

**THE MORPHOLOGICAL AND ANATOMICAL PROPERTIES  
OF ENDEMIC *CROCUS LEICHTLINII* (D. DEWAR)  
BOWLES (IRIDACEAE) IN TURKEY**

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**Abstract**

In this investigation, some morphological and anatomical characteristics of *Crocus leichtlinii* (D. Dewar) Bowles, an endemic species which has flowering time in early spring, were observed. The specimen was collected from Şanlıurfa, South East Anatolia, within C7 of the grid system; its habitat and population status was also determined.

Morphological features of species such as leaf, bracteol, flower, and fruit have been described in detail. The determination of the anatomical characteristics present the first data available in the literature. In anatomical studies, transverse sections of leaf and root have been examined and supported by illustration. Anatomical characters of species were observed to have been similar to usual features of Iridaceae anatomy.

**Introduction**

*Crocus* is distributed mainly in the Mediterranean region and includes 80 species worldwide (Mabberly, 1997). There are 63 taxa (including subsp. and var.) of *Crocus* in Turkey. Thirty-one of these are endemics for Turkey. Five species of *Crocus* occur in South East Anatolia. Among these, *Crocus biflorus* Miller subsp. *pseudonubigena* Mathew and *Crocus leichtlinii* (D. Dewar) Bowles are endemics and known only from the neighbourhood of the type localities (Mathew, 1984, 1988, 2000).

Close to our research area, a chorological study of geophytes of Iridaceae in the Diyarbakır region and Karacadağ mountain was carried out by Malyer (1982). The other studies related to *Crocus* for different parts of Turkey were carried out by Pasche (1994a, 1994b), Kerndorff & Pasche (1994, 1996a, 1996b, 1997) and Mathew (1984; 1988; 1995). Some anatomical studies have been investigated on different genera belonging to Iridaceae and Liliaceae by Kandemir & Engin (1998), Kandemir *et al.*, (2000), Çoşkunçelebi & Beyazoğlu (1999), Koca (1996), Uysal (1992), Küçüker (1990a, 1990b); Özdemir *et al.*, (2004), and Özhatay & Üstün (1986). Studies on the anatomy of *Crocus* sp., in Turkey are limited. A recent study has been done on the anatomical structure of Autumn species of *Crocus* of Şanlıurfa by Akan & Eker (2004).

In the present study, the morphological and anatomical characteristics of *Crocus leichtlinii* (D. Dewar) Bowles were studied in order to provide opportunity for further works in future. With this study, the determination of the anatomical characteristics present the first data available in the literature. Moreover, the observation on its populations is given.

## Materials and Methods

Specimens were collected in early spring season from Şanlıurfa which is located in the C7 square. A collector's number was given and the specimens were dried according to standard herbarium methods. The specimens are kept in the herbarium of Harran University, Şanlıurfa. The "Flora of Turkey and the East Aegean Islands" (Mathew, 1984; 1988; 2000) was used to identify them. The plant description was confirmed by the image of type specimen (K, photo!) and the herbarium specimens of the examined species in the DUF, herbarium of Dicle University, Turkey.

Collected living materials were fixed in 70% alcohol for anatomical studies. Transverse sections and surface preparations of root and leaves were made manually for anatomical studies. Sartur (Baytop, 1972) reactives were applied to the sections for a better understanding of some anatomical structures. Olympus BX50 binocular microscope with drawing tube were used in anatomical studies.

## Results

### Morphological characteristics

*Corucus leichtlinii* (D. Dewar) Bowles (Figs. 1-3).

Syn: *C. biflorus* Miller var. *leichtlinii* D. Dewar

Plants 7-20 cm tall, corm 1-3 x 1-2.5 cm, corm tunic coriaceous, brown, splitting longitudinally into many triangular teeth. Leaves 3-10, synanthous, narrow, 5.5-17.5 cm x 1-1.5 mm. Bracteole present, much narrower than bract. Perianth tube 3-8 cm long; throat of perianth glabrous, shiny orange; scape 0.7-7 cm long, 1-flowered; segments 2-4 x 0.5-1.5 cm, obtuse to rounded, lilac-blue or blue, suffused orange or dark yellow near base. Stamens 3, filaments 3-5 mm, orange, glabrous; anthers 9-11 mm, greyish-green or brownish-green before dehiscence; pollen yellow. Pistil 1, style dividing into 3 yellow to orange branches, style usually equal with stamens, 1-1.5 cm long. Fruit capsule, cylindrical, 14 x 9 mm long, above ground level. Seeds numerous, brownish, 3 mm long.  $2n=20$ . *Fl.*: 3-4.

