Histoanatomical analysis of *Begonia rex* Puiz. leaf

**RODICA BERCU, A. BAVARU, D. R. POPOVICIU**  
1 Faculty of Natural and Agricultural Sciences “Ovidius” University, Constanța, Romania  
*Corresponding author  
D. R. Popoviciu, Ph.D.  
Faculty of Natural and Agricultural Sciences “Ovidius” University,  
Campus, Aleea Universității, nr. 1, Corp B, 900 525, Constanța, Romania  
Phone: +40(0)761.178.785, e-mail: dr_popoviciu@yahoo.com

**Keywords.** Anatomy, petiole, lamina, stomata, *Begonia rex.*

**Summary**

The paper presents anatomical aspects concerning the leaf structure of two Begonia × hiemalis Fotsch (Begonia Hiemalis Group) varieties, belonging to Begoniaceae family: *Begonia elatior* ‘Britt Dark’ and *Begonia elatior* ‘Clara’. Anatomically, the petiole has a single-layered epidermis, the cortex and the vascular system. The vascular system is a fascicular type one, with a large number of poorly developed collateral bundles, placed into a basic tissue. The lamina is composed of a single upper layer of cells for *B. elatior* ‘Britt Dark’, and a hypodermis for *B. elatior* ‘Clara’, a single-layered lower epidermis and the mesophyll. The mesophyll is differentiated into palisade tissue and spongy tissue with the same vascular bundle structure such as that of the petiole but with foliar arrangement of conductive tissues. Glandular hairs, druses and taniniferous cells occur in the petiole and blade. Stomata are present on the lower epidermis.

**Introduction**

*Begonia rex* Putz. (Begoniaceae family) is a rhizomatous Begonia species, native to the tropics and subtropical regions of Africa, Asia and America. It is a herbaceous decorative indoor plant especially through the multitude of combinations of colors and hues present on the surface of leaves. On a single leaf, three or four colors and so many shades can be distinguished. The leaves have cordate asymmetric, slightly crenate margins, with pink, green, silver, red, purple and brown spots on the upper surface of the lamina. In some species, the leaves are velvety surfaced, others are curved, some have soft edges, others are crested (Web 1).

Fig. 1. Natural view of *Begonia rex* Puiz.
Succinct reference of begonias leaves, especially concerning the photosensitive cells of epidermal cells, are found in Vogelmann and Brodersen (2007), Sandved (1969), Vogelmann et al. (1996) and Wagner et al. (2003) studies.

In Romania few authors have studied begonias from a morphological, physiological (Romocea et al., 2010; Romocea, 2011) and anatomical (Bercu & Jianu, 2004, Bercu, 2005) point of view.

The aim of this work is to analyze the anatomy of the petiole and lamina of Begonia rex, bringing additional knowledge about this group of plants, in general and, in particular, for this species.

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 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.

Results and discussions

The petiole in cross section is circular in shape (Fig. 2). The epidermis has a single layer of cells covered by a thick cuticle. Here and there some long, simple protective, non-glandular hairs (40-50 cells) and as well rare peltate (8 cells) glandular hairs are present (Fig. 2, A, B).

Fig. 2. Cross section of the petiole - ensemble (A: x 80; B: x 60): bt- basic tissue, c- cortex, e-epidermis, gh- glandular hair, ngl- non-glandular hair, vb - vascular bundle.
Fig. 3. Cross section of the petiole – details. Portion with epidermis and cortex (A, x 150). A petiolar vascular bundle of the (B, x 300): co- collenchyma, e- epidermis, gh- glandular hair, ic- inner cortex, ph- phloem, ngh- non-glandular hair, x- xylem.

Fig. 4. Cross sections of the lamina. Portion with mesophyll and mid-rib (A, x 70). Portion with mesophyll (B, x 350): co- collenchyma, h- hipodermis, le- lower epidermis, ms- mesophyll, pt- palisade tissue,
s- stoma, st- spongy tissue, ue- upper epidermis, vb- vascular bundle.

