

Morpho-anatomical structure of *Orchis mascula* (L.) L. and its contribution to the taxonomy of Orchidaceae

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Abstract

In this study, the morphological and anatomical structure of Orchis mascula (L.) L. collected from Anatolia, have been studied. In Turkey, for many centuries, various kinds of Orchis have been extracted from the tubers and consumed as hot drink with the name of “salep” and it has been exported as well. Orchis mascula has the tubers entire and usually used for making the “salep” and ice-cream. In morphological investigations, the structure of flower, lateral sepal, petal, dorsal sepal, lip, anther cap and column was determined. The findings were compared with those in Flora of Turkey. In anatomical investigations, the structure of root, stem and leaf were determined. Also, stomata and epidermal cell of leaves were investigated. The anatomical results were discussed with similarities and differences with the anatomical structure of other Orchis L. species.

Keywords: *Orchis* L., morphology, anatomy, Orchidaceae

1. Introduction

The family Orchidaceae is one of the largest and the most diverse in Monocotyledons, including about 27.800 species which are distributed in all around the world (<http://www.theplantlist.org/>). In Turkey, Orchidaceae is represented by 26 genus and about 166 species, of which 60 are endemic (Davis 1978; Davis et al. 1988; Güner et al. 2000; <http://www.bizimbitkiler.org.tr/>).

According to Lang (1987 & 1999), the genus *Orchis* L. comprises about 80 species, mainly distributed in the temperate regions of the northern hemisphere, extending throughout Europe to northern Africa, then across Asia to Japon and Taiwan in the east and the Himalayas in the south. There are about 34 species in Turkey (Davis 1978; Davis et al. 1988; Güner et al. 2000; <http://www.bizimbitkiler.org.tr/>).

Orchis tubers contain starch (8-30%), sugars (glycose, fructose), nitrogenous compounds and glycomanous mucilage. The substance from *Orchis* tubers is called “salep” and it is used widely in pharmaceutical sector and have also been used as balancer in ice-cream production, in Central Anatolia. *Orchis* tubers are taken from wild plants from the ancient times till today (Sezik 1967 & 1984).

Some morphological and anatomical properties of the Orchidaceae family and the genus *Orchis* were reported by Rao et al. (1989), Avetisyan and Mekhakyian (1990), Ingram and Dunster (1991), Luo and Chen (2000), Gönüz (2001), Aybeke et al. (2010), Sevgi et al. (2012), Tyteca et al. (2012), Durmuşkahya et al. (2015), Güler (2016), Aybeke (2017), Bulut-Solak et al. (2017).

The aim of the present study is to describe the morphological and anatomical structure and in addition to investigate the epidermal cell and stomata of leaves of *Orchis mascula*. Moreover the research contributes to the taxonomy of the genus *Orchis* and Orchidaceae family.

2. Materials and Methods

Orchis mascula was collected from Eskişehir: Sarıcakaya-Hekimdağ, Yarımca village, below *Quercus* trees, 1280 m., 17.05.2002 and stored in the Eskişehir Osmangazi University Herbarium as a herbarium specimen (-OUFE 11951-) (Bridson and Forman, 1999). Determination of the species was made according to the Davis (1978 & 1988). Morphological descriptions are based on living plants and herbarium specimens. Morphological drawings was made using Sm-LUX Leitz drawing tube by İlham Eröz Poyraz.

In anatomical studies, the collected plant were stored in 70% alcohol, and made permanent with glycerine-gelatin by taking cross-sections from their root, stem, leaf and surface sections of the leaf (Vardar 1987). A light microscope was used to examine the sections and photographs were made using a Olympus CX41, diagnostic digital camera.

The terminology adopted by Esau (1977), Stearn (1992) and Beentje (2010) are used for descriptions.

3. Results

3.1. Morphological Results

Orchis L.

Erect perennials with globose to ellipsoid undivided tubers. Leaves unspotted or spotted, ±arranged near base. Emerging spike by spathe-like leaves, many flowered, ±cylindrical. Flowers in various shades of red, purple, and yellow, rarely white. Bracts membranous. Lateral sepals spreading to reflexed or all sepals connivent with petals, forming a hood. Labellum ±directed down-wards, entire or 3-lobed, with entire or ±divided middle lobe, glabrous or ±papillose above, with saccate to filiform spur. Anther firmly attached to short, erect column, folded median part of rostellum placed between the parallel anther cells (loculi). Pollinia 2, clavate, narrowed below to caudicles, attached to separate viscidia, which are enclosed in a single pouch (bursicula). Ovary cylindrical, sessile, twisted, glabrous.

