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Anatomy of *Fittonia verschaffeltii* (Lem.) Van Houtte (Acanthaceae)

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Summary

The paper presents a detailed histoanatomical description, of the vegetative organs (root, stem and leaf) and microphotographs of *Fittonia verschaffeltii* (Lem.) Van Houtte. It was observed that the root has a typical primary dicot structure. The stem has a cortex differentiated into two regions and the stele comprises one ring of open collateral vascular bundles with secondary xylem due to cambium activity. The petiole anatomy is quite similar, in its basic structure, to that of the stem. The blade shows a heterogenous and hypostomatic mesophyll and a number of vascular bundles in the midrib zone. Remarkable is the presence of the filamentous, uniseriate non-glandular hairs on the stem, petiole and leaf blade. The mechanical tissue is present in the stem, petiole and blade as well.

Introduction

Fittonia verschaffeltii (Lem.) Van Houtte is native to the Peruvian rainforest and was first brought to Europe in 1867. The plant is named after two 19th Century Irish botanical writers, Elizabeth and Sarah Mary Fitton.

Due to its bizarre appearance, it is also commonly known as "mosaic plant" or "nerve plant". It is an evergreen creeping herbaceous perennial, up to 10 cm high and is noted for its attractive foliage.

The venation of the oval olive green leaves is well-drawn and presents a delicate network marked white, red or ivory into a "snake skin" or mosaic-like pattern (one of the many popular names under which it is also known). The flowers, grouped in inflorescences, are very small, light green color or even whitish. They are not impressive and must be removed to allow the plant to grow.

Fittonia verschaffeltii, appreciated for it decorative foliage, is often used in terrariums or arrangements in various combinations of plants to decorate offices and housing.

Few data are available on this species' anatomy. Most of the studies refer to its taxonomy, physiology such as the perception of light, growth and development under different condition etc. (Wagner, 1902; McConnell *et al.*, 1982, Georgiady, 1994) or plant care (Keswick, 2003; Mioulane, 2004; Pleasant, 2005). Some data concerning the epidermal cells of three Fitonia species belong to Khwaja (1978).

In Romanian literature data about the plant sensitivity to light, the presence of ocelli, are mentioned in sporadic manuals of plant morphology and anatomy (e.g. Ciobanu, 1971; Andrei, 1978; Bercu & Bavaru, 2002).

The aim of the present study was to analyze the vegetative organs of *Fittonia verschaffeltii* and to contribute to the knowledge of this species.

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Materials and methods

The plant leaves were collected from S.C. Iris International S.R.L. greenhouse. Small pieces of root, stem and leaves were fixed in FAA (formalin: glacial acetic acid: alcohol 5:5:90). Cross sections of the vegetative organs were performed by the freehand technique (Bercu & Jianu, 2003). The cross section 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 digital camera attachment.

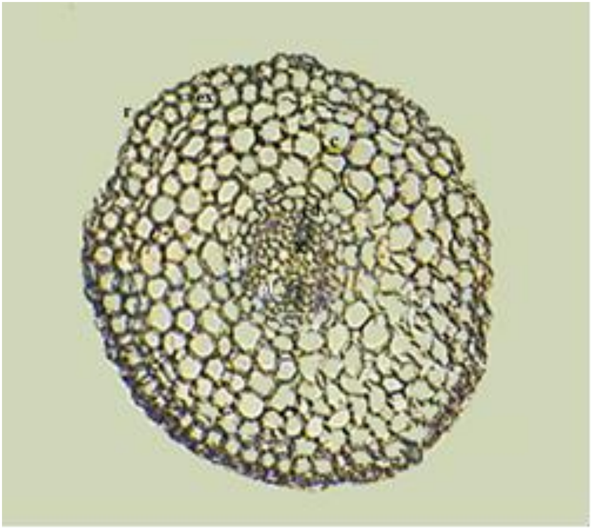

Fig. 1. Cross section of the root – ensemble (× 180): c- cortex, ex- exodermis, ed- endodermis, pc- pericycle, ph- phloem, r- rhizodermis, x- xylem.

Results and discussions

Root structure is shown in Fig. 1. The general stem structure and structural details are shown in Fig. 2-4.

