

COMPARATIVE ANATOMY OF TWO CULTIVATED SPECIES OF *COLEUS BLUMEI* BENTH. (LAMIACEAE) LEAVES WITH ORNAMENTAL VALUE

RODICA BERCU

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES, "OVIDIUS" UNIVERSITY,
CONSTANTZA

ABSTRACT

The paper presents a comparative study concerning the leaf anatomy of two ornamentally by leaves varieties of Coleus blumei Benth.: Coleus blumei 'Black Dragon' and C. blumei 'Violet Tricolor'. The comparative study discloses both similarities and differences in the leaf anatomical structure of the two Coleus species. Anatomically, the leaves of the studied species are quite similar in the basic structure but differences appear concerning the petiole shape, the non glandular and glandular trichomes types, diversity, structure and density on the petiole and lamina surface, the number of vascular bundles in the petiole. Both species have a bifacial leaf and a homogenous, hypostomatic mesophyll.

Key words: leaf anatomy, petiole, lamina, trichomes, *Coleus blumei*

INTRODUCTION

The perennial plant *Solenostemon scutellarioides* (L.) Codd is synonym to *Coleus blumei* Benth., *Coleus hybridus* hort. ex Voss, *Coleus scutellarioides* (L.) Benth. etc.). About two hundred species of **Coleus** are found in Africa, Asia and Malaysia, but **Coleus blumei**, which is a native of Java, is one of the most attractive plants for cultivating in pots. Taxonomists have now placed the varieties of *Coleus* into a closely related genus, *Solenostemon*, with a species name of *Solenostemon scutellarioides* (Lemke, 2004). *Coleus blumei* 'Black Dragon' is a wonderful house plant because it is very unique with its deep purple maroon colour, dramatic toothed edge foliage and ruffled leaves. On the upper blade surface, axially the leaf slightly green iridescences occur (Mahesh and Singh, 2005). The deeply toothed edges, gives the plant a dishevelled appearance, causing its characteristic ornamental pattern. The leaves have pinnate reticulate venation, an acuminate tip and a slightly cordate base. Very interesting is the fact that, although the plant has the deep colour of the leaves, it can grow in any light conditions or full sun but with the condition to ensure high humidity, either in the shade. The petiole is short and dark purple such as the blade (Fig. 1, A) (Hărăguș, 2008; Web 1).

Coleus blumei 'Violet Tricolor', a sun-loving coleus, is known for its vibrant and attractive foliage. The intense deep-violet of the upper surface of the leaves have a wide purple edge and netted bright green to olive rim. The center of the leaf is turns to deep burgundy then to olive. The lower surface is deep purple, such as the petiole. The blade has denticulate margin, pinnate reticulate venation and a rounded tip. The petiole is short (Fig. 1, B).

Very little information is currently and sporadically known about the leaf anatomy (petiole and lamina) of *Solenostemon scutellarioides* species, mostly in Plant Anatomy lectures (Batanouny, 1992). An anatomical study of a variegated clone of *C. blumei* belongs to Fisher (1985). Mostly recent are some physiological studies (Bataillé et al., 1990; Halaban, 1968), or pharmacological (Ratsch, 2005; Schultes et al., 2001). In

literature an anatomical study of these two varieties of *Solenostemon scutellarioides* leaf lack entirely.

The purpose of this paper is to highlight the similarities and differences between the two studied species leaves and to contribute with more information to the knowledge of this species structure and Lamiaceae family as well.

