

## MORPHOLOGICAL AND ANATOMICAL STUDIES ON TWO ENDEMIC *CROCUS* SPECIES OF TURKEY AREA

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### Abstract

Morphological and anatomical characteristics of *Crocus danfordiae* Maw and *C. fleischeri* Gay which are endemic to small areas of Turkey were investigated. *C. fleischeri* has flowers with stained purple at base and on tube, *C. danfordiae* has anthers with black basal lobes at its base. These properties are characteristics for the investigated species. In anatomical studies, cross section of *C. danfordiae* and *C. fleischeri* root, stem and leaf parts were examined and demonstrated.

### Introduction

*Iridaceae* is a large and diverse family of about 92 genera and c. 1800 species mainly distributed in the southern hemisphere (Ali & Mathew, 2000). The *Crocus* genus has been represented by 32 species in Turkey. Many species of the *Iridaceae* family are grown in parks and gardens as ornamental plants due to its beautiful flower (Baytop, 1984). *Crocus* species have been used as a dye, perfume and medicament since 1600 B.C.

The saffron crocus (*C. sativus* L.) is in cultivation as an economic plant since very ancient times. After saffron, the numbers of crocus species brought into cultivation has gradually increased (Brighton *et al.*, 1980).

The classic work on crocus is the monograph of the genus by Maw (1886). Not much information is available on *C. fleischeri* and *C. danfordiae*. The aim of the present paper to provide information about the two economically important endemic species.

### Materials and Methods

Material was collected from natural population during the February-April period both in flowering times in the years 2002-2003. Plant specimens were taken from the following areas.

<i>C. fleischeri</i> specimens	B1 Manisa; Maldan district 450 m. 06. 02. 2003 02. 03. 2003, Endemic.
<i>C. danfordiae</i> specimens	B1 Manisa; Spil mountain 1240 m. 02. 02. 2003 05. 04. 2003, Endemic.

Specimens were preserved in the herbarium Celal Bayar University, Faculty of Art and Science, Department of Biology. Description of the plants was made according to Davis (1984). Fresh samples were used in each case for experimental analysis and measurements. During the anatomical investigations, root, stem and leaves of plants were used as fresh and as material in 70% alcohol and paraffin infiltrated tissues (Algan, 1981).

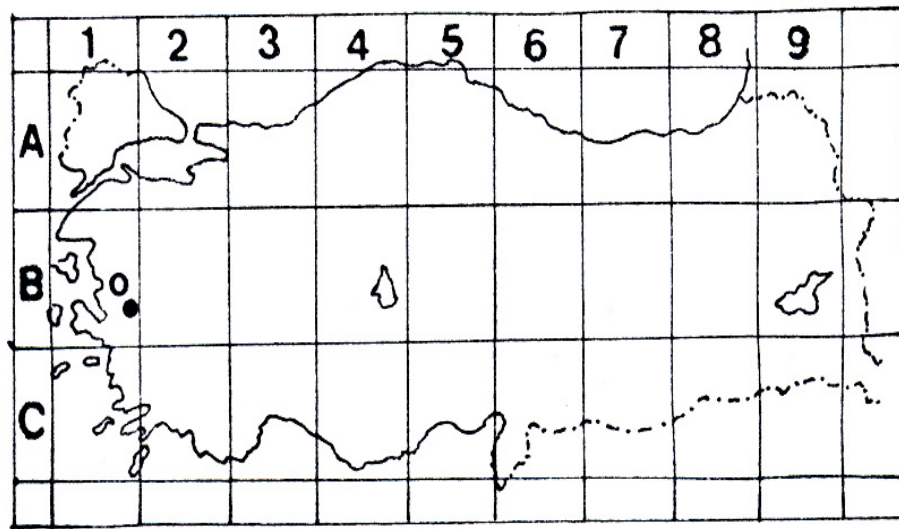


Fig. 1. The locality from which plant samples were collected in small areas of Turkey