O. mascula (L.) L., Fl. Suec. ed. 2: 310. 1755 (Figure 1)

Plant 20-40 cm. Stem slender, often flexuous. Basal leaves 4-6, obovate to oblong, spreading, c. 8-12 x 1.5-3 cm, shining-green, unspotted (seldom faintly marked with dark lines near base). Spice cylindrical, lax, many-flowered. Flowers mauve to red. Sepals obovate, lateral ones

spreading to reflexed. Labellum 3-lobed, convex, with few darker dots near base or undotted; middle lobe elongate, clearly exceeding the ovate lateral lobes, reniform to nearly 2-lobed. Spur slightly curved upwards, \pm dilated at tip, \pm equalling ovary. **Fl.** 5-6. Glades and edges of coniferous forest, *Fagus* forest, *Quercus* scrub, 150-2400 m.



Figure 1. *O. mascula* morphology: **A** habit, **b** flower, **c** lateral sepal, **d** petal, **e** dorsal sepal, **f** lip, **g** anther cap and column

3.2. Anatomical Results

The anatomical structure of the *O. mascula* was given in the tables (Table 1-3) and the figures (Figure 2-3):

Table 1. Root anatomy of *O. mascula* (Figure 2A)

Root	<i>Orchis mascula</i>
Epidermis	one layered
Exodermis	2 layered
Cortex	8-9 layered, irregular cells, parenchymatic, scattered raphides crystal present
Endodermis	quite small and irregular, thickness not distinguish
Vascular bundles	10 radial bundles, between the bundles parenchymatic
Pith	parenchymatic

Table 2. Stem anatomy of *O. mascula* (Figure 2B)

Stem	<i>Orchis mascula</i>
Cuticle	thin
Epidermis	one layered, oval/round cells
Cortex	10-13 layered parenchymatic cells with thin cell membrane and getting larger and thick cell walled parenchymatic cells through central cylinder with starch grain
Vascular bundles	scattered collateral bundles in the parenchymatic cortex
Pith	Parenchymatic with raphides crystal

Table 3. Leaf of *O. mascula* (Figure 3A-B)

Leaf	<i>Orchis mascula</i>
Upper epidermis	elongated rectangular cells
Lower epidermis	square shaped cells
Mesophyll	unifacial, abundant chloroplast parenchymatic
Vascular bundle	collateral, no bundle sheath
Midrib	towards the lower epidermis, paranchymatic with chloroplast

