ANATOMICAL ASPECTS OF PHALAENOPSIS AMABILIS (L.) BLUME

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Summary

The paper presents the structural features of the aerial root, stem, leaf and perigone of an epiphyte orchid with ornamental value Phalaenopsis amabilis (L.) Blume, belonging to Orchidaceae family. The aerial root presents a primary structure with typical elements which could be considered an adaptation to an epiphytic habit and humid environments. The stem reveals a primary characteristic structure of monocots. The leaf and floral elements disclose the same structure, both presenting an amphystomatic, homogenous mesophyll with aerial spaces, the latter considered as well an adaptation to the environmental habit of the plant.

Keywords: anatomy, root, stem leaf, perigon, Phalaenopsis amabilis.

Introduction

Orchidaceae is a very large family of flowering plants that contains at least 20,000 species and 735 genera, distributed throughout the world except in the coldest areas, and most numerous in damp equatorial regions. In addition, orchidists are creating new genera by creating intergeneric hybrids, involving two or more natural genera. The flowers are the most highly evolved of the plant kingdom; they have three sepals and three petals and sometimes grow singly, but more usually appear with other flowers on spikes, growing up one side of the main stem, or all around the main stem, which may be upright or drooping. The lowest petal of each flower, the lip, is usually large, and may be spurred, fringed, pouchet, or crested.

Orchid fruits are usually 1-chambered capsules with many very small seeds. Many tropical orchids are epiphytes – attached to trees but feeding independently on decayed plant and animal remains and rainwater – but temperate orchids commonly grow on the ground (Dycus and Knudson, 1957).

Phalaenopsis, the moth orchid, is perhaps one of the most cultivated orchids as indoor plants and is a favorite of those who have emissions. The generic name comes from Greek, where “phalaina” means “moth” and “opsis”-“like” and, of course, describes the species of Phalaenopsis flowers resembling moths are in flight (Steven, 2008). That is why the popular name of the plant is moth orchid. Phalaenopsis originate in Southeast Asia, the area between the Himalayas until Polillo islands and Palawan in the Philippines, and northern Australia. They generally know little about Phalaenopsis about their habitat and ecology.

Most are epiphytic plants that live in the shade, some are lithophytes. The natural habitat is usually found in moist forests foliage, protected from direct sunlight, but in dry or cold environments (Christenson, 2001).

Phalaenopsis amabilis is one of the best-known of the phalaenopsis orchid species. It's an epiphytes growing high in trees either in dense forests or sometimes, close to the ocean. Phalaenopsis amabilis is actually quite easy to grow and adaptable. Given its native habitat, it will thrive in temperatures from 20° (65°F) at night to 30° (85°F) during the day. Low night temperatures are more important in the fall
and winter months to induce blooming which often takes place over several months during the spring, and early summer as the flowers are very long-lasting. It's fairly typical for the species to produce two spikes at the same time when mature with blooms neatly arranged on either side of the spike. That leaves of the species tend to be more oval in shape and the plant is quite attractive even when not in flower. This species has been bred to produce round well shaped flowers with a crystalline texture, far removed from the more open flowers of their wild ancestors (Reinikka, 1995).

This study describes the anatomical structure of orchid *Phalaenopsis amabilis*, with the purpose of contributing to the knowledge of this group of plants. Structural characters of this plant could be considered plant adaptations to an epiphytic habit.

**Material and methods**

The species was collected from S.C. Iris S.R.L. greenhouse. Median region of the roots, stem, leaves and tepals were fixed in FAA 50 and transferred to alcohol 50%. For the anatomical study, freehand sections were stained using different staining methods, such as alum-carmine and iodine green (the trasversal sections), saphranin 0,5% (the paradermal sections). The lignin was identified by acidified floroglucin solution (Johansen, 1940, Bercu and Jianu, 2003). The photomicrographs were obtained in a BIOROM –T photomicroscopy.

**Results and discussions**

Cross section of the aerial root exhibits that the outer one-layered rhizodermis consisted of radially arranged thick-walled large cells, followed by a uniseriate velamen. The velamen was formed by polygonal cells, which could be, elliptic or rectangular, in cross section (Fig. 1, A, B). The velamen was also found in others monocotyledons such as Araceae, Liliaceae, Dioscoreaceae, Taccaceae, Amarillidaceae and Commelinaceae (Dahlgren and Clifford, 1982, Cuttler et al., 2008). The size of the velamen could be related to environmental factors, especially to water and temperature. Therefore, species from dry environments or exposed habitats have a velamen with many layers, and those from humid environments have a single layered velamen (Sanford and Adanlawo, 1973). The outer velamen layer in *Phalaenopsis amabilis* has no hairs as in other epiphytic species (*Pleurothallis smithiana*) (Withner, et al., 1974).

