or grouped in a small number on the internal side of the ring, in a rich cellulosic parenchyma, within which a few vessels are also dispersed (Fig. 5). On the inner side of the secondary xylem ring, numerous girdles of sclerenchymatic elements may be noticed, in the same concentric arrangement, yet separated by a cellulosic parenchyma with few vessels.

All fibers of the libriforme have intensely thickened walls, yet less lignified than the mechanical elements from the cortex.

As to the structure of the *L. perfoliatum* rhizome, the observation was made that the activity of the cambium resulted in massive areas of secondary phloem (in which the parenchyma is prevailing) while,

at the border between them and thea areas of secondary phloem, a very thick, multilayered cambium may be observed.

At the level of the secondary phloem, separated by very large medullary rays, the intensely lignified libriform is prevailing, the vessels occurring as discontinuous, radial rows.

On the internal side of the secondary xylem areas, the primary xylem, with vessels shorter in diameter, separated by cells of cellulosic parenchyma, remains visible.

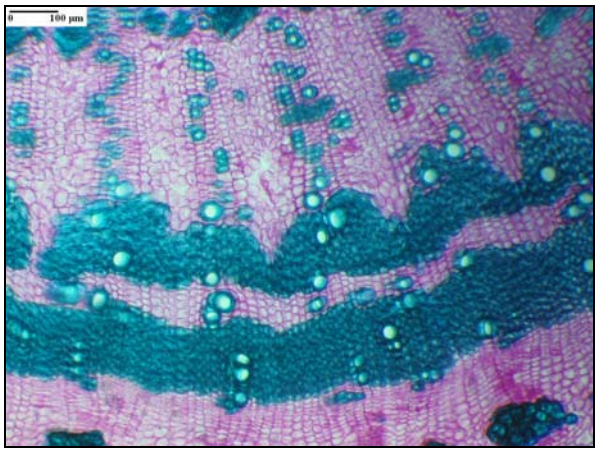

Fig. 5 Cross section through the rhizome of *Lepidium latifolium*

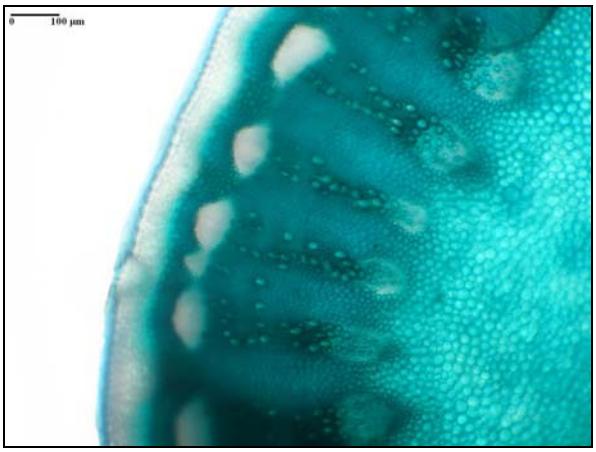

Fig. 6 Cross section through the aerial stem of *Lepidium cartilagineum* ssp. *crassifolium*

In the **aerial stem** of *L. cartilagineum* ssp. *crassifolium*, the cortex is parenchymatic-cellulosic, of meatic type, a few atypical vascular bundles, with the sclerenchymatic fibers at both poles, being observed.

The central cylinder contains numerous vascular bundles (Fig. 6), of various sizes, all separated by intensely sclerified, and moderately lignified medullary rays. At the periphery of the phloem, all vascular bundles have a relatively thin girdle of moderately lignified sclerenchymatic fibers (Fig. 7).

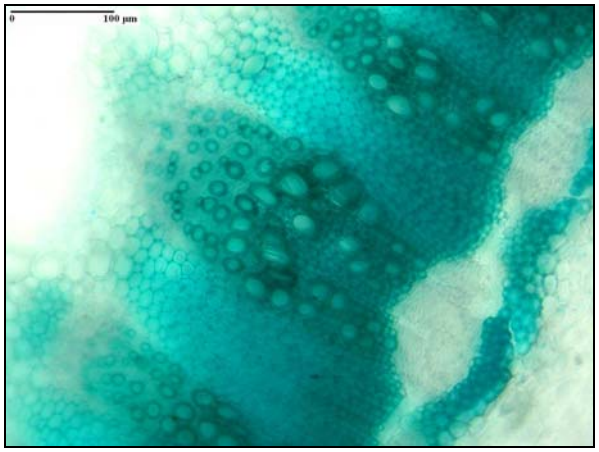

Fig. 7 Cross section through the aerial stem of *Lepidium cartilagineum* ssp. crassifolium