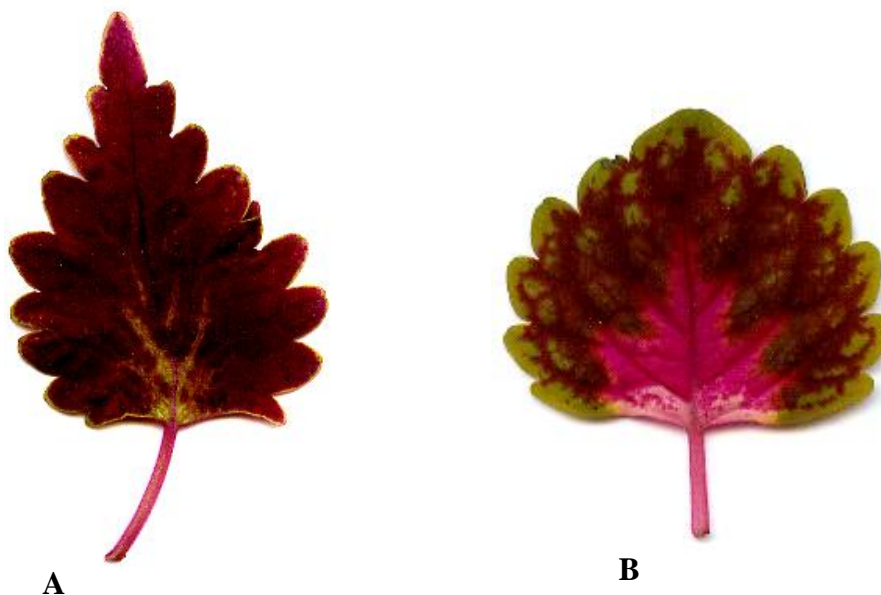


Fig. 1. The leaf of *Coleus blumei* 'Black Dragon' (A) and *Coleus blumei* 'Violet Tricolor' (B) (A, B- orig.).

MATERIAL AND METHODS

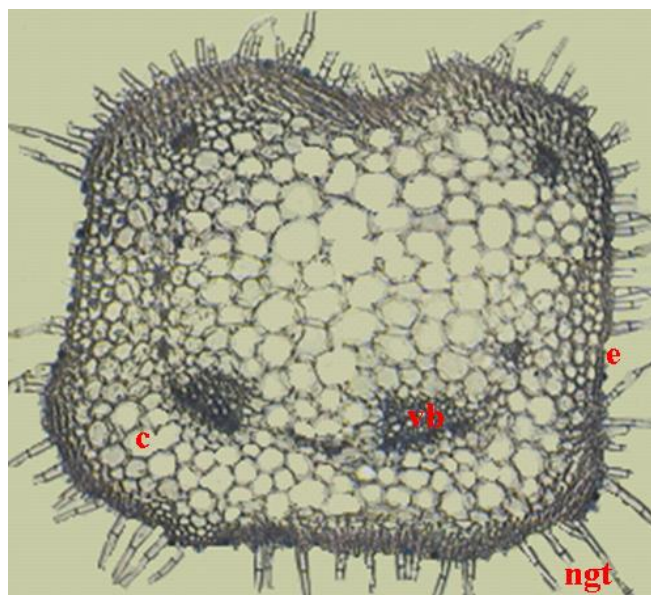
The leaves were collected from S.C. International S.R.L., glasshouse Constantza County in June 2012. Small pieces of leaves were fixed in FAA (formalin: glacial acetic acid: alcohol 5:5:90). Cross sections of the vegetative organs were performed by the free hand made technique (Bercu & Jianu, 2003). The samples were stained with alum-carmin 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 DISCUSSION

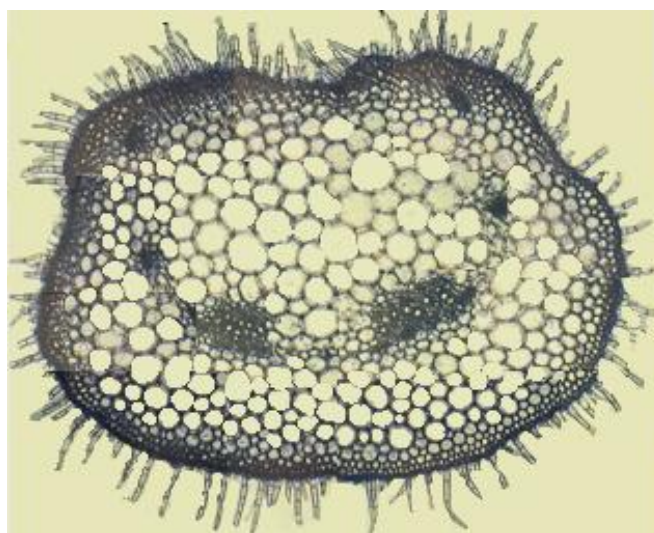
The petiole in cross section exhibits an irregular and polygonal 4-coasted shape for *Solenostemon scutellarioides* 'Black Dragon' and semi-circular with an adaxial superficial ditch for *S. scutellarioides* 'Violet Tricolor' (Fig. 2, A, B). Both species have a one-layered epidermis. The epidermal cells of *S. scutellarioides* 'Black Dragon' are slightly elongated whereas those of *S. scutellarioides* 'Violet Tricolor' are isodiametric but both of them are covered by a thin cuticle. The epidermis continuity is broken by the presence of uniseriate non-glandular and glandular trichomes and stomata as well.

