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Morpho-anatomical observations on three *Romulea* (*Iridaceae*) taxa of Turkey

Abstract

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The morphological and anatomical features of some vegetative and generative organs of three *Romulea* taxa (*Romulea bulbocodium* var. *bulbocodium* (L.) Seb. & Mauri, *Romulea bulbocodium* (L.) Seb. & Mauri var. *crocea* (Boiss. & Heldr.), *Romulea bulbocodium* (L.) Seb. & Mauri var. *leichtliniana* (Heldr. ex Hal.) Bég. from the flora of Turkey have been investigated in this research for the first time. The morphological characteristics of organs such as corm, leaf, flower and the general outlooks (habitus) of all taxa have been given along with pictures in the section of morphology. The grooves, papillae, mesophyll and the distribution of the vascular bundles in just transverse sections of the leaf lamina have been shown with microphotographs in the section of anatomy.

Introduction

Romulea Maratti is a South Africa originated genus having 90 different species that are spread out from Mediterranean area to Canary Islands and in the East to the Australia. However a few surveys have been realized on this genus up to now (Grey 1937; Mathew & Baytop 1984; Dahlgren & al. 1985; Rudall & Goldblatt 1991). The genus *Romulea* is represented with 7 different taxa in the Flora of Turkey; *R. bulbocodium* (L.) Seb. & Mauri var. *bulbocodium, R. bulbocodium* (L.) Seb. & Mauri var. *crocea* (Boiss. & Heldr.) Baker, *R. bulbocodium* (L.) Seb.&Mauri var. *leichtliniana* (Heldr. ex Hal.) Bég., *R. tempskyana* Freyn, *R. linaresii* Parl. subsp. *graeca* Bég., *R. ramiflora* Ten. subsp. *ramiflora. R. columnae* Seb. & Mauri subsp. *columnae.* These taxa are mainly spread out through the coastal regions of Marmara, Aegean and Mediterranean Seas (Marais 1984). A series of researches are being conducted to examine the detailed morphological and anatomical features of the Turkish populations of the genus *Romulea.* This kind of study dealing with Turkish *Romulea* taxa has been published by Erol (2000). The purpose of the present work is to examine the morpho-anatomical features, three varieties of *Romulea.* The data that have been gathered as a result of this study and the photographs that are taken from the living samples of these three varieties will be helpful in the morphological descriptions and the works related with flora of Turkey. Most of the anatomical findings have been obtained for the first time and the results are reliable source for trying to identify *Romulea* taxa.

Material and methods

Romulea bulbucodium var. *bulbocodium* is collected near Çeşmealtı region of İzmir province (Bl), from grassy slopes that are facing south. *Romulea bulbocodium* var. *crocea* is obtained from Sorgun region of Manavgat district of Antalya province (C3), under *Pinus* - sandy soil - *Romulea bulbocodium* var. *leichtliniana* is collected from Tasocakları region of Antakya province (C6) and this taxon also prefers grassy slopes - Taxonomical descriptions of plants was made according to Davis (1984) also confirmed by the herbarium samples of examined taxa in ISTE. The samples were brought to Botanical Garden and planted in large clay pots. Voucher specimens are deposited in ISTF.

The basal leaves were used as fresh and as 70% alcohol material in the phase when the leaves turned yellowish at the tips, 5-8 mm pieces which were cut from the tip, middle and basal parts of the leaves were then sliced with the razor blade. These transverse-sections were then dipped in 1% water solution of Safranin. After this process, the transverse-sections were placed in microscopic slides and semi-permanent preparations are made with 20% glycerol (Prasad 1986). The slides were then examined under the Reichart-Neopan microscope and micro-photographed with the aid of an Olympus photomicroscope

Morphological Treatments

Romulea bulbocodium* (L.) Seb. & Mauri var. *bulbocodium
(ISTF 37433)

Corm asymmetrical, 8,0-15 mm x 6,6-10 mm, the tunic dark-brown, imbricate. Leaves (basal + cauline) up to 5. The basal leaves are recurved and their measures are 50-190 mm x 0,6-1,0 mm; and the measures of the cauline leaves are 55-210 mm x 0,4-1,0 mm. The flowers are 1-4 in number; the tepals are lilac on the tips, white near by the middle and yellow on the throat. The back faces of the outer perigonium segments have slightly brownish-purple or greenish-brown veins. The bract has narrow membranous edge, light violet colored and rarely reddish-brown specks. The bracteol is membranous, sometimes it has a narrow carina with reddish brown-specks. Perigonium tube is about 3-6 mm. The anthers are yellow coloured and 6-7 mm in length, the filaments are ivory-yellow coloured, 6-8 mm and basal parts are hairy. Stylus is ivory-white colored and 19-20 mm in length (Fig. 1A).