Aspects of Fittonia verschaffeltii leaf petiole are shown in Fig. 5-7.

Finally, Fig. 8-11 show the leaf blade, including the mesophyll structure, mid rib and upper epidermis with ocelli.

Transection of the root reveals the outer most layer of cells epidermis (rhizodermis), followed by a one-layered exodermis with suberized cells, larger than those of epidermis. The inner cortex is parenchymatous – 4-5 layers of large cells - with intercellular spaces among them. The one-layered endodermis possesses Casparian strips.

Just below the endodermis is the stele consisting of pericycle, made up of a row of cells and the vascular system with radial and alternately arranged 3 vascular bundles of xylem and phloem. Primary pith rows are present between them (Fig. 1).

Cross sections of the stem is circular-shaped and discloses the outer layer of the stem - epidermis - composed of small isodiametric, cutinized cells. The external epidermal cells walls are covered by a thin cuticle (Fig. 2). The continuity of the epidermis is interrupted by the presence of stomata and long or short (uniseriate, three-celled) and many-celled (6-7-celled, uniseriate), sharp-typed non-glandular hairs, feature also mentioned for other Acanthaceae species (Esau, 1977).

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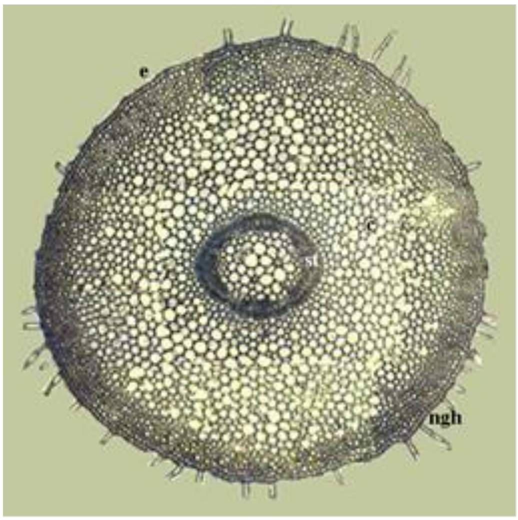

Fig. 2. Cross section of the stem – ensemble (× 50): c- cortex, e- epidermis, ngh- non-glandular hairs, st- stele.

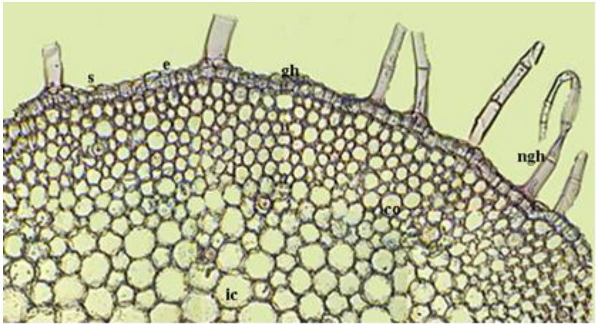

Fig. 3. Portion of the stem with epidermis and cortex in cross section (× 170): co- collenchyma, e- epidermis, gh- glandular hairs, ic- inner cortex, ngh- non-glandular hairs, s- stoma.

The epidermal cells are covered by a thin cuticle. Rare sessile glandular hairs are present. Just bellow the epidermis is the cortex, differentiated into two zones, one zone consisting of 5-6 layers of angular collenchyma and the other area made up of several layers of parenchyma cells with intercellular spaces (Fig. 3).

The stele is centrally located and protected by a one-layered primary endodermis. The compact disposal of the conductive tissues in the stele is made up by the xylem secondary elements, due to the cambium activity. However, the vascular tissues (xylem and phloem) are circular, forming two rings, one made of thick xylem elements inwards and other more poorly developed represented by phloem tissue on the outside (Fig. 4).

The xylem vessels have a radial arrangement in a cellulosic parenchyma.

