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The Anatomical Properties of Endemic *Lilium ledebourii* (Baker) Bioss. (Liliaceae) Species

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Abstract: The endemic *Lilium ledebourii* (Baker) Bioss. (Liliaceae) was investigated anatomically. Studies were performed on plants collected from Damash of Ammarloo areas of Guilan province in Iran. For anatomical studies, cross-sections of the root, stem, leaves, ovary and anther were investigated for the first time. Surface sections of the leaves, stomata and trichomes and longitudinal sections of the stem vessels were examined and compared with previous findings. Furthermore, the micromorphological properties of the pollen grains have been investigated by SEM.

Key words: *Lilium ledebourii*, endemic, anatomy

INTRODUCTION

Lilium ledebourii (Baker) Bioss. is natively growing in Damash and Kalchooleh areas of Guilan province in the north of Iran (Ghahreman, 1997). Its local name is Susan-e-Chelcheragh. This plant, the rarest lily, is extremely attractive and under surveillance. It is a perennial plant that has good ornamental value, especially as a pot plant.

The genus *Lilium* L. belongs to the Liliaceae family and includes about 100 species that are geographically distributed in the northern hemisphere (Siljak-Yakovlev *et al.*, 2003). This plant is strongly resistant to cold and even when land is covered with snow, it begins to sprout and produces beautiful white flowers in June (Padasht Dehkaei, 2005).

There have been no detailed anatomical studies on *Lilium ledebourii* which is mostly due to the specific characteristics of this species and its naturally distribution in Iran. Some anatomical properties of this plant were reported by Farsam *et al.* (2003).

One of the taxonomical references in classification of plants is the comparative anatomy. Anatomical studies on this rare plant and the other lilies have been very little.

The purpose of this study was to investigation the anatomical and micromorphological features of *Lilium ledebourii* (Baker) Bioss. in order to provide more detailed descriptions for future works.

MATERIALS AND METHODS

Plant specimens in vegetative (May, 2007) and flowering stages (June, 2007) were collected from Damash of Ammarloo areas of Guilan province in the North of Iran.

The specimens for anatomical studies were kept in alcohol 70%.

Cross-sections of the stem, root, leaf, ovary and anther and longitudinal sections of the stem vessels, also surface sections of the stomata and trichomes (hairs) were manually taken for anatomical studies. The sections were stained with methyl green and kongorot and fixed with glycerin-gelatin (Vardar, 1987).

Furthermore, the micromorphological properties of gold-plated of the pollen grain have been investigated by SEM, LEO model. Suitable sections were taken for microscopic studies.

All images were digitally captured using Fine Pix A350 camera attached to SA Iran light microscope. Identification of different cells and tissues were fulfilled on the digital images of each specimens in late June, 2007.

RESULTS AND DISCUSSION

Lilium ledebourii (Baker) Bioss. is a rare endemic species on the heights of Damash and Dorfak in the north of Iran. Anatomical characters of the most organs

of this plant, which is probably given for the first time, with enrich certainly the botanical information on this species.

The anatomical properties of *Lilium ledebourii* (Baker) Bioss. showed some similarities and differences compared to the other monocots.

In the cross-sections of the root (Fig. 1) the epidermis cells are almost square or rectangular. The cortex is composed of the parenchyma cells with 15-20 layers. These cells are hexagonal and without intercellular spaces. The single-layered endodermis containing thick-walled cells was seen below the cortex parenchyma. The passage cells are opposite of the protoxylem, exactly. The pericycle is single-layered and thin walled. The primary xylem is distributed toward the pith zone. Therefore the main part of the pith area is occupied by the metaxylem. The pith is composed of the parenchyma cells.

The number of primary xylem ridges is 7 or 8 and they are alternatively with the phloem. The rays are not distinguishable and there is no cambium.

Above mentioned information are similar to the other monocots. Most of the anatomical properties of *Lilium ledebourii* (Baker) Bioss. roots are resemble to those of the monocots.