***Romulea bulbocodium* (L.) Seb. & Mauri var. *crocea* (Boiss. & Heldr.) Baker**
(ISTF 27435)

Corm asymmetrical 9,0-19 mm x 7,0-7,2 mm the tunic dark brown, imbricate. Leaves (basal + cauline) up to 8. The basal leaves are recurved, the measures are 100-270 mm x 0,5-1,0 mm. The measures of cauline leaves are 37-185 mm x 0,2-0,9 mm. The flowers are 1-4 in number. The tepals are light-orange or yellowish colored. The back faces of the outer perigonium segments have clearly brownish-purple or greenish-brown veins. The bract has narrow membranous edge, light-violet colored and rarely reddish-brown specks. The bracteol is a membranous sometimes it has a narrow carina with reddish-brown specks. Perigonium tube is about 4-5 mm. The anthers are yellow coloured and 7-8 mm lengths; the filaments are ivory-yellow coloured, 6-8 mm and basal parts are hairy. Stilus is ivory-white colored and 18-20 mm in length (Fig. 1B).

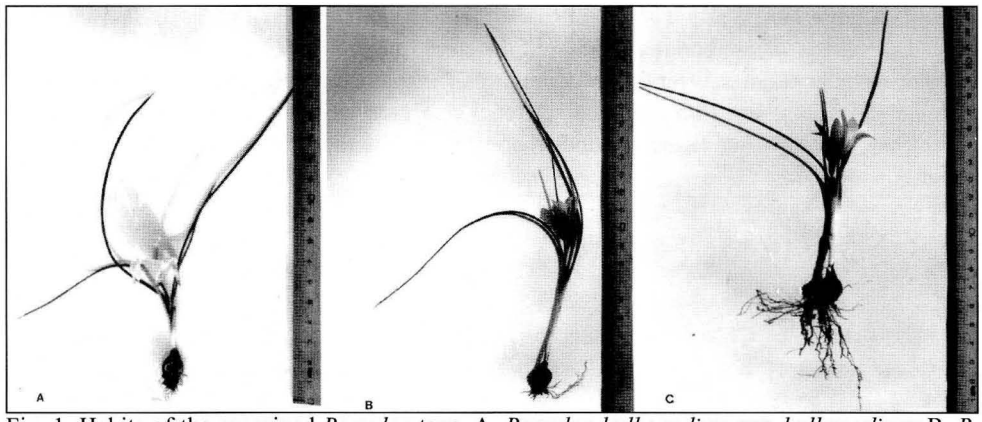

Fig. 1. Habits of the examined *Romulea* taxa. A. *Romulea bulbocodium* var. *bulbocodium*; B. *R. bulbocodium* var. *crocea*; C. *R. bulbocodium* var. *leichtliniana.*

***Romulea bulbocodium* (L.) Seb. & Mauri var. *leichtliniana* (Heldr. Ex Hal.) Bég.** (ISTF 37434)

Corm asymmetrical, 7,4-18,5 mm x 10-12 mm, the tunic dark-brown imbricate. The total number of the leaves (basal + cauline) up to 7. The basal leaves are erect in contrary to the other varieties and their measures are 145-330 mm x 0,5-3 mm. The cauline leaves are 30-220 mm x 0,2-1,1 mm in measure. The numbers of the flowers are 1-5. The flowers are white; yellow colored on the throat. The back faces of the outer perigonium segments have clearly brownish-purple or greenish-brown veins. The bract has narrow membranous edge, light violet colored and rarely reddish-brown specks. The bracteol is membranous, sometimes it has a narrow carina with reddish-brown specks. Perigonium tube is about 4-5 mm. The anthers are yellow colored, 6-7 mm filaments are ivory-yellow, 7-8 mm, towards the basal parts are hairy. Stilus is ivory-white coloured and 18-20 mm in length (Fig. 1C).

ANATOMICAL TREATMENTS

Transverse sections were identified as unifacial type and the leaves are circular-elliptical appearance. The leaves have two grooves on each side and the grooves have two edges on outer parts. The edges compose of sclerenchyma cells. The epidermal cells of the grooves have micropapillae. The shapes of epidermal cells commonly are square like or square like oval and one layer of cells. The walls of the neighboring cells are thin and upper walls are thick. The epidermal cells that cover large vascular bundle and pseudomidribs are larger than the epidermal cells at the sides of the grooves. Near the grooves epidermal cells get smaller. It is discovered that epidermis cells have a thick layer of cuticle.