- *C. fleischeri* Maw
- ° *C. danfordiae* Gay

## Results

### Morphological characters

#### *Crocus fleischeri*

Leaves 4-12 to 3-15 cm  $\times$  0.5-13 mm, erect, synanthous, green with a distinct white median stripe, glabrous (Figs. 2 & 4). Flowers 1-(-2) white with suffused yellow near base and stained purple at base and on tube. Perianth 15-25  $\times$  4-8 mm, tube 3-6 cm long. Style longer than anthers or equal, coloured as dark orange, divided into many branches. Filaments yellow, 4-8 mm long. Anthers coloured as pale yellow, 5-12 mm long. Corm 1-2.5 cm in diameter, depressed globose, tunics fibrous, fibres interwoven (Fig. 4).

Flowering period is January- March; distributed at 750-1300 m height, open rocky hill sides or in Quercus and Pinus woods.

#### *Crocus danfordiae*

Leaves are generally 4, 6-10 cm  $\times$  0.5-1.5 mm, erect synanthous, green with a distinct white median stripe, glabrous (Figs. 3 & 5). Flowers 1-2 perianth segments orange or yellow, 0.5-0.9  $\times$  1-1.5 cm, tube pale yellow 3-5 cm long style longer than anthers, orange, divided into three expanded branches. Filament is pale yellow 2-3 mm, anthers with black basal lobes at base. Corm 0.8-12 cm in diameter, depressed globose, tunics membranous or coriaceous, splitting into rings at base, rings usually entire or toothed (Fig. 5).

Flowering period is February-April; distributed at 900-2000 m height, open hill sides, scrub in Pinus woods.



Fig. 2. General appearance of *Crocus fleischeri* in natural habitat.



Fig. 3. General appearance of *Crocus danfordiae* in natural habitat.