The non glandular trichomes of *S. scutellarioides* 'Black Dragon' are longer (4-5 cells) than those of *S. scutellarioides* 'Violet Tricolor' (2-3 cells), ending in a slightly rounded tip. Sometimes ruptures are visible (Figs. 2, A, B; 3, A, B, C).

The glandular trichomes are short-capitate built of a basal cell, a stalk cell and a uni- or bicellular ovoid to globoid head for both *Solenostemon scutellarioides* varieties. Rare peltate trichomes, with a very short stalk and a large round head with many-celled secretory cells, are arranged in a disc (Figs. 4, 5, A, B), occur, such as Fisher (1985) and Ascensão et al. (1999) reported for *Coleus blumei* and *Plectranthus* respectively (Fig. 3, A, C).



A

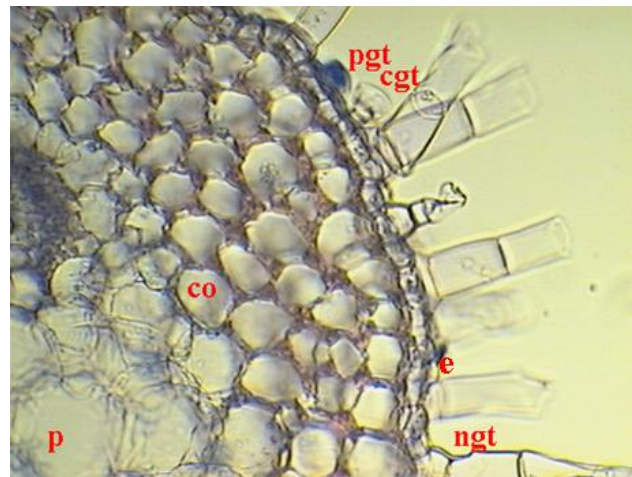


B

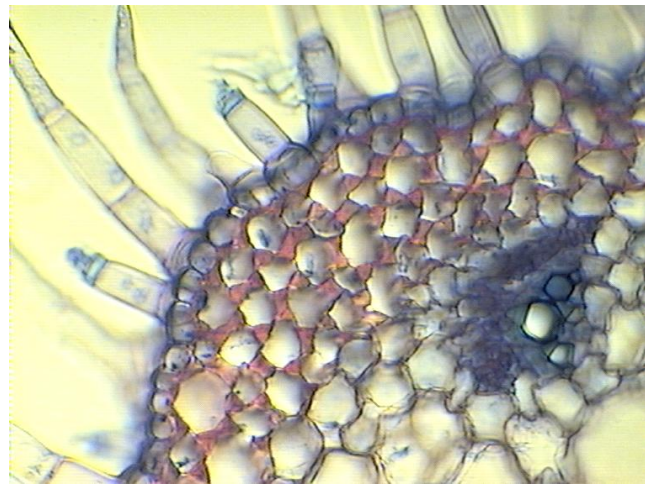
Fig. 2. Cross section of the petiole – ansamble. *Solenostemon scutellarioides* 'Black Dragon' (A, x 50) and *Solenostemon scutellarioides* 'Violet Tricolor' (B, x 45): c- cortex, e- epidermis, ngt- non glandular trichomes, vb- vascular bundle.