In the cross-sections of the stems (Fig. 2), the epidermis composed of a single-layer of almost square or rectangular compactly arranged cells and it lacks the stomata. The epidermis layer are covered with a thick cuticle. There are the silica prickles on the stem (Fig. 3). The silica cells were observed in some other plants especially Poaceae and Cyperaceae families (Lawton, 1980; Metcalfe, 1963). The silica hairs to exist on the some of these silica prickles (Fig. 4, 5). The collenchyma tissue, which is immediately located under the epidermis is 4-5 layered and the angular type. There are 3-4 layered compressed sclerenchyma below collenchyma tissue. The cortex parenchyma is distributed all over the spaces below the sclerenchyma. The parenchyma cells are round or hexagonal and thick walled containing the low intercellular spaces. There are no the endodermis, pericycle and cambium. The vascular bundles are scattered throughout the cortex. The number of these bundles is 40-50. Vascular bundles are surrounded by a sclerenchyma bundle sheath. These findings are almost similar to other monocots.

In the longitudinal sections of the stem, vessels are trachea and tracheid (Fig. 6, 7). Tracheids are very less than tracheas. The lignified secondary wall in tracheas are normal spiral and condensed spiral. The stem is composed of long parenchyma cells. These results are consistent with the description given by Farsam *et al.* (2003).

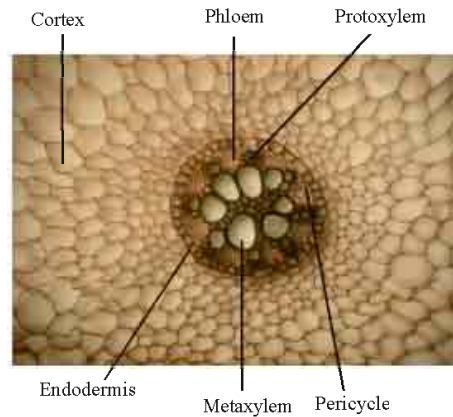


Fig. 1: The cross-section of a part of the root containing the cortex and stele (x10)

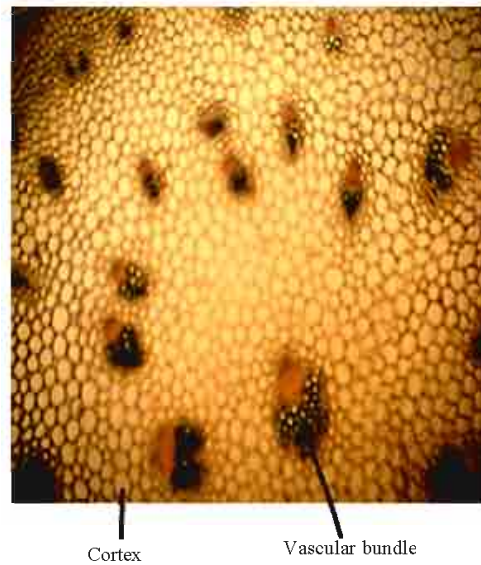


Fig. 2: The cross-section of a part of the stem containing the vascular bundle and ground tissue (x10)

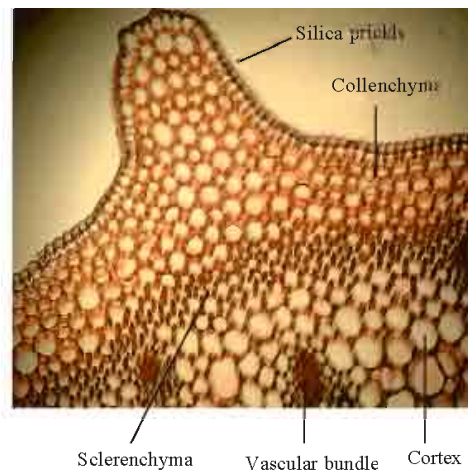


Fig. 3: The cross-section of a part of the stem containing the silica prickle (x10)