Anomocytic type stomas are found only in the grooves. The mesophyll of the leaves consists generally oval, circular, in some degree square or rectangular parenchyma (chlorenchyma) cells, which contain much more chloroplasts. The chlorenchyma cells that are close to epidermis are smaller and contain more chloroplasts. Central chlorenchyma cells are much larger, contain less chloroplasts and worn out at the center. For this reason,

there is a large lacuna at the center of the lamina. The mesophyll contains several kinds of vascular bundles. These bundles show four different types: Pseudomidrib, midrib, large and smaller vascular bundles. Over the pseudomidribs, the midribs and the large vascular bundles's phloem poles, one can find ring like sclerenchyma area which is generally larger on the pseudomidribs. Smaller vascular bundles don't have like these rings (Fig. 2).

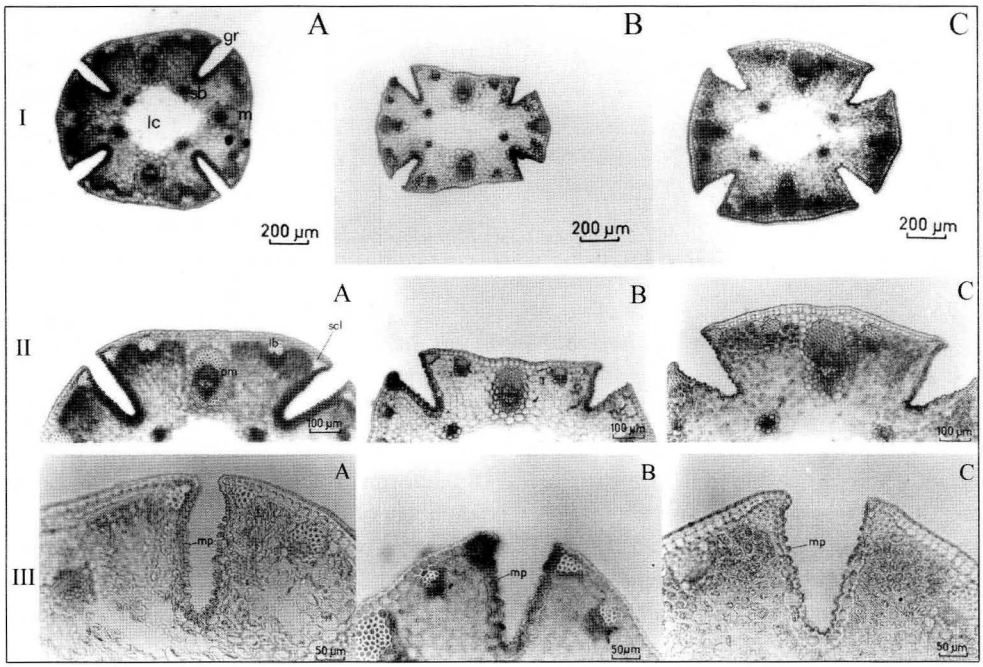

Fig. 2. I - The appearances of the basal leaves in transverse section; II - pseudomidribs; large and smaller vascular bundles; III - grooves [*Romulea bulbocodium* var. *bulbocodium* in the left column (A); *R. bulbocodium* var. *crocea in* the middle (B) and *R. bulbocodium* var. *leichtliniana* in the right column (C)]; pm = pseudomidrib; m = midrib; lb = large vascular bundle; sb = smaller vascular bundle; mp = micropapillae; gr = groove; scl = sclerenchyma; lc = lacuna.

Romulea bulbocodium* (L.) Seb. & Mauri var. *bulbocodium

The transverse-sections of the leaf lamina are generally circular-elliptical. The grooves are deep and narrow tubulat. The epidermal cells are more or less square in shape and have finger-like micropapillae. Parenchyma cells of the mesophyll are generally hexagonal and the lacuna is narrow (Fig. 2).

***Romulea bulbocodium* (L.) Seb. & Mauri var. *crocea* (Boiss. & Heldr.) Baker**

The transverse-sections of the leaf lamina are generally oval-elliptical. The grooves are carinate. The epidermal cells square in shape and have more or less finger-like micropapillae. Parenchyma cells are hexagonal and the lacuna is narrow (Fig. 2).

***Romulea bulbocodium* (L.) Seb. & Mauri var. *leichtliniana* (Heldr. ex Hal.) Bég.**

The transverse sections of the leaf lamina are generally circular-elliptical. The grooves

are carinate. Epidermal cells are nearly rectangular and they have more or less horn-like micropapillae. Mesophyll consists of hexa or mostly polygonal cells and the lacuna is narrow (Fig. 2).