Fig. 5. Paradermal sections of the lower epidermis. Ensemble (A, x 200). Detail (B, x 520): ec- epidermal cell, sc- subsidiary cell, s- stoma cell.

It is followed by the cortex, differentiated into an external (hypodermis) and an inner one. The external cortex is represented by an angular collenchyma, 3-4 layers of cells, and the inner one is more developed, composed of 3-5 layers of parenchymatous cells (Fig. 3, A).

Such as in other Begonia species leaves petiole, the vascular system, embedded into a basic tissue, is of fascicular type (Barkley, 1971; Bercu, 2005), composed of a large number of collateral vascular bundles (Barkley, 1971; Bercu, 2005). In Begonia rex the petiole has 14 vascular bundles arranged on two circles (7 on the inner circle and 7 on the external one) (Fig. 2, A, B). Each vascular bundle has the phloem tissue next to the epidermis and the xylem tissue near the pith zone. Phloem tissues is composed of phloem vessels, companion cells and phloem parenchyma, whereas the xylem one of xylem vessels and xylem parenchyma. The vascular bundles are surrounded by a bundle sheath (Fig. 3, B).

The central zone is made up of large thin-walled cells with intercellular spaces (Fig. 2). Cross sections of lamina disclose an upper epidermis made up by a layer of slightly tangent elongated cells, without spaces between cells, covered by a thick cuticle. Between the upper epidermal cells, photosensitive papillae, which are characteristic to shadow Begonias (Brodersen & Vogelmann, 2007; Vogelmann et al., 1996), have not been observed in our findings.

The same non-glandular and glandular hairs of the petiole, are mostly present in the mid rib zone. A three-layered hypodermis follows, composed of large, radially-elongated cells.

The mesophyll is poorly developed, differentiated into palisade and spongy tissue (heterogenous mesophyll). The palisade tissue is composed of a small number of cell layers (2 layers), while the more developed spongy tissue has 4-5 layers of cells (Fig. 4, A, B). However, Li JingXiu et al. (2007) research showed, as an ecological adaptation, that species of Begonias in areas with low light and humidity, have thinner mesophyll with poorly developed palisade tissue (the rhizomatous Begonias with erect stems) than those living in full sun and xerofitic environment. The mid rib is more prominent on the lower epidermis than on the upper one (Fig. 4, A). The vascular system of the mid rib is composed of four vascular bundles, a larger one in the center and three smaller towards the upper epidermis. The vascular bundles have the same structure to those of the petiole but with typical foliar conductive tissues arrangement. Stomata are present only on the lower epidermis (hypostomatic lamina).

The lower epidermis cells, in paradermal sections, discloses hexagonal cells with straight walls and anisocytic type stomata, more specifically, amphianisocytic with two
circular rows of subsidiary cells. The inner circle possesses two subsidiary large cells and a small one, whereas the external one is incomplete, with two subsidiary cells. Remarkable are the rare twin stomata (Fig. 5, A, B).

The lower epidermis possesses relatively few small stomata 29.65 st./mm² with 0.181 stomatal index (IS) (Dilcher, 1974, Monton, 1976).

Conclusions

The petiole has a single-layered epidermis and a differentiated cortex.

The vascular system is fascicular, composed of a large number of collateral vascular bundles, arranged on two circles, embedded in a basic tissue.

The lamina has an single-layered upper and lower epidermis and hypodermis, as well. The mesophyll is poorly developed, heterogenous and hypostomatic. The vascular system of the mid rib is represented by four vascular bundles with foliar arrangement of the conductive tissues. The strength of the petiole and lamina is due to the collenchyma tissue.

The lower epidermis, in paradermal sections, disclose hexagonal cells with straight walls and anisocytic type stomata. It has relatively few stomata 29.65 st./mm² with 0.181 stomatal index.

Acknowledgements

We express our thanks to dr. ing. Elena Bavaru manager of S.C. “Iris International” S.R.L., Constanța, for the plant material supplied for this study.

References

Web 1 http://www.plantemania.ro/plante-decorative/plante-de-interior-2/begonia-rex/