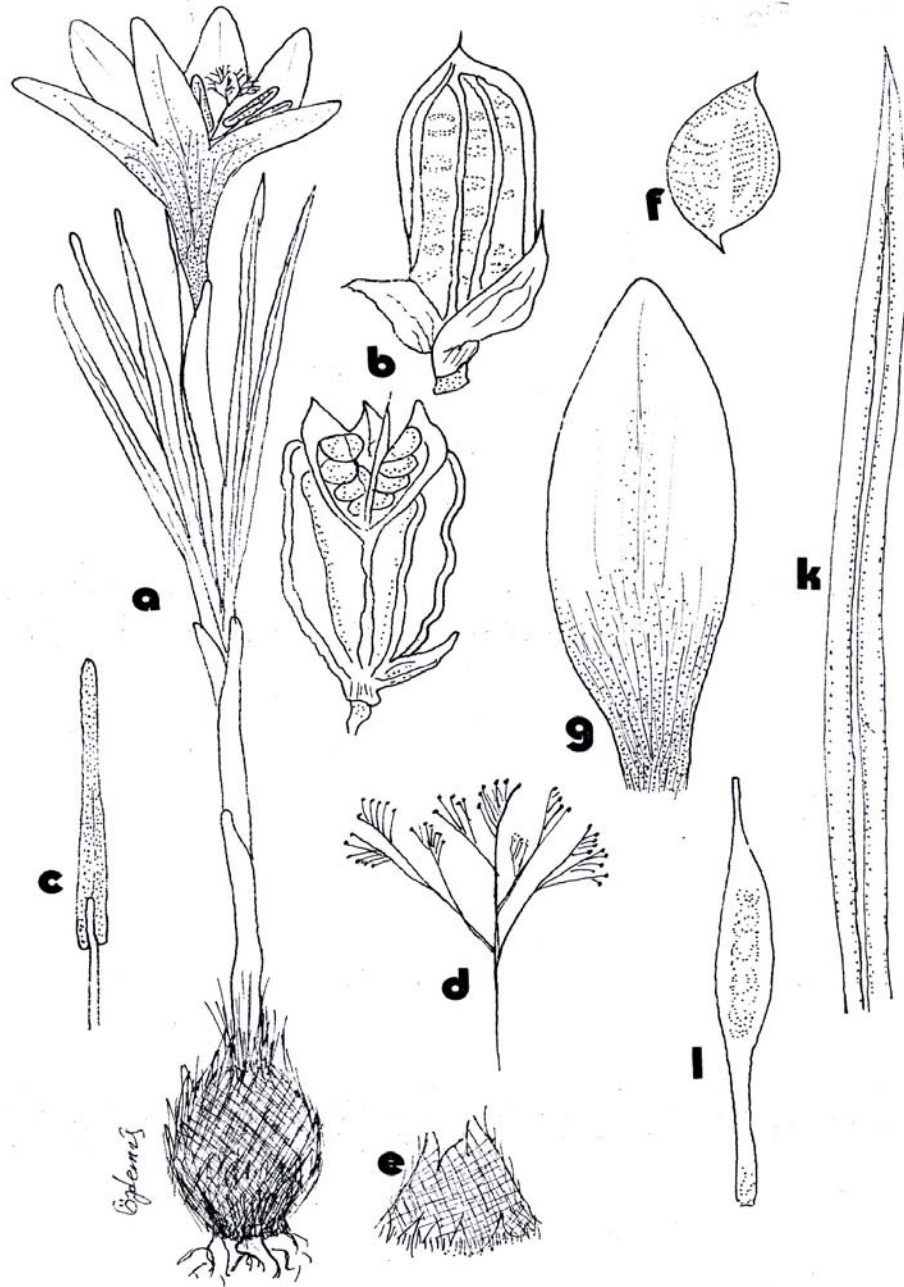


Fig. 4. General appearance of *Crocus fleischeri*

a- flower; b- fruit; c- stamen; d- style; e- corm tunic; f- seed; g- tepal; k- leaf; l- ovary;  
 a: x 1.2; b: x 0.1; c: x 0.2; d: x 0.4 e: x 0.6; f: x 0.2; g: x 0.3; k: x 1; l: x 0.2