Below the epidermis is a hypodermal area of angular collenchyma, more or less equable developed for *Solenostemon scutellarioides* 'Violet Tricolor' than those of *S. scutellarioides* 'Black Dragon' where this mechanical tissue is better represented in the coasted areas. The many-layered inner area is a parenchymatous one with larger cells in

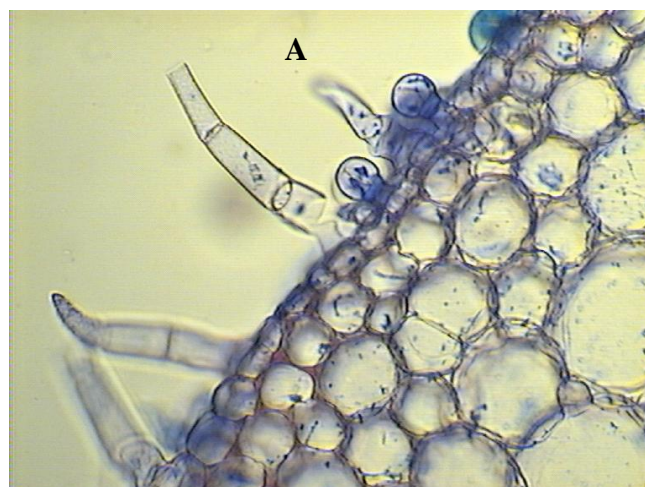
Solenostemon scutellarioides 'Violet Tricolor' than those of *S. scutellarioides* 'Black Dragon'.



A



B



C

Fig. 3. Portions of a cross section of the petiole - details. *Solenostemon scutellarioides* 'Black Dragon' (A, x 190) and *Solenostemon scutellarioides* 'Violet Tricolor' (B, C, x 190): cgt- capitate glandular trichome, co- collenchyma, e- epidermis, ngt- nonglandular trichome, p- parenchyma, pgt- peltate glandular trichome.

The petiole stele possesses a number of close collateral bundles for both species petiole. The petiole stele of *Solenostemon scutellarioides* 'Black Dragon' is made up of 8-9 vascular bundles, larger on the abaxial position and smaller to the adaxial one. The petiole stele of *S. scutellarioides* 'Violet Tricolor' consists of 6 vascular bundles, 2 larger in abaxial position and 4 smaller adaxially (Fig. 3, A, B). They consist of xylem vessels to the inner side and phloem elements to the epidermis. The vascular vessels are radial arranged in a cellulosic parenchyma. Phloem is poorly developed for both species (Fig. 4, A, B).

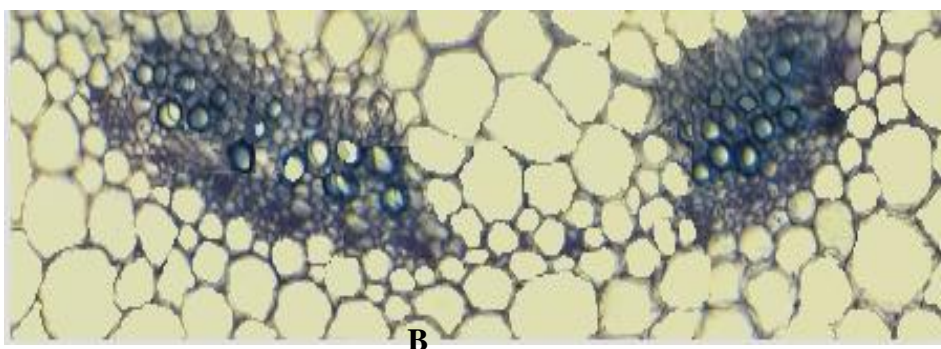
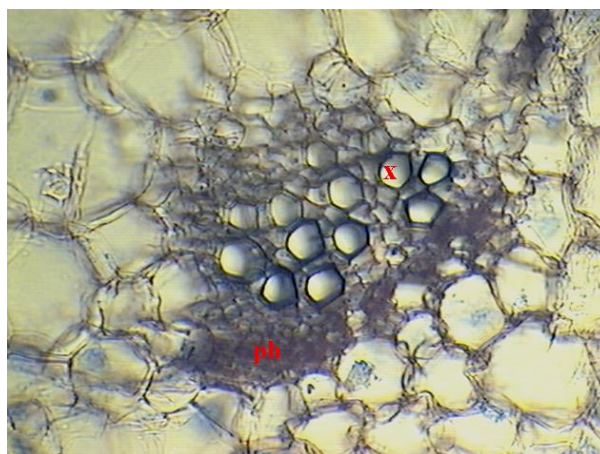
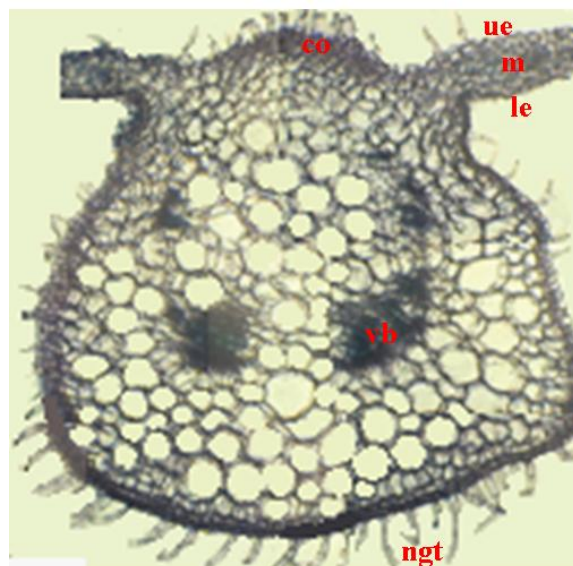