**Habitat:** Rocky places, steppe regions, among *Astragalus* sp., stream side, by late snow patches on limestone, 900-1900 m.

**Vernacular name:** Çiğdem, çiydem, pivog

**Phytogeographic region:** Irano-Turanian element.

**Distribution of the species:** Turkey (Endemic)

**Distribution of the species in Turkey:** E. Anatolia (Upper Euphrates & Mesopotamia): Şanlıurfa, Diyarbakır, Elazığ, Mardin (Fig. 4).

**Type:** Turkey: C8 Mardin, cult. Kew from corms sent by *Leichtlin* (holo. K, photo!).

**Examined specimens:** (Turkey): C7 Şanlıurfa: Siverek, Karacadağ, Rame Stream, 28.03.2003, 1390 m, İ.Eker 369 & Akan; ibid. 29.03.2003, 1539 m, İ.Eker 384 & Akan; ibid., Kızılkuyu, 29.03.2003, 1750 m, İ.Eker 375 & Akan; ibid, Ekşitepe, 29.03.2003, 1800 m, İ.Eker 379; ibid., Badırtepe, 29.03.2003, 1770 m, İ.Eker 381; ibid., Şeytan Stream, 30.03.2003, 1100 m, İ.Eker 393 & Akan; Kızılkuyu hill, 28.04.2002, 1700 m, İ.Eker 162 & Akan, ibid. Mergimir hill, 1750 m, İ.Eker 166 & Akan, ibid., Tırbebella hill, İ.Eker 178 & Akan, Viranşehir; Karacadağ, Demirci, 16.04.2003, 987 m, İ.Eker 489 & Akan.



Fig. 1. General appearance of *Crocus leichtlinii* (D. Dewar) Bowles in field, (İ. Eker 369 & Akan, photo by İ. Eker)



Fig. 2. The holotype of *Crocus leichtlinii* (D. Dewar) Bowles (K, K000099462)

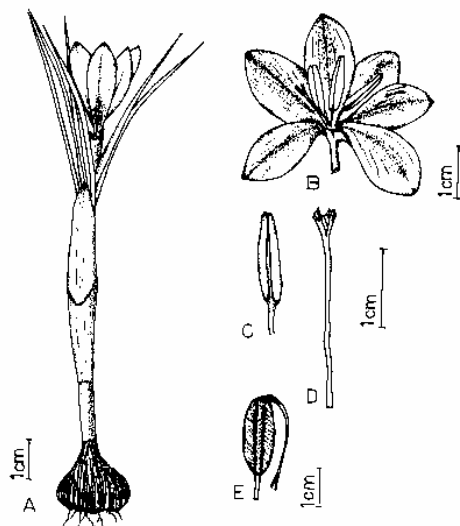


Fig. 3. *Crocus leichtlinii* (D. Dewar) Bowles, (İ. Eker 384 & Akan).  
A. Habit, B. Perianth, C. Stamen, D. Pistil, E. Fruit