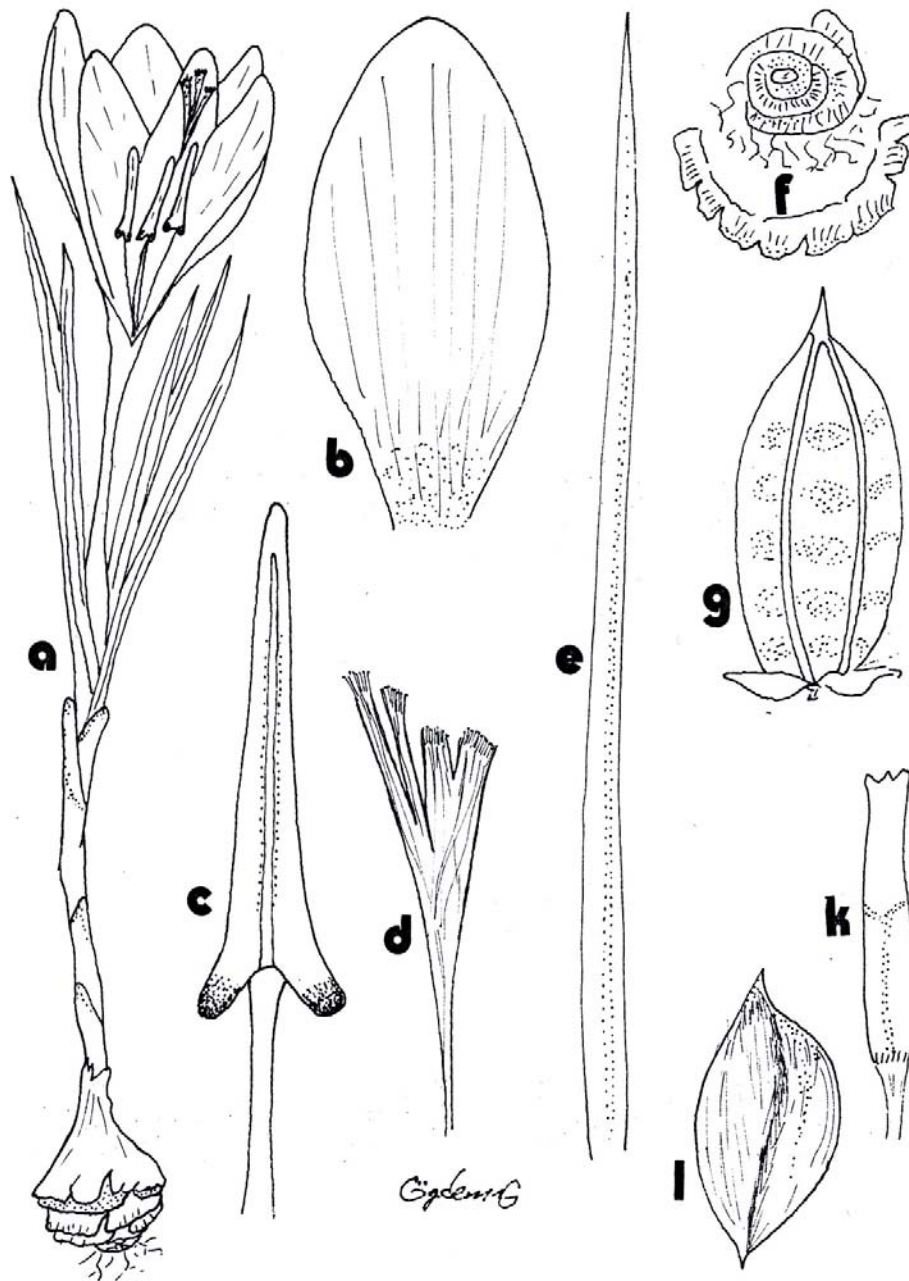


Fig. 5. General appearance of *Crocus danfordiae*

a- flower; b- tepal; c- stamen; d- style; e- leaf; f- corm tunic; g- fruit; k- ovary; l- seed.  
 a: x 0.9; b: x 2.5; c: x 0.2; d: x 0.16; e: x 0.9; f: x 1; k: x 0.6; l: x 0.16

### Anatomical characters

#### *Crocus fleischeri*

**Root:** Epidermis two layered, cells usually ovoidal and thin walled,  $10-32 \times 16-32 \mu$  cortex 7-8 layered, ovoid, parenchymatic with intercellular spaces. Cells  $10-50 \mu$  in diameter. Endodermal cells  $10-20 \times 5-10 \mu$  with wall thickenings. Pericycle cells  $5-15 \times 2.5-5 \mu$  and thin-walled. Metaxylem single on the median part of vascular cylinder  $25-30 \mu$  in diameter. Xylem strands are present on the periphery of the vascular cylinder (Fig. 6).

**Stem:** Epidermal cells  $\pm$  isomorphic,  $10-25 \times 15-25 \mu$ . Cortical cells located under epidermis,  $15-45 \mu$  in diameter without intercellular spaces. Vascular bundles present in periphery and central part of stem, those of periphery are smaller than vascular bundles located at the central part of stem (Fig. 7).

**Leaf:** Leaves of *C. fleischeri* have a central rectangular keel and two lateral arms, with their margins recurved towards the keel with a pale stripe running axially along the center of the leaf formed by the parenchymatous echlorophyllous cells. Both adaxial and abaxial surface except groove part of leaf have the cuticle. Epidermis single layered on abaxial and adaxial surface of leaf. These cells, except groove part of abaxial surface are with straight walls. The epidermal cells on groove part have walls with papillae. Stoma cells are present only on groove part of leaf. These cells are in sunken position between epidermis cells with papillae. Palisade parenchyma cells are 1-2 layered. Spongy cells present on abaxial side. Vascular bundles are located in one row in arms of keel and extending round abaxial margin of keel, but not across adaxial side. Major bundles occur at angles of keel and towards arm margins (Fig. 8).

