Annals of West University of Timişoara, ser. Biology, 2015, vol XVIII (1), pp. 7-12

ANATOMY OF *BEGONIA LUCERNAE* WETTST. (BEGONIACEAE) LEAF

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Received 29 December 2014; accepted 19 May 2015

ABSTRACT
The paper presents anatomical aspects concerning the leaf structure of Begonia lucernae Wettst. belonging to Begoniaceae family. Anatomically, the petiole has a unistratous epidermis and a differentiated mesophyll. The vascular system is fascicular type with a large number of collateral bundles placed into a basic tissue. The lamina is composed of an upper and a lower epidermis and hypodermis as well and the mesophyll. The mesophyll differentiated into palisade tissue and spongy tissue with the same vascular bundle structure such as those of the petiole but with foliar arrangement of the conductive tissues. Stomata are present to the lower epidermis. Paradermal section discloses stright walls epidermal cells and anisocytic stomata. It was calculated the number of stomata/mm^2 of leaf surface and the stomatal index as well.
KEY WORDS: *anatomy, leaf, mesophyll, photosensitive papillae, Begonia lucernae*

INTRODUCTION

The family Begoniaceae consists of two genera: *Begonia* Linnaeus, with approximately 1,500 species and pantropical distribution (spread in Central and Southern America, Asia, Africa, the Pacific Isles) and the monospecific *Hillebrandia* Oliver, from the Hawaiian Islands (Jacques & Mamede, 2005). Begoniaceae family comprises perennial herbaceous plants, suffrutescent or frutescent plants, alternate-leafed plants, sometimes asymmetrical, stipellated, whole or with a lobed side, lobed or divided, variously colored (Cruceru, 2011). The family is characterized by three-winged capsular fruits, bifid styluli and peculiar seed micromorphology (Forrest *et al*, 2005). Most Begoniaceae are monoecious perennials with very few dioecious exceptions. Begonias are widely spread in the rainforest in the humid mountain areas, inside the woods, on the edge of water courses, on rock walls, where water drops. They most likely originated in the mid-Eocene to late Oligocene and reached their current distribution by multiple intercontinental dispersal events (Goodall-Copestake *et al*, 2009). Over 10000 begonias hybrids and cultivars have been introduced by commercial growers. Many begonias are popular ornamentals (Awal *et al*, 2008).

The large size of the genus *Begonia* and its variation makes it ideal for studies of speciation (Ali, 2013). At the mega-diverse genus level *Begonia* is divided into 66 sections. *Begonia* is now considered to be one of the five largest genera of vascular

plants (Hoover *et al*, 2004). These plants display a big variety of shapes, colours, patterns and textures in their leaves rarely seen in other groups of plants. Sheue *et al*. (2012) concluded that the variegation is structural, like the intracellular space, where the light areas were created by internal reflection between the intercellular spaces. The intracellular space may occur below the superior epidermis or below the tissue that store water, both forms may have a common origin, where the dermal tissues it is loosely connected to mesophyll. Some investigation evaluates the antimicrobial and in vitro antioxidant potential of extracts of *Begonia* (Indrakumar *et al*, 2014), histo-anatomical and physiological aspects (Lee, 1974; Stratu *et al*, 2011), chromosome cytology (Zeilinga,1962; Peng *et al*, 2014), phylogenetic relationships (Tebbitt *et al*, 2006), somatic embryogenesis and plant regeneration (Rosilah *et al*, 2014), the effect of potassium silicate on the growth and leaf epidermal characteristics (Lim *et al*, 2012). Many species are observed to have a hypoderm and abnormal stomatal patterning ("stomatal cluster") (Dehnel, 1961; Tang *et al*, 2002). Medullary and cortical vascular bundles in the petiole and stem represent an anatomical pattern more like monocotyledons than dicots. The stem has superficial cork-cambium. Correlations between leaf shape and the numbers and size of trichomes were examined (Mclellan, 2005). Physiologically, *Begonia* is distinct for the presence of oxalic acid in cytoliths, another characteristic limited in the angiosperms (Pireyre, 1961; Grudnicki & Ianovici, 2014). Calcium oxalate crystals are most widespread storage material in plant (druses and prismatic types) (Ianovici, 2010). *Begonia* species are examples of plants with paedomorphic secondary xylem containing thin walled, wide libriform fibers (Dulin, 2008).

Begonia "Lucernae" Wettstein syn. *Begonia* "*Corallina de Lucerna"* obtained from *Begonia corallina*; the second parent is unknown. This species is part of the rizomatous begonias. The strain is about 1 m height; leaves are heart-shaped and oblong, toothed on the sides, dark-green olive-like. There are silver-like stains on the upper side of the leaf, and reddish ones, on the lower side of the leaves, as well as on the strain. The petiole is cylindrical, short, thick and reddish too. The lamina feature is the presence of a large number of white-silver spots on the upper side of the leaf. The flowers are pink coral, arranged as 4-5 in dichasiums but may also be lonesome (Fig. 1). The fruit is a capsule with many very small seeds. It is an apartment plant, little pretentious, which grows on all types of flowers (Cruceru, 2011). It is recommended that periodic rejuvenation by removing the woody shoots.

