ANATOMY OF THE VEGETATIVE ORGANS AT *Syngonium podophyllum* Schott.

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Abstract. This article has as an objective establishing the structure of the vegetative organs at *Syngonium podophyllum*. The structure is specific for herbaceous monocotyledonous: root has a primary structure, the stem primary structure is an intermediary form between an aerial stem and a rhizome (the presence in a fundamental parenchyma of the colaterally closed vascular bundles and the leptocentric ones). The leaf petiole has the suberified epidermis. It is characterised by the colaterally closed vascular bundles disposed peripherically and extremely well protected by the sclerenchyma and in the centre of the petiole, in the fundamental parenchyma, the same type of fascicles are placed. The middrib has a structure similar to that of the petiole. The leaf mesophyll is homogenous. The parenchyma of aerial vegetative organs of this species is crossed by aeripherous channels and their cells contain calcium oxalate crystals. The leaf is amphistomatic, the stomatic complexes are an amarilidaceous type, tetracitic or hexacitic.

Keywords: *Syngonium podophyllum* , anatomy, vegetative organs

INTRODUCTION

Syngonium podophyllum Schott., family *Araceae* [6], original from the tropical woods in South and Central America, is part of the category of flowery decorative plants through leaves and port. It is a tropical plant, initially with an aspect of bush, then with a stem like a hanging plant that can reach up to 1.5-2 meters. The young leaves are full and having an arrow-like form, and as the plant grows older it is divided into 3-5 lobes. It is interesting through its capacity of modifying the form and aspect of the leaves once with its growing old.

At this species there were carried out morphologic research referring to the form of the leaves [8], to the foliar system of the plants of *Syngonium podophyllum* in the case of eliminating the polluting agents from inside the households [11], to the filotaxia of this species [7]; anatomic studies concerning the type and location of the calcium oxalate crystals in the leaves [3]; phyisiological studies, the increase of the peroxidasic activiy in the leaves of *Syngonium podophyllum* to the adaptation of the plants from the aseptic life conditions „in vitro" to the septic conditions „ex vitro"[9], the regeneration of the plant *Syngonium podophyllum* "variegatum" through direct somatic embriogenesis [12], the significant favourable effect of the mycorrhizal interference into the process of acclimatizing of the vitro small plantlets of this species [4]; genetical, there were analysed the genetic differences of 19 species selected out of the somaclonal variations of *Syngonium podophyllum* [2].

Syngonium podophyllum is an ornamental plant extremely useful in purifying the atmospheric air. As such, it can be kept without any problem in the bedrooms. The present paper has as an objective establishing the structure of the vegetative organs – the root, the stem and the leaf – at the species of *Syngonium podophyllum.*

MATERIALS AND METHODS

The biologic material used by us was represented by fragments of vegetative organs taken from the plants of *Syngonium podophyllum* grown in pots in the green house of Botany Department of Faculty of Science of the University of Oradea. After being conserved in ethylic alcohol of 70º there was taken into study the structure of the vegetative organs of the plant. After sectioning there were carried out: Congo red colorations and colorations with ioded zinc chlorine, microscopic analysis and micrommetry. There have been made provisional microscopic prepared material, which was analysed with various sets of ocular-objective and photographed with a camera Canon A550 type, 7.1 megapixels, 4x optical zoom, attached at the ocular of the microscope with an adapter. The photographs were procesed with a program ACD See Photo Manager.

RESULTS

Anatomy of the root

At the level of the sections made through the root, there can be observed the rizodermis with root hairs (Fig. 1B). It is formed of a stratum of cells with thin, cellulosic walls. A part of the cells of the rizodermis are transformed through elongation into root hairs. Next comes the cutis, which is colored in yellow with the ioded zinc chlorine, because it is formed of a few strata of cells having a poliedric form, with cellular walls more or less suberified, thus making up a primary suber with a role in defense after the exfoliation of the rizodermis (Fig. 1A). There can also be observed the depositing parenchyma of the starch grains, made up of several strata of rounded cells, with large intercellular spaces among them, having an important role in depositing the reserve substances (Fig. 1A, B).