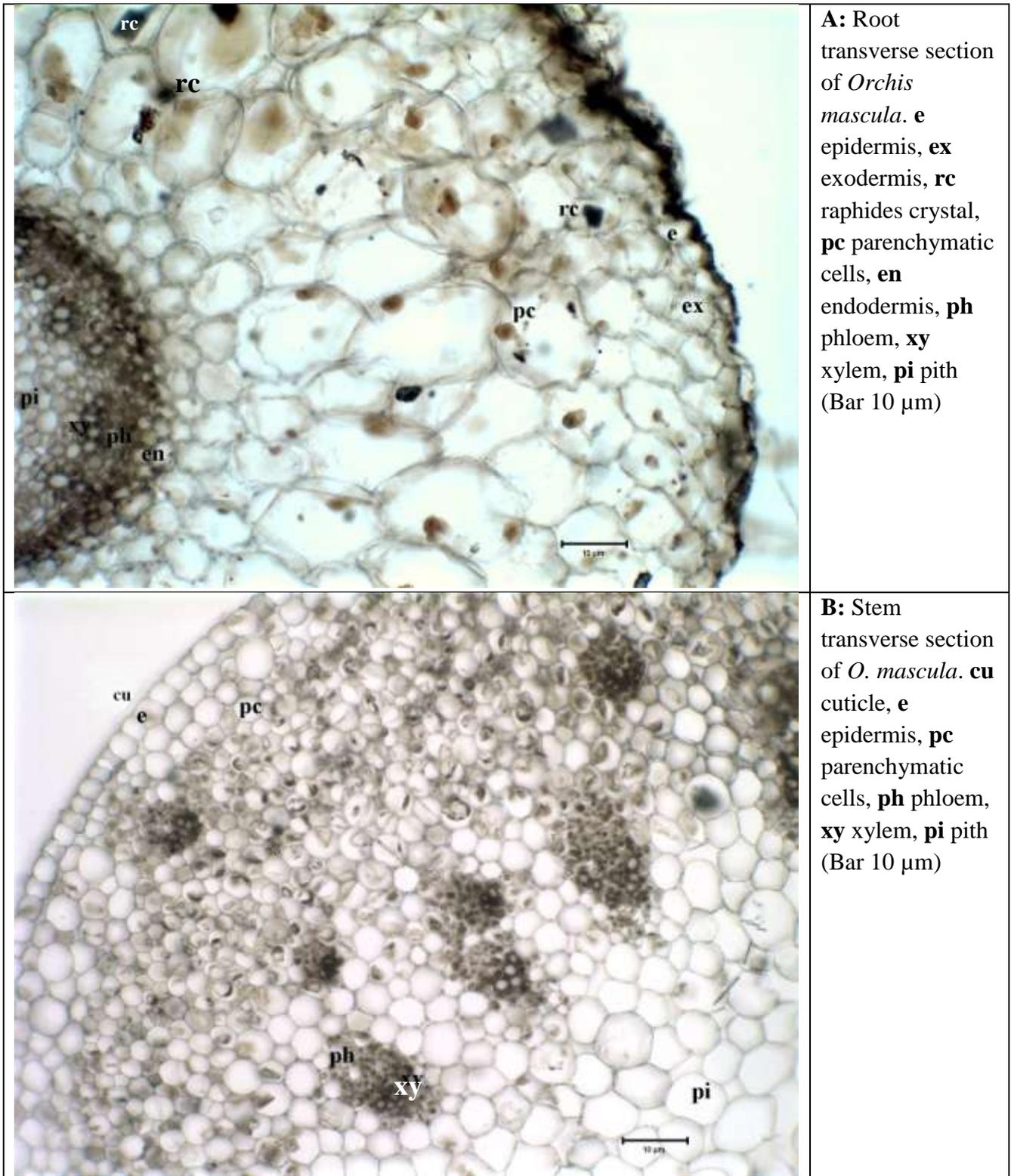


Figure 2. *O. mascula* anatomical structure of root and stem **A:** Root anatomy, **B:** Stem anatomy.