#### *Crocus danfordiae*

**Root:** Epidermis single layered. The cells are prismatical and thin walled. Cortex 5-6 layered, cells ovoidal, parenchymatous  $15-65 \mu$ . Endodermis single layered, endodermal cells  $15-35 \times 10-15 \mu$  with casparion strip. Pericycle single layered, pericyclic cells  $5-10 \times 5-15 \mu$ . Metaxylem single on the median part of vascular cylinder. Xylem strands are 7-8 reaching the pericycle (Fig. 9).

**Stem:** Epidermis single layered and consist of rectangular cell  $5-20 \times 7-25 \mu$ . Cortex 8-12 layered with intercellular spaces. There are three big vascular bundles at the middle of stem. The small vascular bundles 8-14 in number are located in the periphery part of the stem (Fig. 10).

**Leaf:** Leaves of *C. danfordiae* have outline with central keel and two inflexed arms. The large central area of keel has thin walled cells which usually break down to form air space. This case causes a pale striper running axially along the center of the leaf because of lack of chloroplast and break down to form parenchymatous cells in the air space.

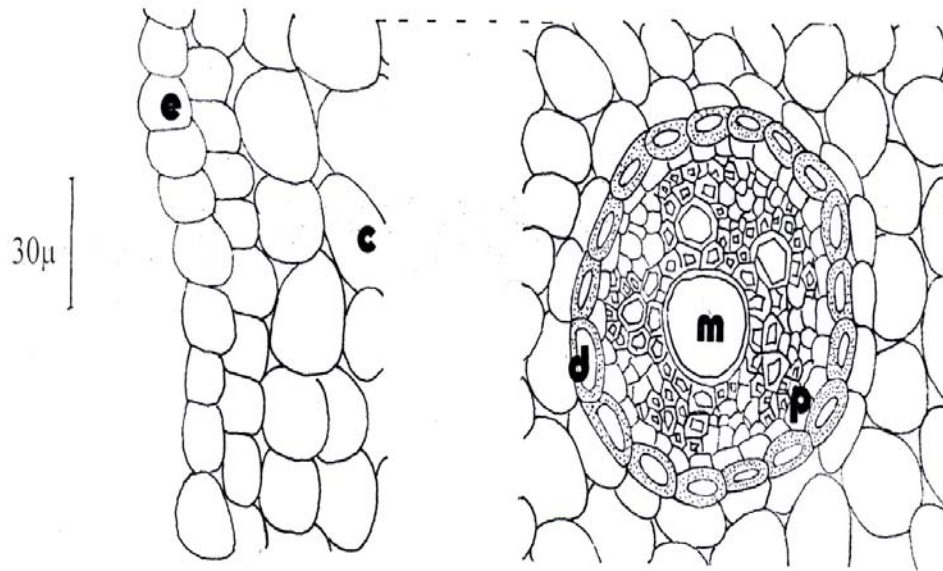


Fig. 6. Cross-section of root of *Crocus fleischeri*  
e- epidermis; c- cortex; d- endodermis; p- pericycle; m- metaxylem