The central cylinder (Fig. 2) is surrounded by a unistratified pericycle, made up of small cells, with thin, pectocellulosic walls. On the internal face of the pericycle are situated the xylem conducting fascicles with the part named protoxylem and phloem conducting fascicles with the part named protophloem. The pericycle is situated right beneath the endodermis. The endodermis at *Syngonium podophyllum* is made up of cells with lignified cellular walls. It performs the function of sustaining and defense of the central

cilynder. Every now and then, there remain in the endodermis cells having cellulosic walls, named passage cells, which enable the transit of the xylem sap, essentially water, from the root hairs to the wooden vessels. The xylem conducting fascicles, in a number of 11-15, are made up of two areas: the metaxylem and the protoxylem. The phloem conducting fascicles are present in an equal number with the xylematic ones. In the vicinity with the pericycle, there is the protophloem, and towards the centre there is the metaphloem. The pith is a sclerenchimatic tissue. The medular rays are placed between the xylem conducting fascicles and the phloemic ones (Fig. 2).

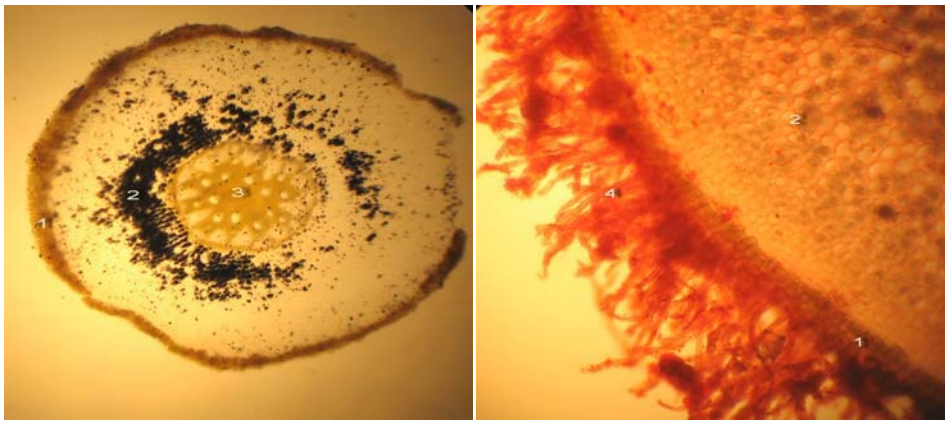


Figure 1. Cross-section through the root of *Syngonium podophyllum*, A- coloration with ioded zinc chlorine (40 x); B - coloration with Congo red (100 x); 1 – cutis; 2 – cortical parenchyma with amiloplasts; 3 – central cylinder; 4 – rizodermis with root hairs.

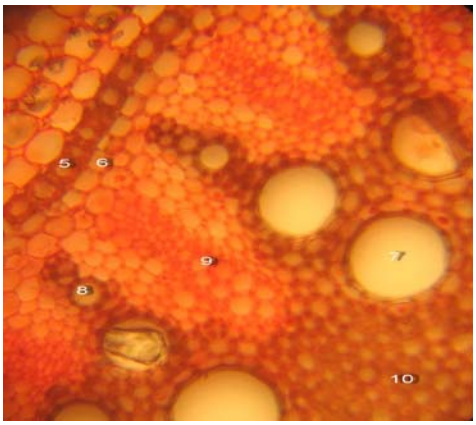


Figure 2. Structure detail regarding the central cylinder of the root of *Syngonium podophyllum* (400 x), coloration with Congo red; 5 – endodermis; 6 – pericycle; 7 – metaxylem; 8 – protoxylem; 9 – phloem fascicle; 10 – sclerenchymatic pith.

Anatomy of the stem

Further to the microscope studying of the cross-sections through the stem, there could be observed the following: the epidermis, made up of a stratum of cells closely united among them, with suberified cellular walls, walls that have couloured themselves in orange–yellow with ioded zinc chlorine (Fig. 5). Beneath the epidermis there can be observed the hypodermis, made up of one stratum of cells having the cellular walls suberified. The following 4-5 strata of cells make up the mechanic tissue named angular colenchyma (Fig. 5). The fundamental parenchyma, a clorenchyma, is made up of several strata of parenchymatic cells with thin, cellulosic walls, and with numerous intercellular spaces, full of starch grains (Fig. 3). Within it, there are spread a lot of conducting fascicles of leptocentric and of colaterally closed type (Fig. 4). At the periphery of