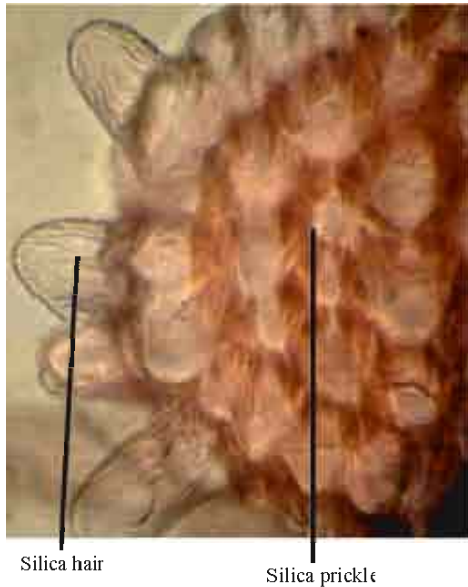


Fig. 4: The cross- section of a silica prickly containing the silica hairs (x40)



Fig. 5: The cross- section of a part of the stem containing a silica hair (x40)

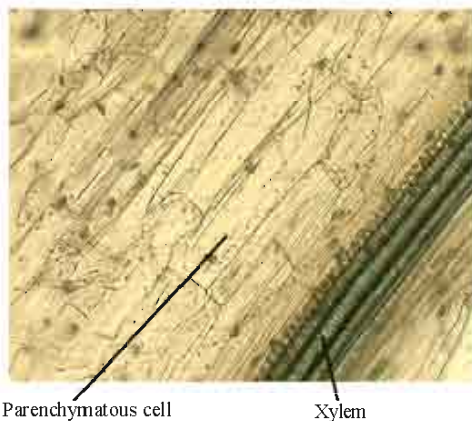


Fig. 6: The longitudinal-section of a part of the stem containing the parenchyma cells and vessels (x40)

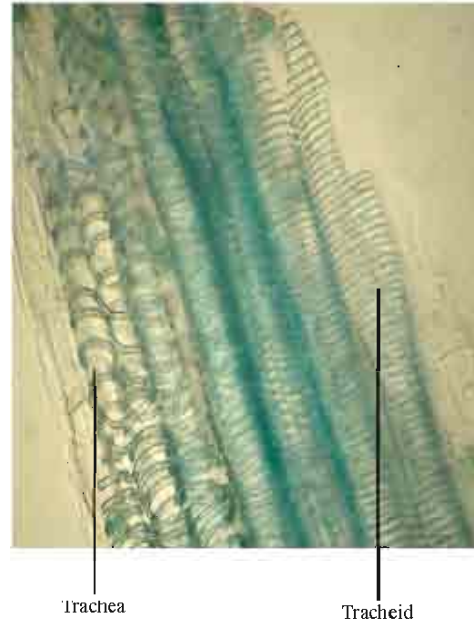


Fig. 7: The longitudinal-section of the trachea and tracheid in the stem (x40)

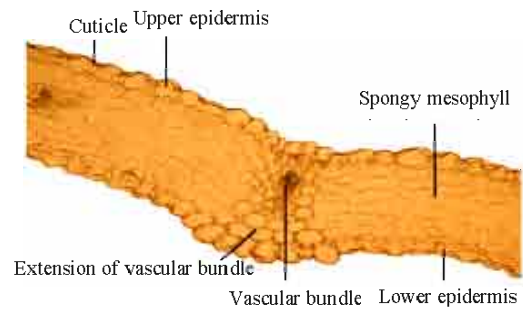


Fig. 8: The cross-section of a part of the leaf containing the various tissues (x10)