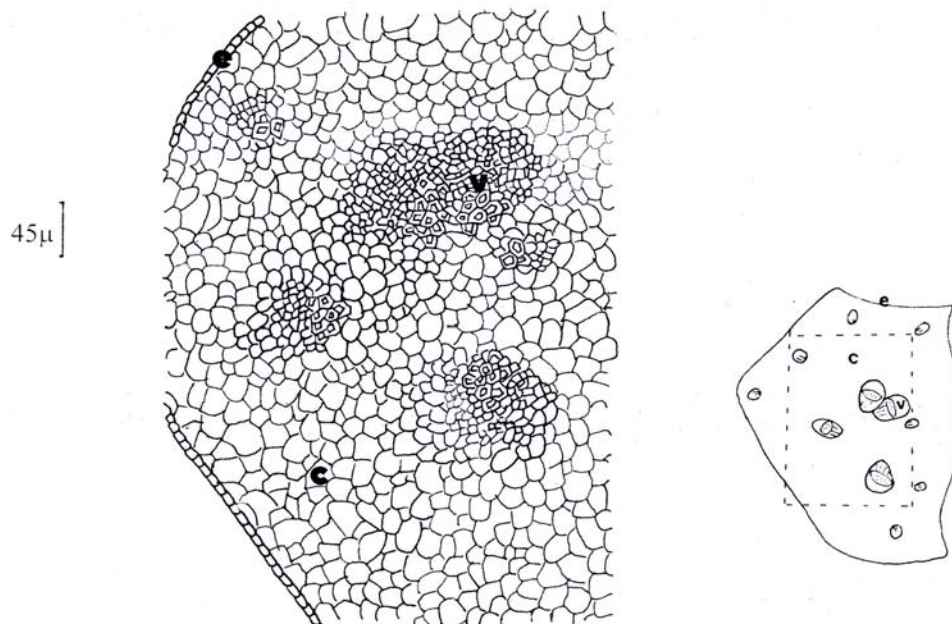


Fig. 7. Cross-section of stem of *Crocus fleischeri*  
e- epidermis; c- cortex; v- vascular bundle



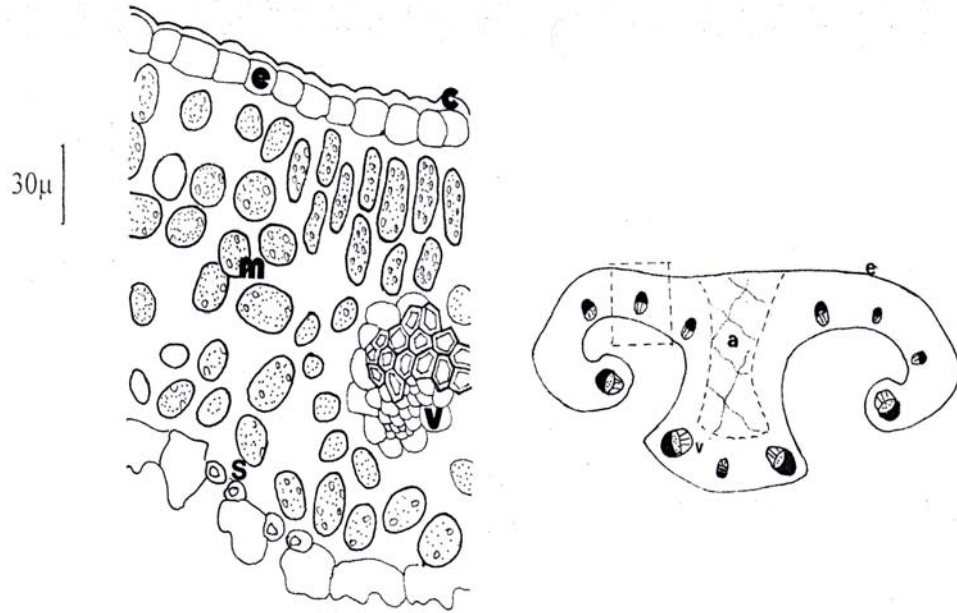


Fig. 8. Cross-section of leaf of *Crocus fleischeri*

c- cuticle; s- stoma cell; e- epidermis; m- mesophyll; a- air space; v- vascular bundle