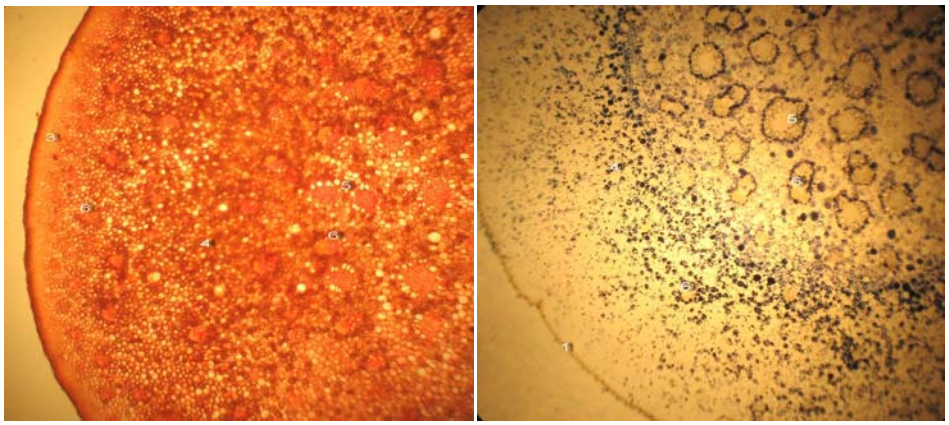


Figure 3. Cross-section through the stem of *Syngonium podophyllum*, A - coloration with Congo red (40 x); B - coloration with ioded zinc chlorine (40 x); 1 – epidermis; 3 – angular collenchyma; 4 – parenchyma with amiloplasts; 5 – leptocentric vascular bundles; 6 – colaterally closed vascular bundles.

the stem, the fascicles are of a colaterally closed type, smaller in dimensions (Fig. 3); towards the centre of the stem, the colaterally closed fascicles are larger and are mixed with leptocentric fascicles (Fig. 4). All the vascular bundles of a colaterally closed type are protected, at the level of the phloem, by thick arches of sclerenchyma (Fig. 4). At the leptocentric vascular bundles (Fig. 4), the phloem is situated in the centre

and the xylem is situated all around. There cannot be identified a delineation of the central cylinder. Around the conducting fascicules the cells of the parenchyma seem to be richer in starch grains.

Anatomy of the leaf petiole

There were made cross-sections through the base (Fig. 6A), the middle (Fig. 6B) and the top of the petiole (Fig. 6C).

The form of the cross-section through the leaf petiole at *Syngonium podophyllum* was variable. Thus, at the base (the part towards the stem), the petiole is wider and it presents two lateral prolongations and whit concavity towards the ventral part (superior) (Fig. 6A), the middle is approximately round, having the upper part slightly flattened (Fig. 6B), and the top has the superior part plane-concave, whilst the inferior one is round (Fig. 6C).

From an anatomic point of view, all the areas of the petiole have the same structure (Fig. 7). On the exterior the epidermis is made up of a stratum of cells having the cellular walls suberified. Right beneath the epidermis there are disposed, all around the section, a lot of colaterally closed vascular bundles, protected by sclerenchymatic arches extremely well represented. The fundamental parenchyma with starch grains is crossed by a multitude of aeripherous channels. In the centre of the section there is a number of 11-12 colaterally closed conducting fascicles. The same as in the stem, at the level of the petiole as well, around the conducting fascicles the cells of the depositing parenchyma of the reserve substances seem to be richer in starch grains.

Anatomy of the foliar limb

At the level of the leaf lamina with *Syngonium podophyllum* there were made cross-sections through the mediane nervure and through its lamina, there were studied and biometrized the cells of the epidermae: superior and inferior.

The contour of the cross-section through the mediane nervure is round towards the inferior face (abaxial) of the leaf and concave towards the adaxial face (Fig. 8).The internal structure of the mediane nervure is similar to that of the leaf petiole. Thus, at the exterior, there is the inferior epidermis, respectively the superior (upper) one. At the level of the ab-axial face of the mediane nervures, right below the epidermis there are a lot of conducting fascicles of a colaterally closed type, protected by sclerenchyma arches. At the level of the adaxial face there is the same type of fascicles but much larger in dimension, with the phloem oriented towards the exterior, and the xylem towards the interior. The mechanic tissue protecting is more poorly represented. The leaf's fundamental parenchyma, at the level of the mediane nervure, is crossed by multitude of aeripherous channels (Fig. 8 & 9) and is rich in starch grains particularly around the vascular bundles.