Fig. 8 Cross section through the aerial stem of *Lepidium latifolium*

In the aerial stem of *L. latifolium,* a few stomata, with a less deep suprastomatic room, could be observed at the epidermis level. The cambium activity resulted in a relatively thin ring of secondary phloem, penetrated by numerous parenchymatic-cellulosic medullary rays, which give a fascicular shape of the phloem as such, with a girdle of sclerenchymatic fibers with highly thickened and lignified walls at the periphery (Fig. 8).

In *L. perfoliatum*, in the aerial stem, the structure is already a secondary, yet of fascicular- type one, at the level of the central cylinder (Fig. 9). The phloem contains sieve tubes, companion cells and a few cells of phloemic parenchyma. The cambium is multilayered. The primary xylem shows vessels separated by cellulosic parenchyma, while the secondary xylem- by libriform (Fig. 10).

Fig. 9 Cross section through the aerial stem of *Lepidium perfoliatum*

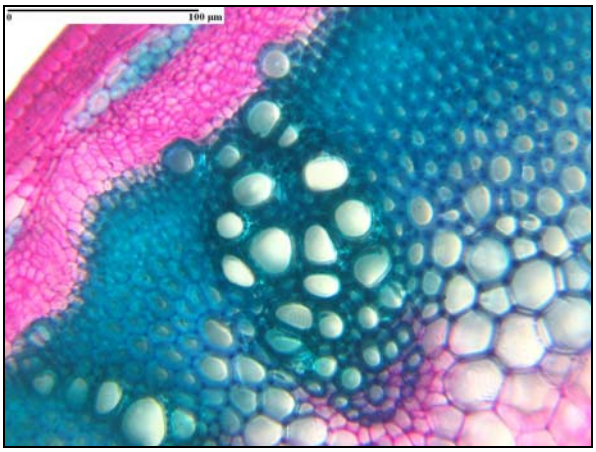

Fig. 10 Cross section through the aerial stem of *Lepidium perfoliatum*

In terms of the foliar limb, the following observations may be made for the species under investigations.

In *L. cartilagineum* ssp. *crassifolium*, the mesophyll is of the palisadic type (2-3 layers) under both epidermis (Fig. 11); between the two palisades, 2-3 layers of izodiametric cells, forming the lacunary tissue, may be observed. Therefore, the limb has a bifacial, equifacial structure, also evidenced in other species of *Brassicaceae* family, such as: *Cakile maritima* or *Eryngium maritimum* (Toma, Flenchea Teodorescu, Raşcanu, Zaharia, 1979) or *Lepidium ruderale* (Chermezon, 1910).

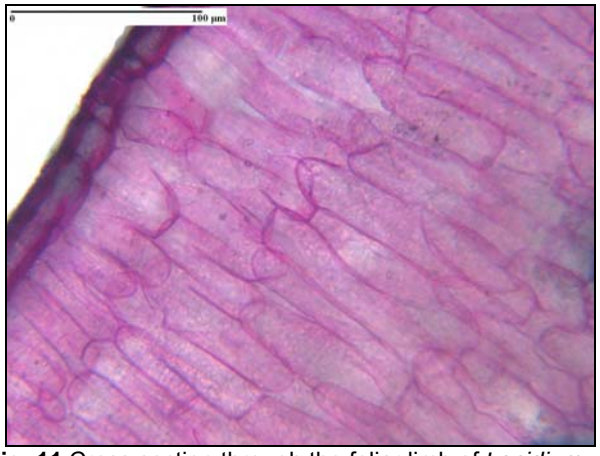

Fig. 11 Cross section through the foliar limb of *Lepidium Cartilagineum* ssp. *crassifolia*