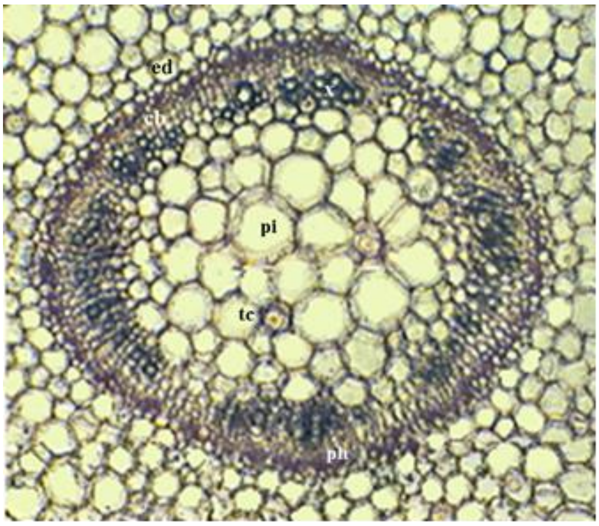

Fig. 4. Cross section of the stem stele (× 170): cb- cambium, ed- endodermis, pi- pith, ph- phloem, tc- tanniniferous cell, x- xylem.

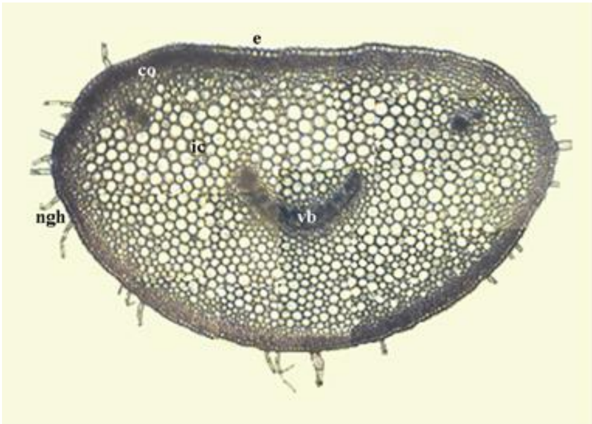

Fig. 5. Cross section of the petiole – ensemble (× 50): co- collenchyma, e- epidermis, ic- inner cortex, ngh- non-glandular hairs, vb- vascular bundle.

Phloem is composed of vessels, companion cells and phloem parenchyma. The centrally located pith is parenchymatic-cellulosed of meatic type. Tannin cells are present in the pith as well in the cortex (Fig. 3, 4).

The petiole, in transverse section, has a flat upper surface and a convex one (Fig. 5). The outermost layer of cells – the epidermis – is made up of isodiametric cutinized cells, the external cells walls are covered by a thick cuticle.

The continuity of the epidermis is broken by the presence of non-glandular hairs the same as those of the stem (Fig. 6 A, B). The epidermis is followed by the cortex differentiated into a hypodermis composed of 6-7 layers of collenchymatous cells, followed by a number of parenchyma cells, forming the inner cortex.

The vascular bundles, embedded in a basic tissue, are represented by three collateral bundles, one larger and circular-arced, to the abaxial surface, and two smaller in adaxial position. They are structured such as those of the stem (Fig. 7).