The superior epidermis is made up of poliedric cells and has an extremely reduced number of stomatae. The stomatae complex is of a tetracitic or hexacitic type (Fig. 10).

At the level of the inferior epidermis one can observe the fact that there are a lot of stomatae (Fig. 11). The stomatae are of the amarilidaceous type, tetracitic or hexacitic, and the epidermal cells are poliedric.

Between the two epidermae there is the leaf mezophyill, which is homogenous, with aeripherous channels (Fig. 9B). In the cells strata beneath the superior epidermis seem, however, there is more chloroplasts. The mezophyil is crossed by colaterally closed type conducting fascicles.

The cells of the upper epidermis (stomatic cells, epidermal annexes, proper) are larger in dimensions comparatively with those of the lower epidermis.

By analysing the micrommetric data, one can state that the dimensions of the stomatic cells in the upper epidermis are comprised between the following values: the length of the stomatic cells between 22.5 and 32.5 µm, and the width between 5 and 7.5 µm; in the inferior epidermis the stomatic cells have the length comprised between 9 and 11 µm, and the width between 2 and 3µm. The cells of the superior (upper) epidermis are larger in dimensions (the length comprised between 45-65 µm; and the width between 25-42.5 µm), comparatively with the cells of the inferior epidermis (the length comprised between 18-26 µm; and the width between 10-17µm).

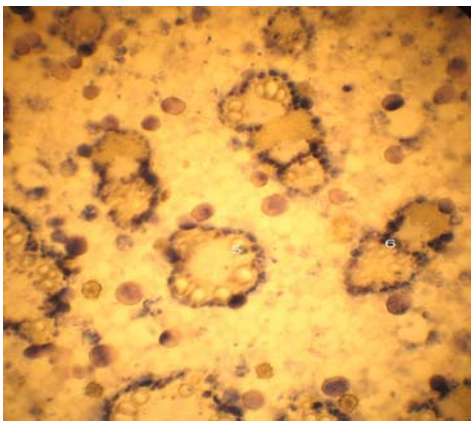


Figure 4. Structure detail regarding the vascular bundles in the stem of *Syngonium podophyllum*, coloration with ioded zinc chlorine (100 x); 5 – leptocentric vascular bundles; 6 – colaterally closed vascular bundles.

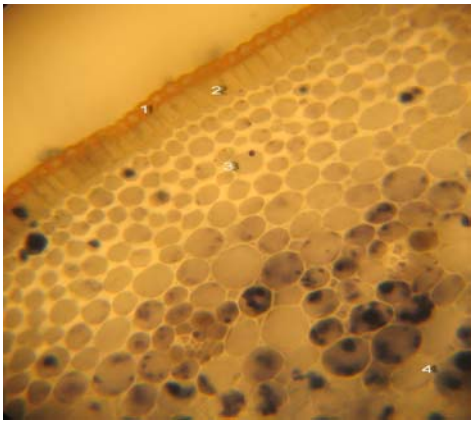


Figure 5. Structure detail regarding the cortex of the stem of *Syngonium podophyllum*, coloration with ioded zinc chlorine (400 x); 1 – epidermis; 2 – hypodermis; 3 – angular collenchyma; 4 – parenchyma with amiloplasts.