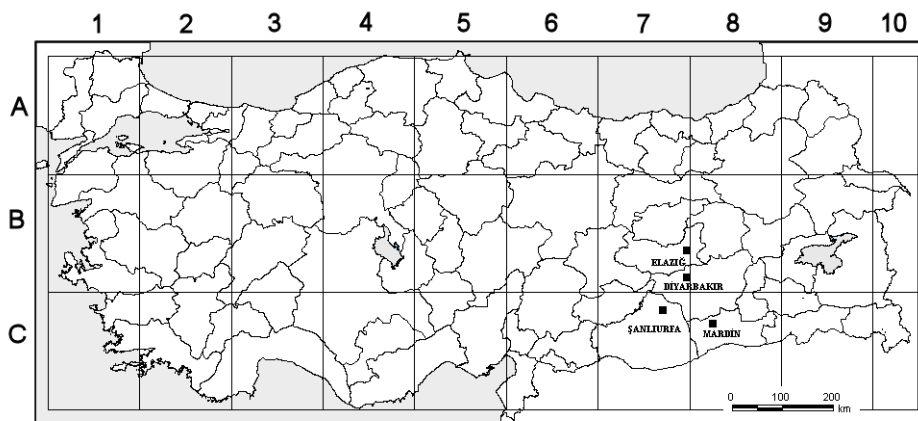


Fig. 4. Distribution of *Crocus leichtlinii* (D. Dewar) Bowles (■) in Turkey

### Anatomical characteristics

#### Leaf (Fig. 5)

The transverse section of the lamina and the midrib and surface preparations of both epidermis revealed that the upper epidermis cells are longer oval and orbicular than lower epidermis cells. Cuticle of the upper epidermis is more thick than that of the lower epidermis.

The stomata type is anomocytic and they occur only on the lower surfaces. They are located on the lower level from the epidermal cells.

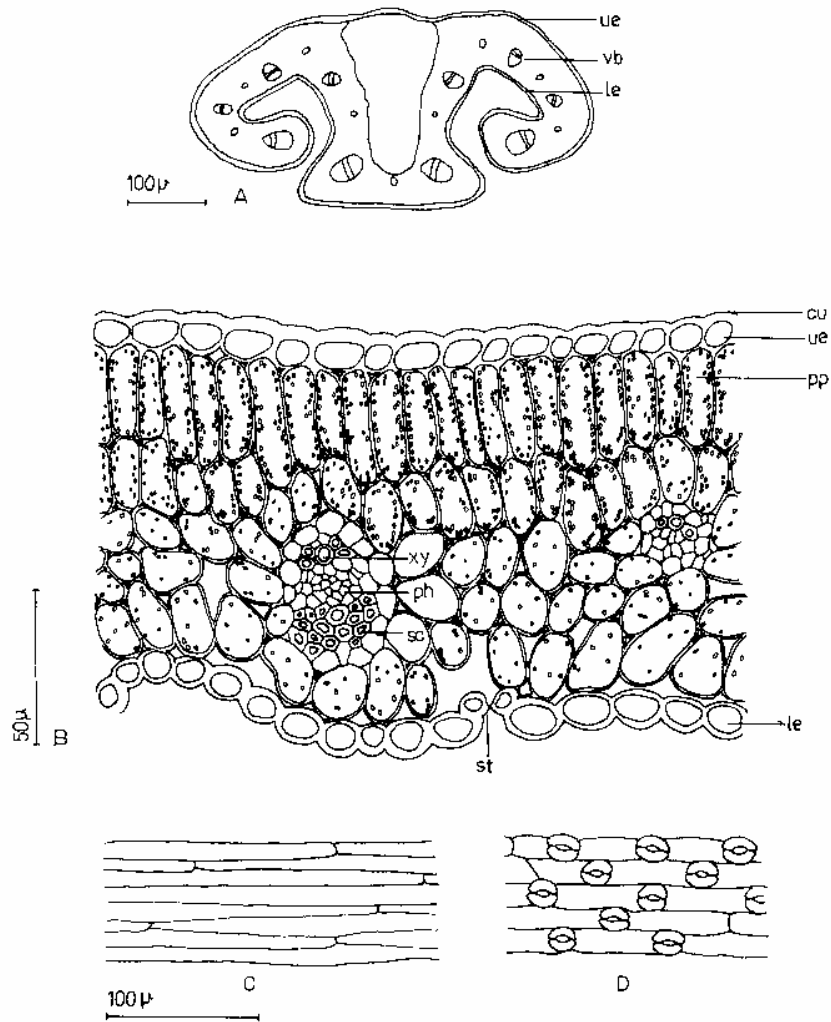


Fig. 5. *Crocus leichtlinii* (İ.Eker 369 & Akan), A-B) Cross-section of leaf, C) Upper epidermis of leaf, D) Lower epidermis of leaf; cu-Cuticula, ue-Upper epidermis, le-Lower epidermis, vb-Vascular bundle, st-Stomata, pp-Palisade parenchyma, sp-Spongy parenchyma, xy-Xylem, ph-Phloem, sc-Sclerenchyma

Leaf is bifacial. Palisade parenchyma cells are usually 2-layered, with chloroplasts in abundance. Spongy parenchymatic cells are 2-3-layered, and they are located on the lower of the palisade parenchyma.