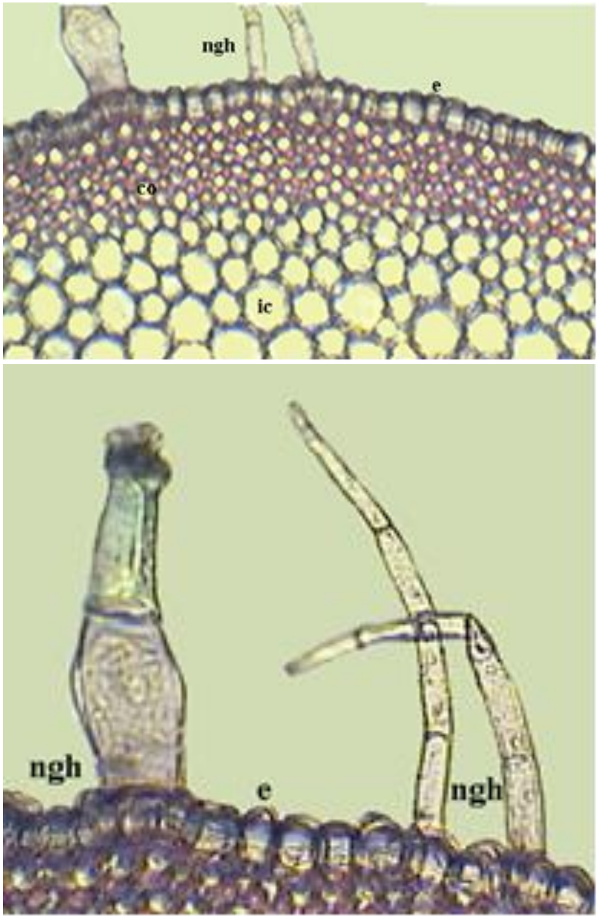

Fig. 6 (A, B). Cross section of the petiole. Portion with epidermis and cortex (A, × 120). Non-glandular hairs – detail (B, × 185): e- epidermis, co- collenchyma, ic- inner cortex, ngh- non-glandular hairs.

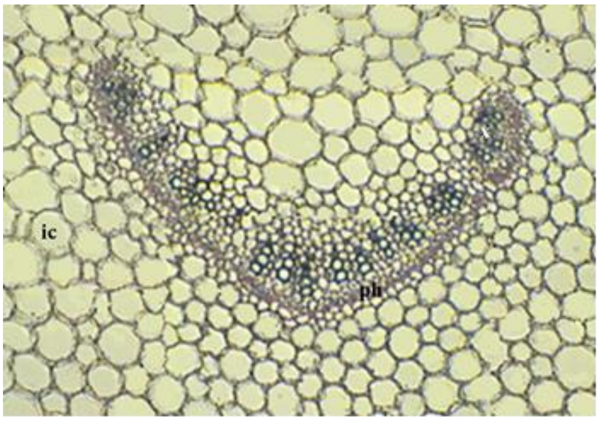

Fig. 7. The large vascular bundle of the petiole in cross section (× 190): ic- inner cortex, ph- phloem, x- xylem.

The blade is bifacial with both surfaces being pubescent. Transection of the blade reveals that the epidermal cells of both surfaces are arranged in a single layer, covered by a thin cuticle. Abaxial, the mid-rib forms a large protuberance (Fig. 8). The upper epidermal cells are flat-topped.

Among the upper epidermis cells, especially of the lower one, in particular to the mid-rib zone, glandular and non-glandular hairs are present, the same found in the stem and petiole. Stomata are present only in between the lower epidermal cells.

Remarkable is the presence of ocelli (lens cells) on the upper epidermis of F. verschaffeltii. The so-called ocelli, first observed and described by Haberlandt (1905), are present in between the upper epidermal cells of the mesophyll and possess two cells. One is a lower stalk-cell, large, polygonal, with chloroplasts. The lower cell serves as a support for the lens and also doubtlessly supplies the protoplasmic membrane on which light is received. The other is an upper smaller bi-convex lens cell which retains a large amount of solar energy (Fig. 9).

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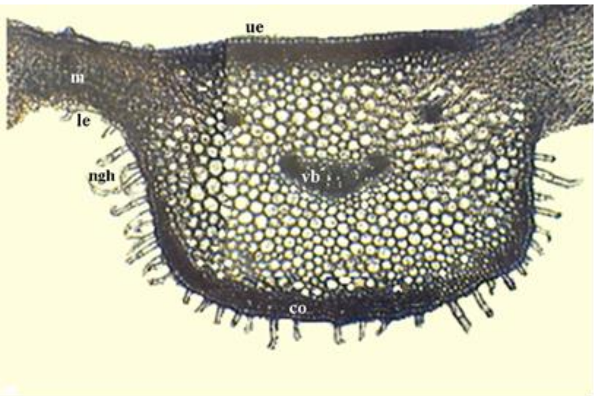

Fig. 8. Cross section of the blade – ensemble (× 70): co- colenchyma, le- lower epidermis, m- mesophyll, ngh- non glandular hairs, ue- epper epidermis, vb- vascular bundle.