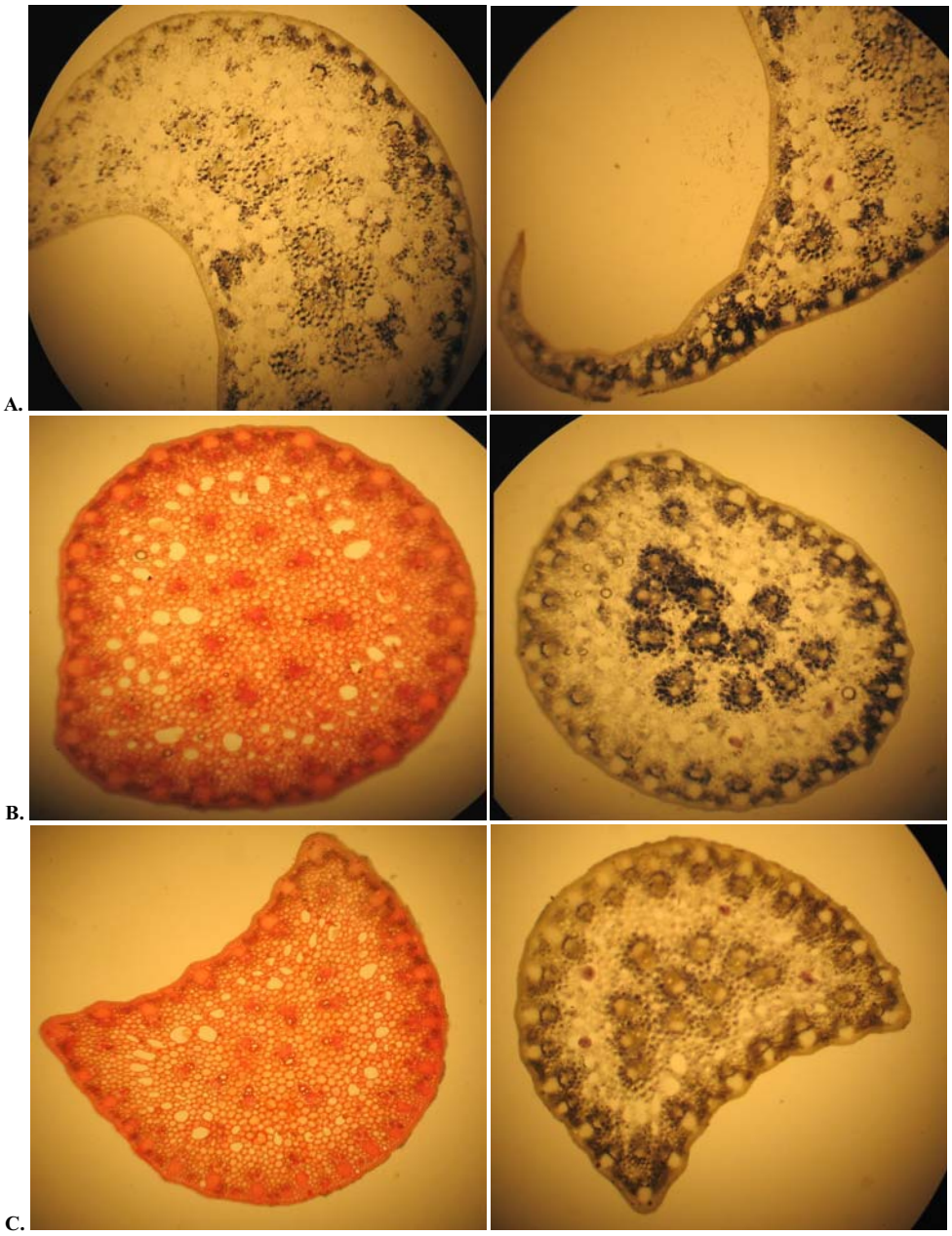


Figure 6. The forms of the petiole (the base A, the middle B and the top C) of *Syngonium podophyllum* leaf (40 x).

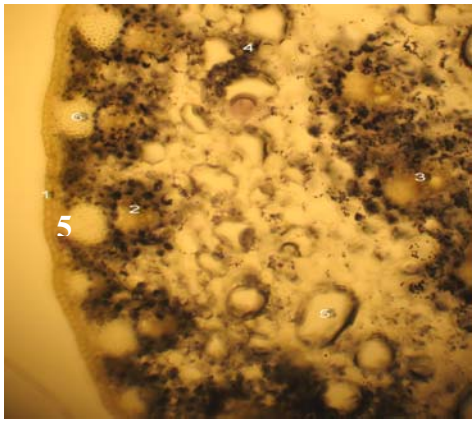
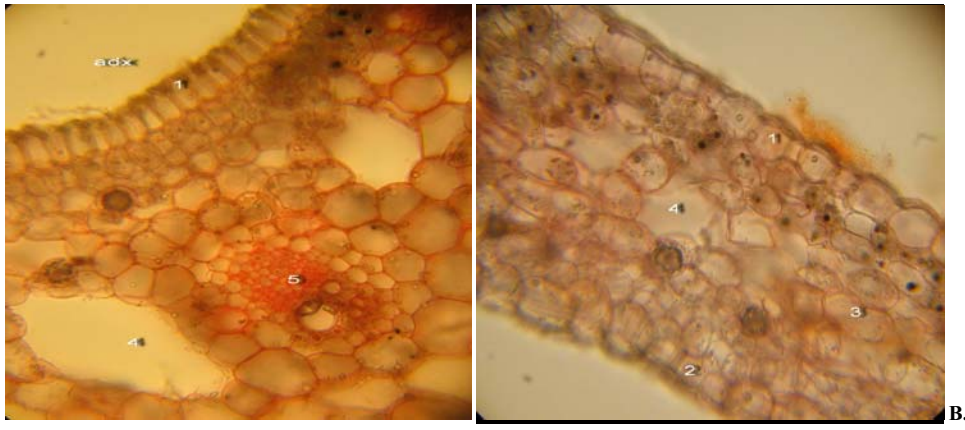