Discussion and conclusion

As a result of this research, the arrangement of the corm tunics in *Romulea* taxa was determined for the first time and it was found that they have more or less imbricate type (Stearn 1993). While explaining the leaf morphology, both basal and caulin leaves' positions - recurved or erect - were analyzed and the floristic data are found to be in accordance with Marais's (1984) results. But there are some distinctions among the varieties.

Otherwise, it was found that the smell of the flowers of *Romulea bulbocodium* var. *bulbocodium* "sweet" (Genders 1994) as a new finding. In addition some new knowledges concerning with flower morphology were presented. The colours of the flowers of each variety were shown in detail.

The anatomical studies on *Romulea* taxa are not plentiful in literature. Also we couldn't find the papers related with *Romulea* taxa that was done in Turkey. Therefore we had a very limited number of researches that we can compare our results with (Rudall & Goldblatt 1991; Rudall 1994; Arber 1925). In speaking of the *Ixioideae* subfamily, a study of Turkish *Gladiolus* species (Üzen 1999) was used. *Ixioideae* subfamily members's leaf transverse sections have large vascular bundles and prominent pseudomidribs. Three different basic types of vascular system were discovered in *Ixioideae*. These are:

a) straight leaf pattern with undetermined small pseudomidribs;
b) plicate leaf pattern without pseudomidribs;
c) cylindrical leaf pattern - patterns are sometimes terete or ensiform type - with prominent pseudomidribs.

The *Romulea* taxa used in this study is in type "c" (Rudall 1994).

During the anatomical research made upon *Romulea citrina* Baker, *R. flava* (Lam.) de Vos., *R. grandiscapa* J. Gay ex Baker, *R. nivalis* Boiss. et Ky., *R. phoenica* Mouterde, *R. ramiflora* Ten., *R. requensii* Parl., *R. rosea* Eckl. and *R. tabularis* Eckl. ex Bég. the vascular system of *R. tabularis* transverse sections of the lamina were specified and pseudomidribs and midribs were examined (Rudall & Goldblatt 1991; Rudall 1994).

Another study with *R. columnae* pseudomidribs, midribs and large vascular bundles were specified and small vascular bundles were shown closer to the lacuna (Arber 1925).

The variations of vascular bundles and the settlement-s within the mesophyll that we revealed in this study shows some similarities with the two studies mentioned above.

Pseudomidribs and midribs in *Ixioideae* subfamily are generally covered with a large sclerenchyma layer at the phloem poles like in the genus *Gladiolus*. The studied *Romulea* taxa too have a sclerenchyma ring resembling *Gladiolus* species. The results, especially the arrangement of vascular bundles, obtained by Rudall & Goldblatt (1991) and Üzen (1999) are similar to those observed in this study. *Gladiolus* species in Turkey and European *Gladiolus tryphyllus* and *G. dichrous* are investigated in this study (Rudall & Goldblatt 1999). The results show that pseudomidribs are placed as two layers right in the middle of the leaf and there appear large and smaller vascular bundles starting from just under the

epidermal cells in two layers (Rudall & Goldblatt 1991). Vascular system of the examined *Romulea* taxa in this work, the existance of large and smaller vascular bundles should be considered as a common character shared by the members of the subfamily.

There are four grooves in terete leaves of *Romulea* taxa (Marais 1984). There had been no explanations about the form of these grooves until now. In this study, it is found that *R. bulbocodium* var. *bulbocodium*'s grooves are "deep and narrow tubular". *R. bulbocodium* var. *crocea* and *R. bulbocodium* var. *leichtliniana*'s grooves are "typical carinate" in shape.

The leaf epidermis cells of *Romulea* taxa like *Gladiolus* species which are the other members of *Ixioideae* subfamily in Turkey, have papillae. As the number of the papils for each cell is more than one, they are concidered as micropapillae (Rudall & Goldblatt 1991). The studied taxa show that micropapillae only exist in the epidermal cells of the grooves. The morphology of micropapillae can be slightly different between the taxa.

These are: *R. buibocodium* var. *bulbocodium* has finger-like, *R. bulbocodium* var. *crocea* and *R. bulbocodium* var. *leichtliniana* have horn-like papillae.

Some species of *Ixioideae* subfamily has been investigated in a study (Rudall & Goldblatt 1991) that there are some criteria for the study of leaf transverse sections: "main feature or outline of lamina", "margin of the leaf", "mesophyll" and the "vascular system" were taken into considerations. The same criteria are used for studying the internal structure of the leaves in this work. The criterium of "main features or outline of lamina" showed differences among the examined *Romulea* taxa. It is discovered that the transverse sections of the leaves have characteristics that vary like circular, circular-elliptic or oval shapes.

However to solidify the descriptive terminology that mentioned above, more samples must be collected and studied using Scanning Electron Microscope (SEM).

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