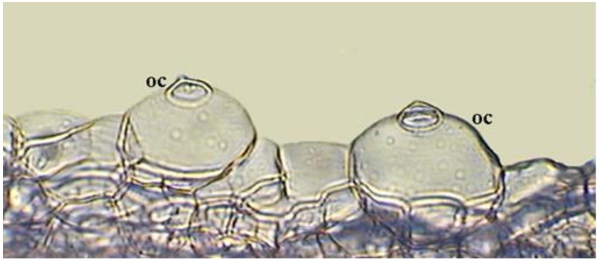

Fig. 9. Portion of upper epidermis with ocelli (× 385): oc- ocellus.

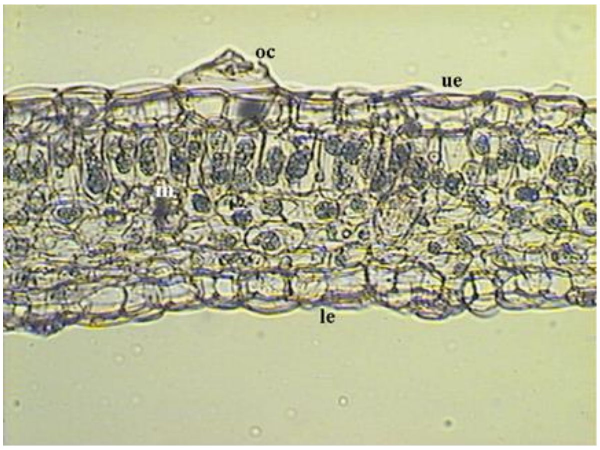

Fig. 10. Cross section of the blade - portion with mesophyll (× 210): oc- ocellus le- lower epidermis, m- mesophyll, ue- upper epidermis.

To this structure it is attributed the capacity of distinguishing differences in light intensity and, thus the leaves move depending on the direction of sunrays as described by Haberlandt (1905), Darwin (1906) and Wagner (1909).

The upper epidermal cells are flat-topped, they cannot function as ocelli, so that these sensory elements are present among the cells of this protective tissue. As Khwaja (1978) reported, the presence of these organs – the ocelli - is a significant taxonomic criterion for identifying this distinct species.

It must be mentioned that ocelli attract a large amount of solar energy for the movement of the leaf to the light.

The mesophyll is composed of palisade tissue and spongy tissues as well. The vascular bundles are embedded in the mesophyll (Fig. 10, 11).

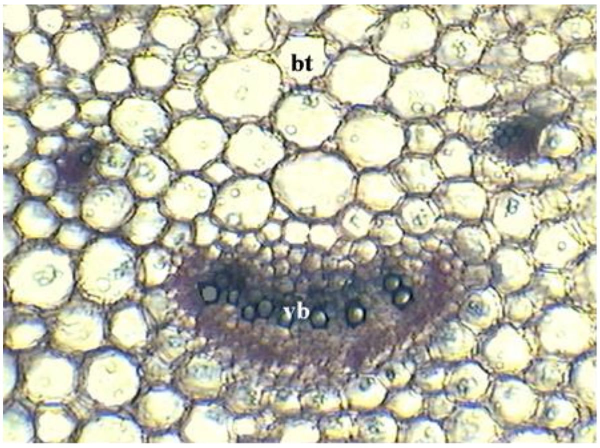

Fig. 11. Portion of the mid rib zone with vascular bundles (× 300): bt- basic tissue, vb- vascular bundle.

Conclusions

This study enabled the investigation of what is a nowadays a frequent pathology which affects young children and which is sometimes encountered in the new-born as well. From our analysis we observed an increase in the number of patients with melanocytic nevi locateds in different areas; many of these patients were considered as having multiple melanocytic nevi. This indicates the increase in the frequency of this pathology and shows the importance of the risk factors related to the potential of becoming malignant, due to their numeric extension on the body areas. Moreover, within the investigated patients we found cases of traumatized pigment nevi. From this point of view, we consider that it is very important for 'at risk' patients to be placed under competent medical supervision in order to monitor the potential of these tegument tumors becoming malignant. Consequently, major importance must be placed on this issue, especially considering that in certain conditions, melanocytic nevi are likely to degenerate and become malignant. Therefore, it is important to emphasize that malignant melanoma is a pathology that easily turns into lethal potential metastasis.

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