The aim of this work is to analyze the anatomy of the petiole and lamina of *Begonia lucernae*. In this way we belive that the present paper brings added knowledge about this group of plants in general and in particular for this species.

MATERIALS AND METHODS

Small pieces of petiole and lamina were fixed in FAA (formalin: glacial acetic acid: alcohol 5:5:90). Cross sections of the leaf were performed by free hand made

technique (Faur &Ianovici, 2005; Bercu, 2005). The samples were stained with alum-carmine and iodine green. Anatomical observations and micrographs were performed with a BIOROM–T bright field microscope, equipped with a TOPICA 6001A video camera.

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. It is followed by the cortex differentiated into an external 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 6-7 layers of parenchymatous cells.

FIG. 1. **Natural view of *Begonia lucernae* Wettst.**

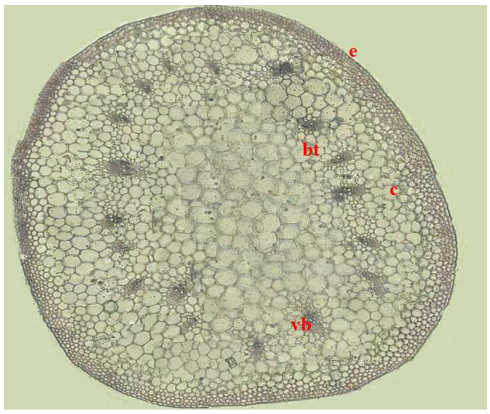

FIG. 2.Cross section of the petiole - ensemble (x 80): bt-basic tissue, c- cortex, e-epidermis, vb- vascular bundle.

Such as other *Begonia* species leaves (Barkley, 1971; Bercu, 2005), the vascular system, embadded into a basic tissue, is of fascicular type, composed by a large number of collateral vascular bundles (18), arranged on a circle (Fig. 2; 3, A). Each vascular bundle has the phloem tissue to the epidermis and the xylem tissue to the pith zone. Phloem tissues is composed of phloem vessels, companion cells and phloem parenchyma. The xylem is composed of xylem vessels and xylem parenchyma. The vascular bundles are surrounded by a bundle sheath (Fig. 3, B). The centraly located zone is made up of large thin-walled cells with intercelulere spaces (Fig. 2).

The lamina. The upper epidermis is made up of a layer of slightly tangent elongated cells, without spaces between cells, covered by a thick cuticle. Between the upper epidermal cells, photosensitive papillae were observed, with thick walls only in the median portion (Fig. 4, B; 5 A). These papillae are specific to shadow or semidarkness Begonias, how Brodersen & Vogelmann (2007) reported for *B. erythrophylla* and *B. bowerae*. It seems that the plants with this type of cell usually have a highly hydrophobic surface, and the convex shape prevents the accumulation of

water (Wagner *et al*, 2003; Bhushan & Jung, 2006). It follows a single layered hypodermis, protodermal in nature, composed of large, radially elongated cells. The mesophyll is differentiated into palisade and spongy tissue (heterogenous mesophyll) (Ianovici, 2010; Ianovici, 2011). The palisade tissue is composed by a small number of layers of cells (2-3 layers) more developed being the spongy tissue with 6-8 layers of cells (Fig. 4, A, B). The mid rib is very prominent to the lower epidermis and less to the upper one. The vascular system of the mid rib is composed of five vascular bundles. The vascular bundles have the same structure to those of the petiole but with typical foliar conductive tissues arrangement (Fig. 4, A; 5, B). Stomata are present only to the lower epidermis (hipostomatic lamina).

The lower epidermal cells are smaller than those of the upper epidermis and in the mid rib zone both epidermis cells are smaller and with a more or less rounded outline. The lower epidermal cells, in paradermal sections, disclose hexagonal cells with straight walls and anisocytic type stomata, more specifically, amphyanisocytic with two circles of subsidiary cell. The inner circle possesses two subsidiary large cells and a small one, whereas the external one is incomplete with two subsidiary cells (Fig. 6, A, B) (Dilcher, 1974). The lower epidermis possesses relatively few stomata 29,65 st./mm^2 with 0,181 stomatal index (IS).