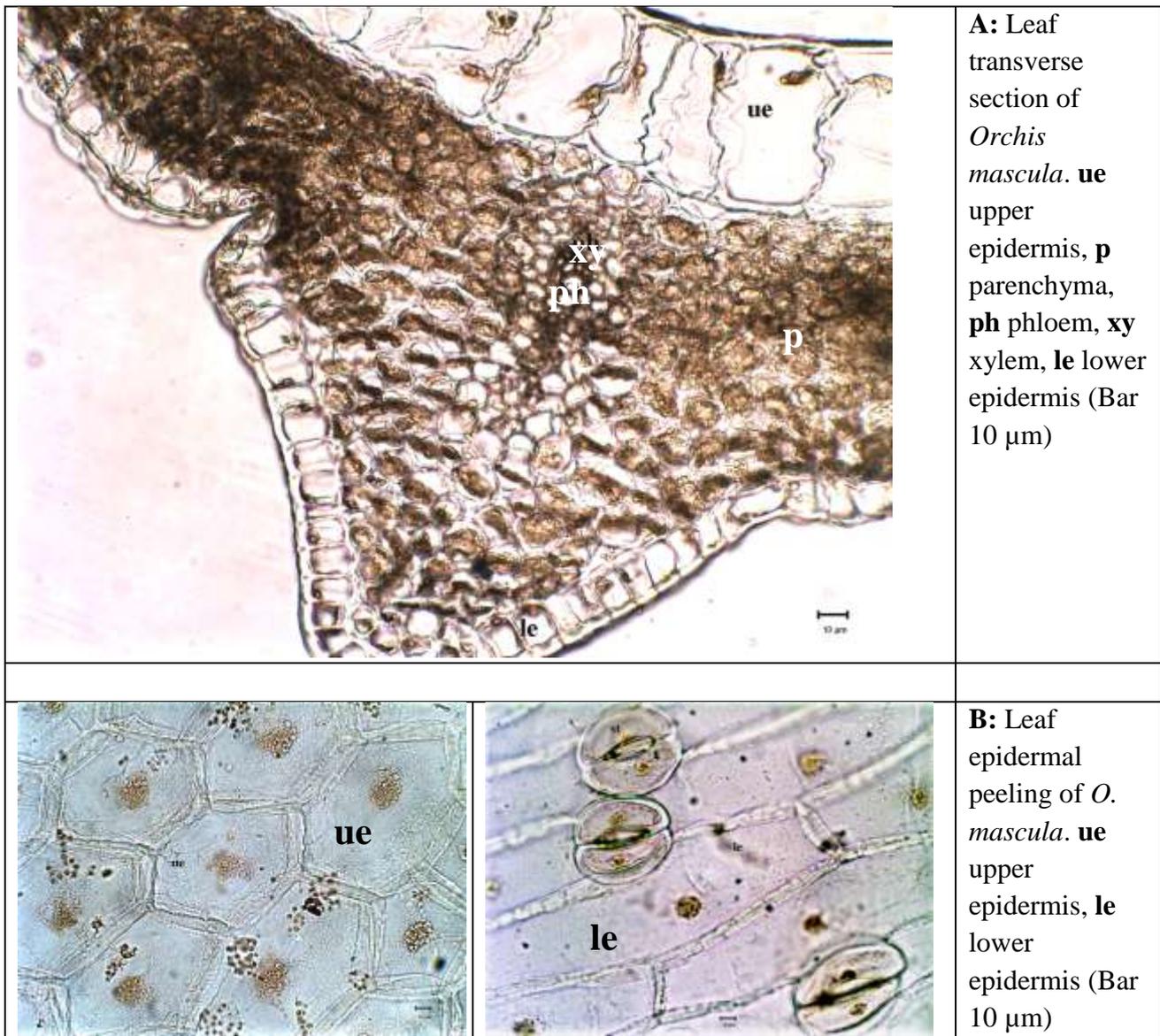


Figure 3. *O. mascula* anatomical structure of leaf **A:** Transverse section, **B:** Epidermal peelings.

4. Discussion

In this study *Orchis mascula* was investigated morphologically and anatomically. Morphological drawings of flower, lateral sepal, dorsal sepal, petal, lip, anther cap and column were made. The results obtained from morphological studies were generally consistent with the description given in the Flora of Turkey (Davis 1978 & 1988).

The anatomy of plant surfaces has been studied intensively under taxonomic and ecological aspects especially during the last century (Martin & Juniper 1970). The anatomical structure of *Orchis mascula* was carried out from the root, stem and leaf cross-sections and leaf surface sections.

The root is annual, characteristics of monocotyledons, outer surface is covered with an exodermis. Cortex consists of parenchyma with scattered raphides crystal. This finding has not been previously reported in any literature review for *O. mascula* root. Raphide bundles were reported in the leaf chlorenchyma at *Orchis tridentata* by Aybeke et al. 2010. However,

Durmuşkahya et al. (2015) reported that there were raphides crystal in the roots of the *Orchis spitzelii*.

The stem is composed of intensely starchy parenchymatic cells. Collateral vascular bundles which is small shape are in the parenchymatic cortex. Pith is parenchymatic with seldom raphides crystal. *O. mascula* stem structure bear a resemblance to the general features of monocotyledons and literature review (Esau 1977; Rao et al. 1989; Avetisyan & Mekhakyanyan 1990; Ingram & Dunster 1991; Luo & Chen 2000; Gönüz 2001; Aybeke et al. 2010; Sevgi et al. 2012; Tyteca et al. 2012; Durmuşkahya et al. 2015; Güler 2016; Aybeke 2017; Bulut-Solak et al. 2017).

The leaf is unifacial and compose of parenchymatic cells with intensively chloroplast. Vascular bundle is collateral and there hasn't bundle sheath. Stoma cells are located only on the abaxial side of the epidermis, as shown in Figure 3B; just as Sevgi et al. (2012) were reported.

As a whole this study increase the knowledge of the morphology and anatomy in *Orchis* reporting data about the *Orchis mascula*.

5. References

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