Fig. 4. Portions of a cross section of the petiole with a vascular bundle in abaxial position. *Solenostemon scutellarioides* 'Black Dragon' (A, x 200) and *Solenostemon scutellarioides* 'Violet Tricolor' (B, x 185): ph- phloem, x- xylem.

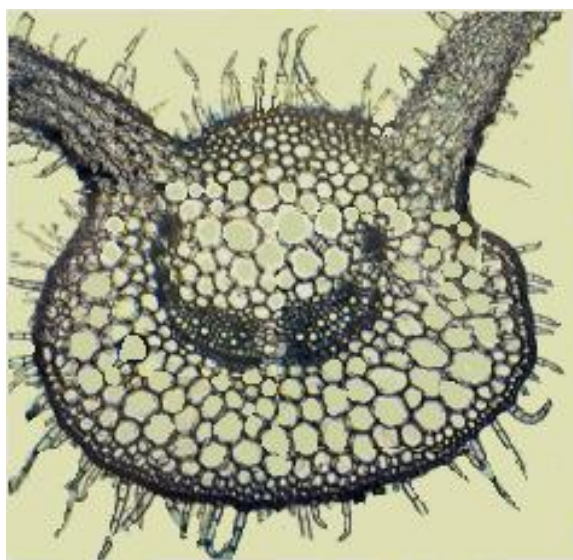
Cross sections of the lamina disclose a bifacial leaf with a heterogenous mesophyll for both species. The upper epidermis is made up of one layer of slightly elongated cells, covered by cuticle for *S. scutellarioides* 'Black Dragon' and papillate for *S. scutellarioides* 'Violet Tricolor'. In addition, the upper epidermal cells of *Solenostemon scutellarioides* varieties possess purple anthocyanins in their vacuolar systems. For both species, the lower epidermis forms in abaxial position a large prominence and has smaller cells than the upper one, barring stomata (hypostomatal leaf) (Fig. 5, A, B).

Nevertheless, the cells of the first layer for both *Solenostemon scutellarioides* varieties, placed just below the upper epidermis, form a palisade tissue possessing a large

number of chloroplasts in their cells, followed by the spongy tissue. Both species possess a 4-5 layers number in the mesophyll (Fig. 6, A, B, C). The non-glandular and glandular trichomes, with role in the plants defense and metabolism (Levin, 1973; Werker, 2000), are more abundant in the mid rib zone of the blade. Non-glandular and glandular trichomes are the same as those of the petiole for both species, described previously (Fig. 7, A, B).