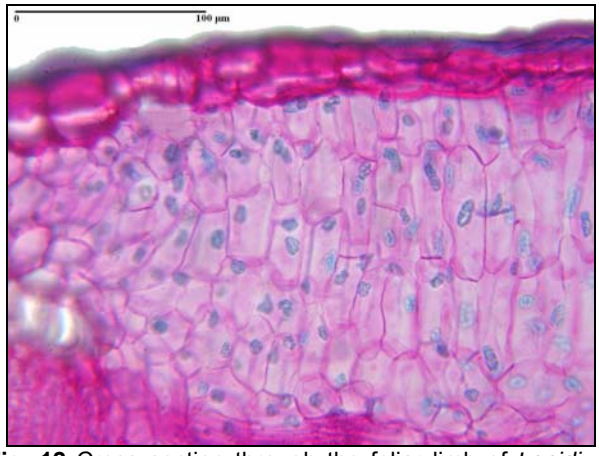

Fig. 12 Cross section through the foliar limb of *Lepidium latifolium*

In *L. latifolium,* the mesophyll is compact, almost wholly and both sides of palisadic type, with relatively low cells (Fig. 12). Only in the middle of the mesophyll, the cells occurring between the lateral nervures are izodiametric.

Consequently, the limb has a bifacial, equifacial structure, with a heterogenous centric mesophyll structure. In both epidermis, the stomata have a visible suprastomatic room, while the external sides of stomatic cells are intensely cutinized (Fig. 13).

In *L. perfoliatum,* the mesophyll is relatively thin, with relatively low cells of the hypodermic layers. The character of low palisadic cells is visible, too, in front of the median nervure, at the upper side (Fig. 14). Here and there, very rare unicellular tectory hairs may be noticed.

CONCLUSIONS

The histo-anatomical observations here discussed complete the data published in "Flora R.P.R", vol. III (1955), on the perenniality of the *L. cartilagineum* ssp. *crassifolium* and *L. latifolium* species. Although their perennial character is explicitly stated, no mention is made on the organ assuring plant's perenniality. In the present study, the authors have analyzed and put into evidence the role played by the rhizome of two species under investigations from a histo-anatomical perspective. The same holds true for *L. perfoliatum* which, however, is not characterized – in the same volume –as a perennial plant. In all taxons under analysis, the rhizome evidences a secondary structure.

Stomata with a suprastomatic room in the epidermis of the stem and the foliar limb have been evidenced in *L. latifolium.*

The foliar limb has a bifacial, equifacial structure in *L. cartilagineum* ssp. *crassifolium*; in *L. latifolium*, a limb with a bifacial, equifacial structure, and a heterogenous centric mesophyll was observed, while in *L. perfoliatum* the mesophyll is relatively compact, with low palisadic cells.

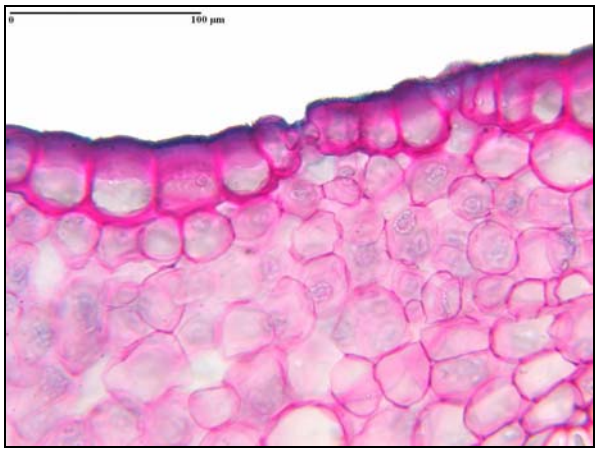

Fig. 13 Cross section through the foliar limb of *Lepidium latifolium*

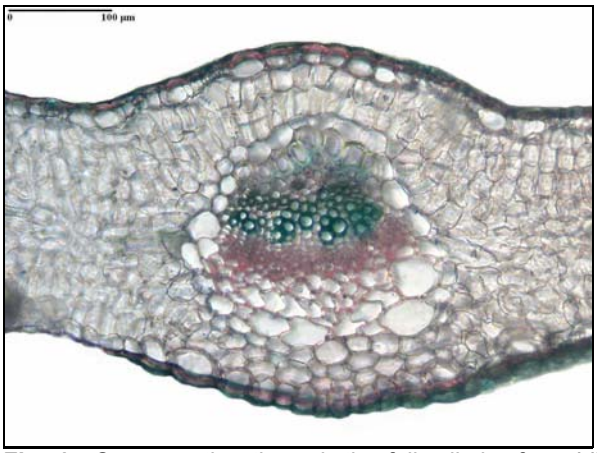

Fig. 14 Cross section through the foliar limb of *Lepidium perfoliatum*

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