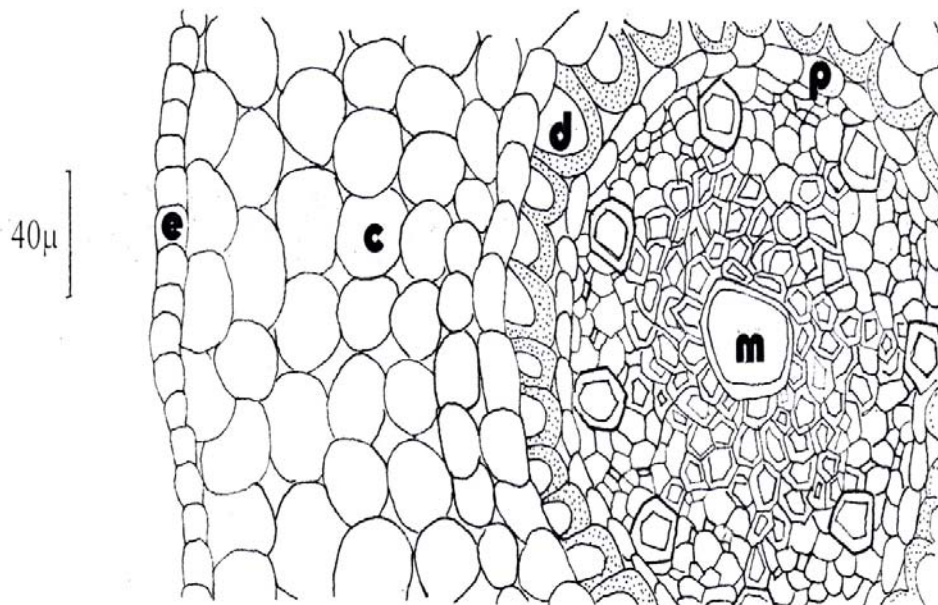


Fig. 9. Cross-section of root of *Crocus danfordiae*

e- epidermis; c- cortex; d- endodermis; p- pericycle; m- metaxylem



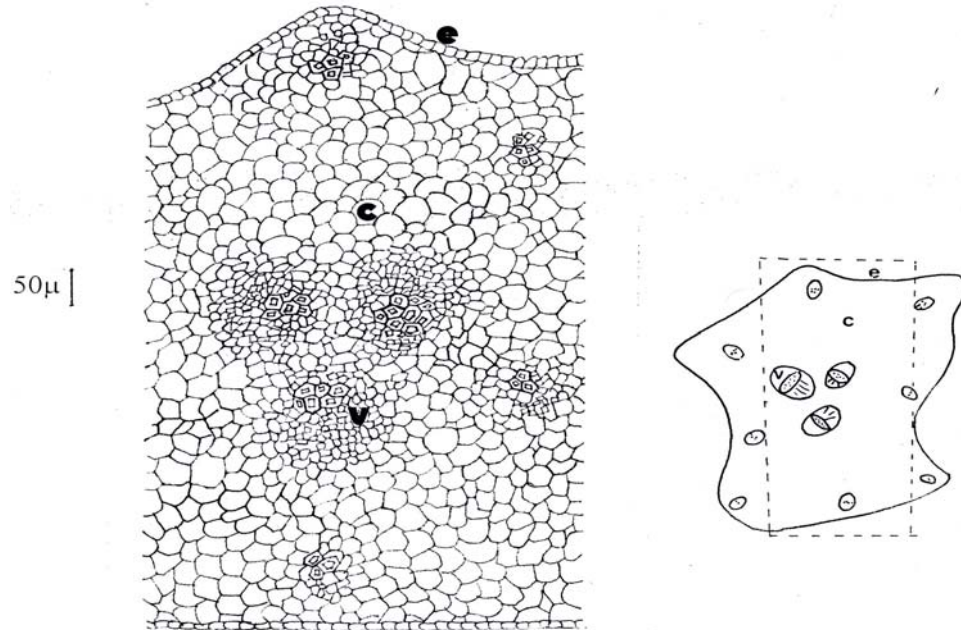


Fig. 10. Cross-section of stem of *Crocus danfordiae*  
e- epidermis; c- cortex; v- vascular bundle