A

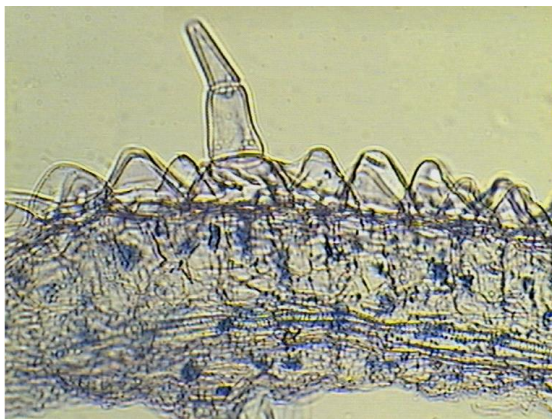
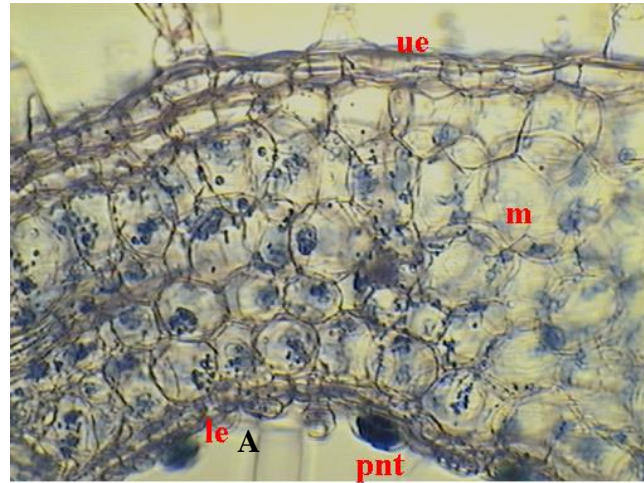


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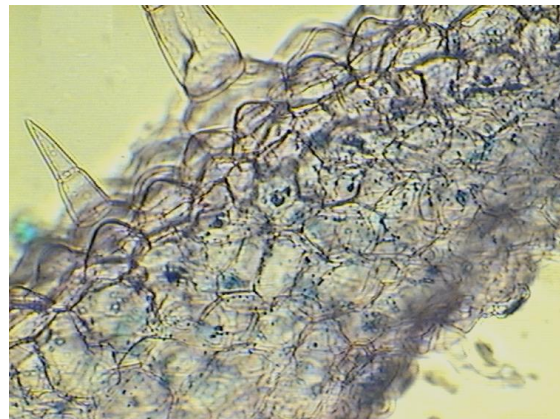
Fig. 5. Cross section of the blade with mid rib - ansamble: *Solenostemon scutellarioides* 'Black Dragon' (A, x 50) and *Solenostemon scutellarioides* 'Violet Tricolor' (B, x 45): co- collenchyma, le- lower epidermis, m- mesophyll, ngt- non glandular trichomes, ue- upper epidermis, vb- vascular bundle.

For both species, the veins vascular bundles, including the mid rib, are quite similar in their structure with those of the petiole but with characteristic foliar disposition of the

conductive elements. They are poor developed and consist of few xylem and phloem elements (Fig. 8, A, B). Between the mid rib and both epidermis collenchyma tissue is present (Fig. 5, A, B).



B



C

Fig. 6. Cross sections of the blade with mesophyll *Solenostemon scutellarioides* 'Black Dragon' (A, x 156) and *Solenostemon scutellarioides* 'Violet Tricolor' (B, x 90, C, x 125): le- lower epidermis, m- mesophyll, png- peltate non glandular trichome, ue- upper epidermis.