Figure 7. Structure detail regarding the petioleof the leaf of *Syngonium podophyllum*, coloration with ioded zinc chlorine (100 x); 1 – epidermis; 2 – peripherycal colaterally closed vascular bundles; 3 – central colaterally closed vascular bundles; 4 – fundamental parenchyma with amiloplasts; 5- aeripherous channels; 6 – sclerenchymatic arches.

Figure 8. Cross-section through the middrib of the leaf of *Syngonium podophyllum*, coloration with Congo red (40 x); adx-adaxial; abx-abaxial.



A. B.

Figure 9. Cross-section through the leaf of *Syngonium podophyllum*, A, B - coloration with Congo red (400 x); 1 – abaxial epidermis; 2 – adaxial epidermis; 3 – homogenous mezophyll; 4 – aerypherous channels; 5 – colaterally closed vascular bundles.

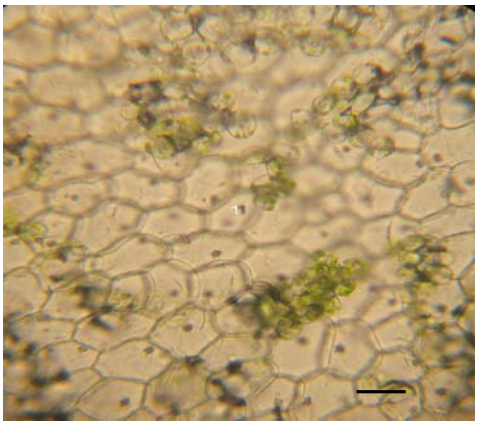


Figure 10. Adaxial epidermis of the leaf of *Syngonium podophyllum* (100 x); 1- epidermal cells (scale bar - 50µm).

Figure 11. Abaxial epidermis of the leaf of *Syngonium podophyllum* (400 x); 1- epidermal cells ; 2- stomatic complexe (scale bar-25µm).

The stomatic complexes are present in both epidermae, the stomatae are rare in the upper epidermis, their density is much higher in the inferior epidermis, and the leaf is amphistomatic.

DISCUSSIONS

Anatomy of the vegetative organs at *Syngonium podophyllum* are in accordance with the literature referring to the general structure of the vegetative organs at the herbaceous monocotyledonous [1, 5, 10] and they have a lot of similar characteristics with *Syngonium cordatum* organs structure [6]. *Syngonium podophyllum* root has a primary structure, presenting from the exterior to the interior: the rizodermis with root hairs, cutis, cortical parenchyma of depositing the starch grains, the endodermis made up of cells with cellular walls completely lignified and of passage cells, the pericycle and in the central cylinder can be observed the same number of the vascular xylem fascicles and the phloemic ones, separated by sclerenchymatic medular rays. The pith is a sclerenchyma. The stem is short, having the suberified epidermis, the hypodermis with secondary thickening and a mechanic tissue of the type angular collenchyma. It is an intermediary form between an aerial stem and a rhizome, fact demonstrated by the presence in the clorenchyma of the colaterally closed vascular bundles and of the leptocentric ones. The leaf petiole has the suberified epidermis, it is characterised by the presence in the fundamental parenchyma of a colaterally closed conducting fascicles disposed peripherically and extremely well protected by the sclerenchyma. The same type of fascicles is placed also in centre of the petiole. The median nervure has a structure similar to that of the petiole, and the leaf mesophyl is homogenous. The parenchyma of aerial vegetative organs of this species is crossed by aeripherous channels and their cells contain calcium oxalate crystals. The leaf is amphistomatic, the stomatic complexes are an amarilidaceous type, tetracitic or hexacitic.

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