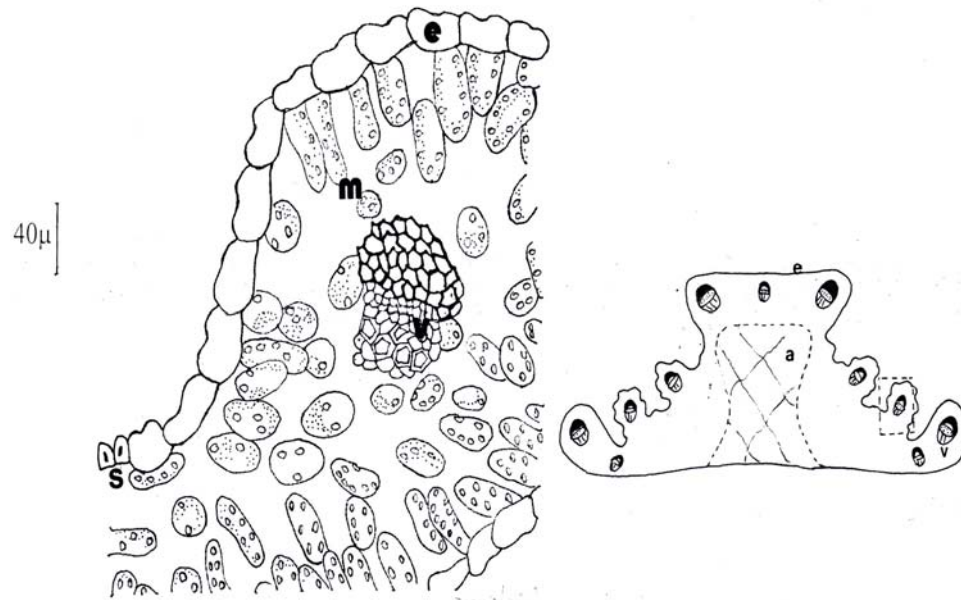


Fig. 11. Cross-section of leaf of *Crocus danfordiae*  
s- stoma cell; e- epidermis; m- mesophyll; a- air space; v- vascular bundle

The abaxial side of arms have two major protrusions (Fig. 11). The epidermal cells of this protrusion have white papillae. Epidermis cuticled except grooved part, single layered with flat-ovoidal cells. In grooved part the epidermal cells are papillate. Stomata usually absent except in grooved part. Mesophyll cells  $\pm$  uniform in shape. Palisade parenchyma 1-2 layered with spongy cells on periphery of vascular bundles. Vascular bundles in one row in margin of arms and keel. Major bundles occurring at angles of keel and arms, small bundles located between the major vascular bundles (Fig. 11).

### Discussion

The morphological characters of both the species were examined in this study with taxonomical value as the structure of corm tunic and style, color of anther and perianth have been found. Perianth segment of *C. fleischeri* is colored as white, with a stained purple center and finely spotted in upper part. Corm tunic is fibrous into fibres interwoven and style is divided into many branches. *C. danfordiae* has the style that is divided into three expanded branches. The corm tunic split into rings at base with toothed and the anther with stained black basal lobes at base. These features of investigated species are distinct from other species of *Crocus*.

In anatomical studies it has been determined that the thickening are clear on the walls of endodermal cells of the root. This type of endodermal cells are common in the roots of Monocotyledons (Fahn, 1982). It has been found that casparion strips appear in walls of the root endodermal cells of *C. danfordiae*. Özyurt (1978) has observed the same properties on the root of *Crocus aërius* Herb., and *Gladiolus atrovioleaceus* Boiss. (Iridaceae). The walls of root endodermal cells of *C. fleischeri* have complete thickening. This feature has also been observed in the cross-section of root of *Lilium ciliatum* P. H. Davis (Özdemir, 2003).

Single metaxylem is present on the median part of root vascular cylinder of *C. danfordiae* and *C. fleischeri*. Kutbay *et al.*, (2001) has observed the same feature on *Romulea columnae* Seb. & Mauri subsp. *columnae*.

The anatomy of stem of both the species is quite similar but differs from other species of *Crocus* in having vascular bundles in central part of the stem and also in periphery. In *C. aërius* and *C. pulchellus* the vascular bundles are located in central part of stem only (Özyurt, 1978; Özdemir & Akyol, 2003).

In leaves of *C. danfordiae* and *C. fleischeri*, parenchymatous cells in the keel lack chloroplast and break down to form air space. Rudall (1994) has also pointed out that leaves of most *Crocus* species have a unique and distinctive shape in cross section, comprising a central square or rectangular “kell” and two lateral “arms”. The present investigations are in agreement with Rudall’s (1994) findings, except that the leaf of *C. danfordiae* has two major protrusion different from the types mentioned above.

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