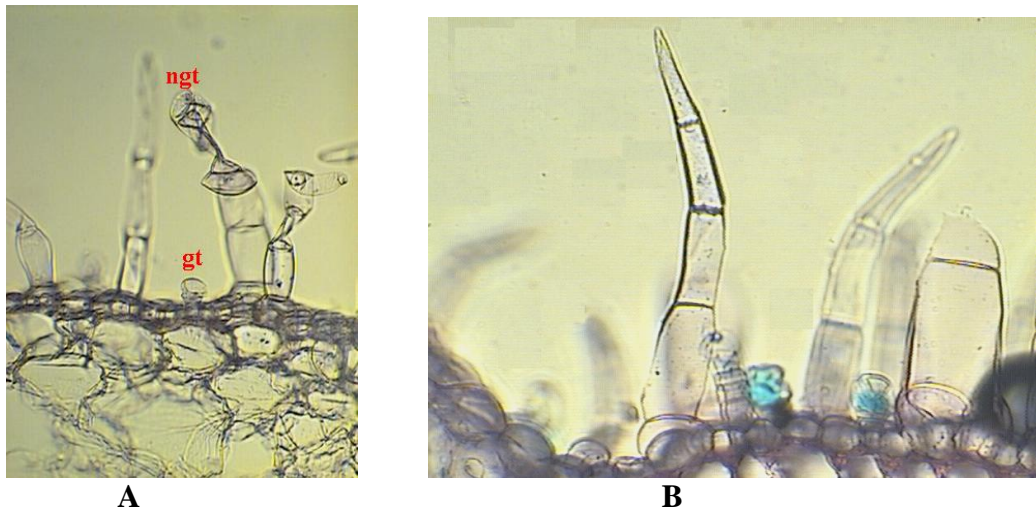


Fig. 7. Non glandular and glandular trichomes on the blade upper epidermis *Solenostemon scutellarioides* 'Black Dragon' (A, x 218) and *Solenostemon scutellarioides*'Violet Tricolor' (B, x 325): gt- glandular trichome, ngt- non glandular trichomes.

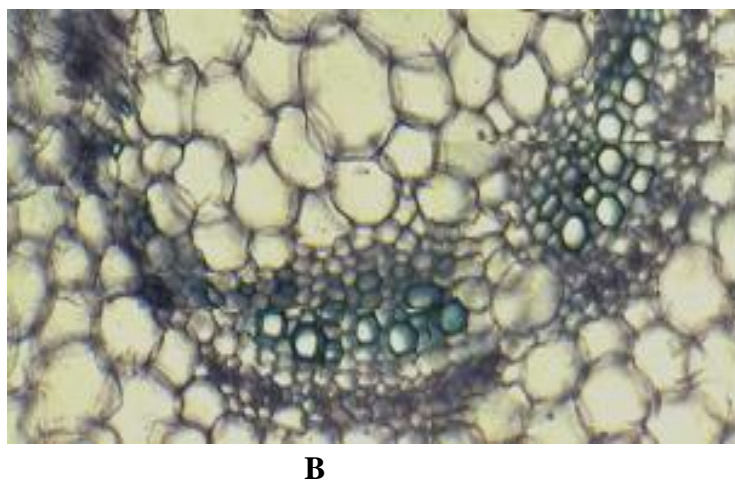
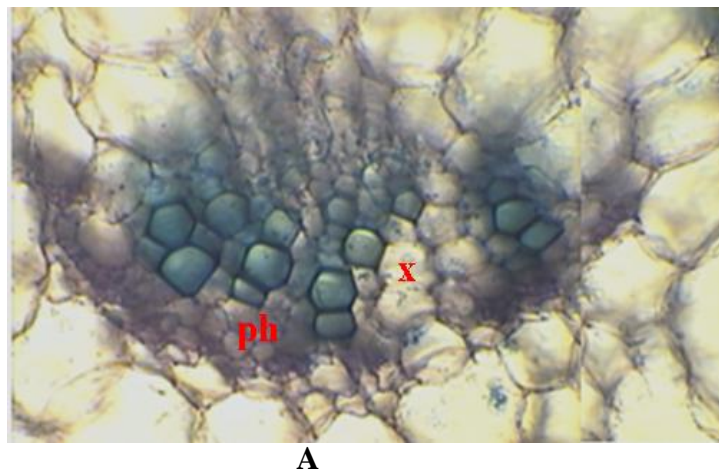


Fig. 8. Portion of the petiole in cross section with vascular bundles - details. *Solenostemon scutellarioides* 'Black Dragon' (A, x 290) and *Solenostemon scutellarioides*'Violet Tricolor' (B, x 260): ph- phloem, x- xylem.

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CONCLUSION

The two *Solenostemon scutellarioides* varieties are similar in structure but they also exhibit differences. The petiole in both species exhibits a differentiated cortex into two zones and a stele. Differences arise concerning the shape of the petiole the collenchyma tissue position and the number of the vascular bundle. Both species have a bifacial leaf and a hypostomatic, heteroheinous mesophyll. Differences occur concerning the non glandular and glandular trichomes types, diversity, structure and density on the petiole and lamina surface. Differences occur concerning the non glandular trichomes structure and density on the petiole and lamina surface (more abundant in *Solenostemon scutellarioides* 'Violet Tricolor').

The mechanical tissue in the petiole and blade is represented, in both *Solenostemon scutellarioides* varieties, by collenchyma tissues more developed in *S. scutellarioides* 'Violet Tricolor'.

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