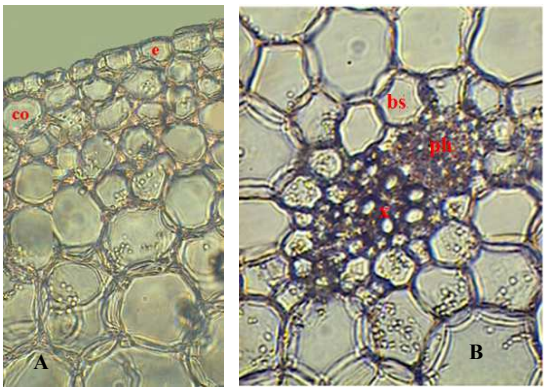

FIG. 3. Cross section of the petiole – details. Portion with epidermis and cortex (A, x 550). A vascular bundle(B, x 300): bs- bundle sheath, co- collenchyma, e- epidermis, ic- inner cortex, ph- phloem, x- xylem.

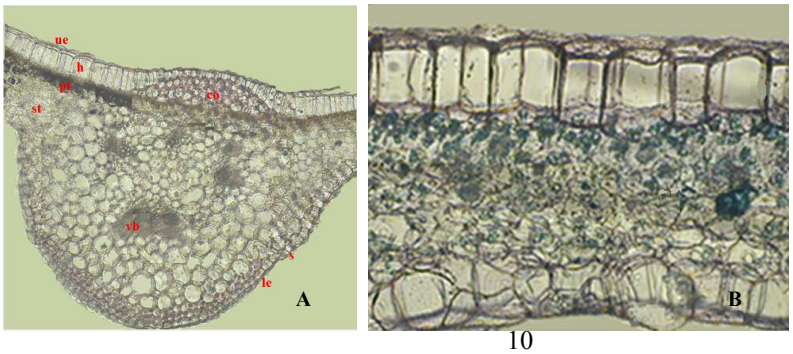

FIG. 4. Cross sections of the lamina. Portion with mid-rib (A, x 70). Portion with mesophyll (B, x350): co- collenchymam, h- hypodermis, le- lower epidermis, ms- mesophyll, pt- palisade tissue, s- stoma, st- spongy tissue, ue- upper epidermis, vb- vascular bundle.

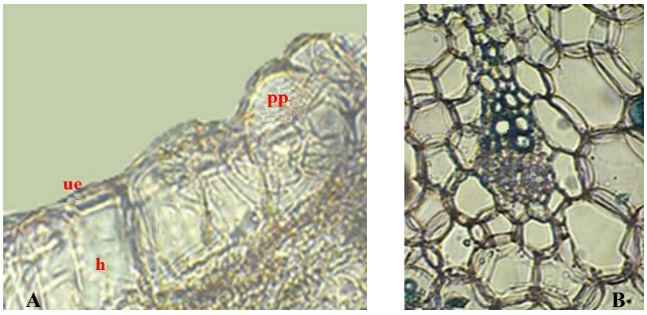

FIG. 5. Portion of the upper epidermis and hypodermis with photosensitive papillae. A vascular bundle of the mid rib (A, B, x 400): h- hypodermis, pp- photosensitive papillae, ue- upper epidermis.

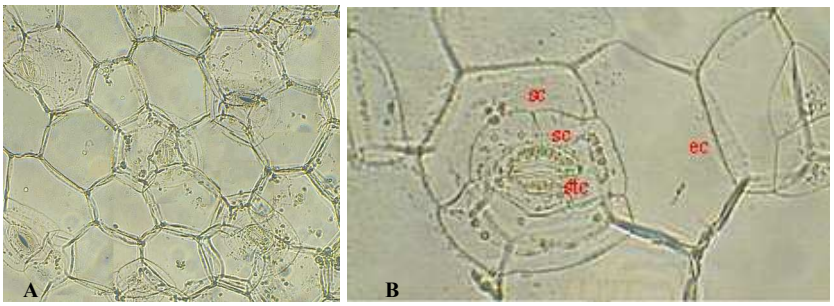

FIG. 6. Paradermal sections of the lower epidermis. Ansemble (A, x 200). Detaliu (B, x 520):ec- epidermal cell, sc- subsidiary cell, stc- stoma cell.

CONCLUSIONS

The petiole has a single layered epidermis and a differentiated cortex (collenchyma and parenchima or inner cortex). The vascular system is of fascicular type, composed by a large number of collateral vascular bundles. The lamina has a unistratous upper and lower epidermis and a hypodermis. Remarkable is the presence of photosensitive papillae to the upper epidermis.The mesophyll is heterogenous and hipostomatic. The vascular system is represented by a number of vascular bundles with foliar arrangement of the conductive tissues. The strength of the lamina is due to the collenchyma tissue, placed between the mid rib and both epidermis.

ACKNOWLEDGEMENTS

We express our thanks to dr. ing. Elena Bavaru manager of S.C. Iris International S.R.L. for the vegetal material made available to us for this study.

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