In the cross-sections of the leaves, isolaral or equifacial, the epidermis is found at the both of outsides (Fig. 8). The upper and lower epidermis comprise uniseriate, almost square or oval cells. Both epidermis are covered with a thin cuticle. The stomata, contrary to the most monocots, occur only on the lower surface (hypostomatic leaf). The large number of glandular hairs are on the margin of leaves. Eglandular hairs are very little. The leaves comprise the silica hairs on the lower epidermis cells (Fig. 9). The presence of the silica hairs on this species was not seen. The properties of the glandular and eglandular hairs have been used as taxonomical characters. The mesophyll is differentiated only in the form of 6-7 layers of the spongy parenchyma cells. The midrib is poorly differentiated and it is surrounded by a parenchymatic bundle sheath that extend to the upper and



Silica hair

Fig. 9: A silica prickles containing the silica hairs from the lower surface of the leaf (x40)



Fig. 10: The stomata from the lower epidermal peelings of the leaf (x40)



Fig. 11: The cross-section of a young anther containing the lobes and pollen sacs (x40)



Fig. 12: The cross-section of a young gynoecium and ovaries with the axial placentation (x40)

lower epidermis. The vascular bundles are collateral type. The xylem is towards the upper surface and phloem is towards the lower surface.

In surface sections of the leaves (Fig. 10), stomata are Ranunculaceous type and anomocytic which to be in agreement with result obtained by Farsam *et al.* (2003).

Anomocytic stomata were also described in some species of *Boraginaceae*, *Ranunculaceae*, *Geraniaceae* and so forth.

The cross-sections of the anther revealed that anther has two lobes and four pollen sacs (Fig. 11). *Lilium ledebourii* (Baker) Bioss. has 6 carpels. The cross-sections of the ovaries showed that placentation is axial (Fig. 12).

It was determined that some of the anatomical characters such as the structure of stomata, placentation type and properties of the glandular and eglandular hairs have been used as taxonomical characters. Assessment of these characters in *Lilium ledebourii* (Baker) Bioss. justify this research.

The micromorphological features of pollen grains observed by SEM (Fig. 13) are as follows; pollen type: monocolpate, pollen shape: boat like, apertures: colpi and long with an end of more or less pointed, pollen length: 107-110 μm (Permagna). These results are almost similar to results obtained by Iwanami *et al.* (1988) with study on *Lilium longiflorum*.

Although our results are generally similar to those in the other monocots, a few differences were determined.

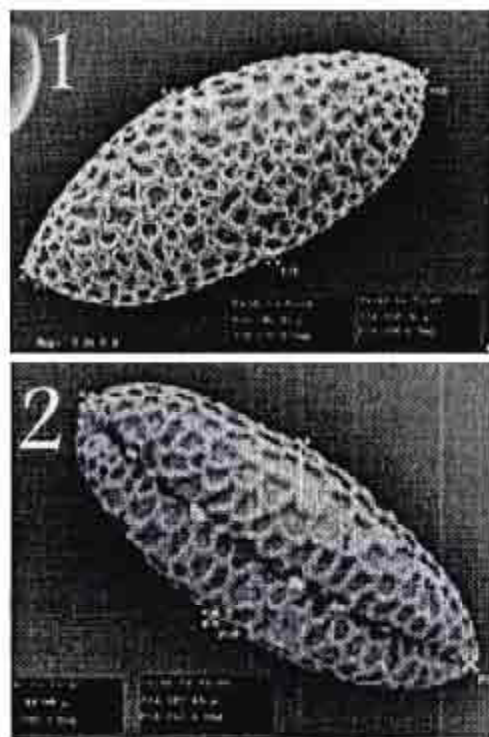


Fig 13: Photomicrographs of pollen grains under SEM (x726), (1) the view of dorsal surface and (2) the view of ventral surface

The most important findings in this research were the presence of the silica prickles and silica hairs on the stem and leaf surfaces, stomata type and placentation type.

Above mentioned information put forth the importance of further botanical studies on this unique plant in spite of limited distribution of this plant.

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