There are large and small vascular bundles in mesophyll. Vascular bundles lie between the palisade and the spongy layer. Vascular bundles is collateral type. The xylem is towards the upper surface and the phloem towards the lower surfaces. There are also sclerenchymatous cells below the phloem.

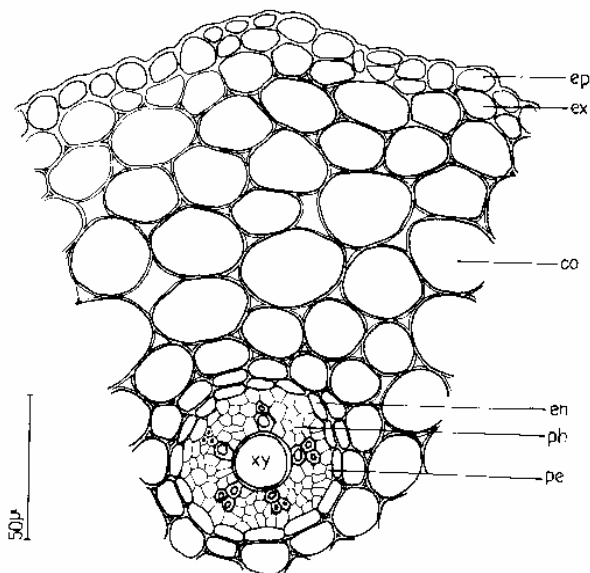


Fig. 6. *Crocus leichtlinii* (İ.Eker 369 & Akan), Cross-section of root, ep-Epidermis, ex: Exodermis, co-Cortex, en-Endodermis, pe-Peryscl, xy-Xylem, ph-Phloem

#### Root (Fig. 6)

The epidermis is composed of a single layer isodiametric cells. There is 1-2-layered exodermis tissue below the epidermis. Cortex is 5-6-layered. The cortex tissue composed of large hexagonal or polyhedral parenchymatous cells. Single layered endodermis consists of ovoid cells. There is caspary bundle in anticline (radial and transverse) walls of endodermal cells. Peryscl is composed of layer parenchymatous cells. Metaxylem is located central part of vascular bundle. Xylem is usually pentarch. Phloem is between xylem arms.

#### Observations on population of *Crocus leichtlinii*

*Crocus leichtlinii* is endemic to Upper Euphrates and Mesopotamia and it was included in the “LR (cd)” (conservation dependent) categories in the “Red Data Book of Turkish plants” (Ekim *et al.*, 2000). However, during the field studies, it was observed that the scarcity of individuals in the population and the destruction in its habitat may cause the extinction in future and for all these reasons the species should be placed into the “CR” (critically endangered) category (Anon., 2001).

*Crocus leichtlinii* distributed in Şanlıurfa around 900-1900 m on rocky slopes and in steppe with *Colchicum szovitsii* Fisch. & May, *Corydalis oppositifolia* DC. subsp. *oppositifolia*, *Gagea fistulosa* Ker-Gawler., *Geranium tuberosum* L. subsp. *tuberosum*, *Iris persica* L., *I. reticulata* Bieb., *Merendera trigyna* (Steven ex Adam) Stapf, *Ranunculus kochii* Ledeb. & *Viola modesta* Fenzl.