The outer layer of cortex, close to the velamen, was differentiated in an exodermis which presented two types of cells. Some of them are higher cells, with thickened wall and isodiametric other shorter cells with thin walls - the passage cells (Fig. 1, B). The longer suberified/lignified cells of the exodermis protect the root cortex against dehydration, while the shorter cells, with thin walls, drive nutritive compounds from the velamen to the root cortex (Evert, 2006; Fahn, 1990; Haberlandt, 1914). In cross section, the exodermis cells showed a U shaped (outer and radial walls thickened), pattern of secondary wall thickenings (Fig. 1, B). A function, attributed to the velamen cell wall thickenings, is to provide mechanical support, avoiding cellular collapse during dehydration (Noel, 1974). The velamen/exodermis complex absorbs passively and maintains humidity temporarily. According to Benzing and Friedman (1982), it was similar to trichomes of Bromeliaceae leaves and formed a complementary absorptive system.

Bellow the exodermis a many-layered parenchymatous cortex with chloroplasts and tracheoidal elements was present. It was formed by round cells, of various sizes and thin walls (Fig. 1, A). The cortical cell layers close to the exodermis and endodermis were smaller than those of the central region. Idioblasts with raphids are common in root cortex of the studied species.
The cortex is followed by a uniseriated endodermis formed a sheath around the vascular cylinder (Fig. 1, C), consisting of lignified thickened endodermis cell walls (O form) (Oliveira and Sajo, 1999). The 1-3 endodermis cells, opposite to the protoxylem poles, were small, had thin walls and were called passage cells. The root had a uniseriated pericycle and was poliarch. Phalaenopsis amabilis root, had many protoxylem poles and were thick, few metaxylem vessels, alternating with phloem vessels. Internal to the vascular tissues there was a medullar parenchymatous tissue.

Cross sections of the stem disclosed a uniseriate epidermis covered by a thin cuticle, followed by two rows of slightly thick-walled collenchymatous cells forming a hypodermis. Bellow the hypodermis a several thin-walled rows formed the cortical parenchyma with air spaces among the cells. The pericycle is many-layered and lignified followed by the stele which consisted of numerous collateral vascular bundles arranged on two rings, embedded in a slightly lignified parenchymatous tissue. Beneath the vascular bundles primary rays occur. Centrally, a medullar parenchyma is present (Fig. 2, A, B).
Fig. 2. Stem in cross section, ensemble (A; x 30), details (B; x 80): C- cortex, E- epidermis, Pc- pericycle, Pi- pith, PiR- pith ray, St- stele, VB- vascular bundle.

The leaf in transversal section consisted of an upper and lower epidermis, a well developed chlorenchyma tissue and the veins vascular bundles. The vascular system of the veins (mid vein) was close collateral such as those of the stem but with the typical foliar arrangement. The mechanical tissue is absent. Rare tracheoidal elements and raphids occur as well (Fig. 3, A-C).
Fig. 3. Cross section of the blade, ensemble (A; x 45), mesophyll (B; x 110) and vascular bundle (C; x 430): LE- lower epidermis, Ms- mesophyll, Ph- phloem, S- stoma, UE- upper epidermis, V- vein, VB, vascular, bundle, X- xylem.
Paradermal sections present, on both epidermis, linear cell with long and short cells alternating and mostly a (paratetracytic type) stoma apparatus (2 cells lateral and parallel to the guard cells and 2 narrow polar cells), and anisocytic stomata (a number of cells around the guard cells) (Dilcher, 1974) (Fig. 4).

Fig. 4. Paradermal section of the blade (x 255): AS- anisocytic stomata, EC- epidermal cell, TS- tetracytic stomata.

Fig. 5. Cross section of the a tepal, ensemble (A; 140), vascular bundle, detail (B; 330): AS- air space, LE- lower epidermis, Ms- mesophyll, Ph- phloem, UE- upper epidermis, VB- vascular bundle, X- xylem.
The tepale (6) structure is quite similar to those of the leaf. Remarkable are the upper papillose cells of the upper epidermis. Here and there few stomata are present.

The vascular bundles are rare and poorly developed and, in between the parenchyma cells of the homogeneous mesophyll, rare lacunar spaces occur. Parenchyma cells consists numerous antocians and few chromoplasts (Fig. 5, A, B).

Lateral sides of labellum (lip) structure are different from that of the 6 petals. Cross section of labellum appeared elliptic in shape without papillose cells (Fig. 6, A). The epidermal cells are small, isodiametric and covered by a striate cuticle. Few air spaces are present. The mesophyll is homogeneous.

Just below the epidermis the mesophyll cells are smaller than those of the rest of it, consisting numerous chromoplasts and antocians.

Fig. 6. Cross section of the labellum, ensemble (A; x 35), details (B; x 105, C; x 380): E- epidermis, Ms- mesophyll, Ph- phloem, VB- vascular bundles, X- xylem.

Fig. 7. Paradermal sections of the petal (A, B; x 265): EC- epidermal cell, R- raphids, S- stoma.
In the mesophyll numerous (9-10) poor developed linear vascular collateral bundles are embedded, similar with those of the perigon elements (Fig. 6, B, C).

Paradermal section of the epidermis on both tepal and labellum are similar to those of the blade (Fig. 7).

**Conclusions**

The root presents a primary structure with typical elements of an epiphytic plants (living in humid areas). The stem reveals a primary characteristic structure of monocots. The leaf is homogeneous and amphystomatic.

The floral elements disclose almost the same structure, presenting homogeneous mesophyll with few air spaces and poor developed collateral bundles.

Remarkable is labellum both sides structure, different from those of the rest of petals.

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**References**