It was observed that the population of *Crocus leichtlinii* has restricted distribution in the field, and there are some other negative factors for the species. Excessive and disorderly grazing and the gathering by the citizens for decorative purposes are reducing the populations. Gaining land for culture and expansion of culture land is another factor that affect the decreasing of natural habitats. On the other hand, few years ago skiing facilities were established in Karacadağ. These facilities are yet not very comprehensive but the new construction of skiing facilities on the top of Karacadağ mountain is a fear or may pose threat to plant diversity in the area.

### Discussion

In this study, *Crocus leichtlinii* (D. Dewar) Bowles, which is flowering in Autumn, was studied. Some morphological characters of this taxa weren't given in *Flora of Turkey*, such as the height of the plant and corms, and the details of fruit and seeds. These characters are provided in this study. There are some differences between the "Flora of Turkey" and our findings but with these differences the descriptions of the taxa are widened; the general findings of this study are in agreement with the Flora of Turkey.

In the anatomical study, anatomical structure of the root and leaves of *Crocus leichtlinii* was observed. Results of the study show that there is 2-layered palisade parenchyma and 2-3-layered spongy parenchyma in mesophyll of *Crocus leichtlinii*, but there is 4-5-layered palisade parenchyma and 3-4-layered spongy parenchyma in mesophyll of *Crocus cancellatus* subsp. *damascenus* and *C. pallasii* subsp. *turcicus* (Akan & Eker, 2004).

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### References

- Akan, H. and İ. Eker. 2004. Some Morphological and Anatomical Investigations on Autumn Species of *Crocus* L. Occurring in Şanlıurfa. *Turk. J. Bot.*, 28: 185-191.
- Anonymous. 2001. IUCN Species Survival Commission. *IUCN Red List categories and Criteria*. Approved by the 51 st meeting of the IUCN Council, Version 3.1 Switzerland: Gland.
- Baytop, A. 1972. *Bitkisel Drogların Anatomik Yapısı*. İstanbul Üniversitesi, Eczacılık Fakültesi. Yay. No. 829. İstanbul.
- Çoşkunçelebi K. and O. Beyazoğlu. 1999. *Lilium ciliatum* P.H.Davis (Liliaceae)'in Anatomisi. In: *Proceedings of I. International Symposium on Protection of Natural Environment and Ehlami Karaçam*. pp. 799-806, Kütahya, Turkey.
- Ekim, T., M. Koyuncu, M. Vural, H. Duman, Z. Aytaç and N. Adıgüzel. 2000. *Türkiye Bitkileri Kırmızı Kitabı (Red Data Book of Turkish Plants)*. Türkiye Tabiatını Koruma Derneği. Ankara.
- Kandemir, N. and A. Engin. 1998. *Iris nectarifera* Güner (*Iridaceae*) üzerinde morfolojik, anatomik ve ekolojik bir araştırma. In: *Proceedings of XIV. Ulusal Biyoloji Kongresi*, Cilt I: 283-299. Samsun.
- Kandemir, N., Ö.E. Akçınand, A. Cansaran. 2000. Amasya çevresinde yayılış gösteren bazı geofitler üzerinde morfolojik ve anatomik bir araştırma. *Ot Sist. Bot. Derg.*, 7(2): 127-147.

- Kerndorff, H. and E. Pasche. 1994. *Crocus mathewii*. A new Autumn-Flowering *Crocus* from Turkey. *New Plantsman*, 1(2):102-106.
- Kerndorff, H. and E. Pasche. 1996a. *Crocuses* from Turkey to Jordan. *Quart. Bull. Alp. Gard. Soc.*, 64(3): 296-312.
- Kerndorff, H. and E. Pasche. 1996b. *Crocuses* from Turkey to Jordan. (Part 2). *Quart. Bull. Alp. Gard. Soc.*, 64(4) : 459-467.
- Kerndorff, H. and E. Pasche. 1997. Two remarkable taxa of the *Crocus biflorus* complex (Iridaceae) from northeastern Turkey. *Linz. Biol. Beitr.*, 29(1) 591-600.
- Koca, F. 1996. Morphological and Anatomical studies on some endemic *Iris* L. species (Sect. *Iris*) in Turkey. *Türk. Bot. Derg.*, 20 (ek sayı): 43-57.
- Küçükler, O. 1990a. Studies on the Endemic *Colchicum* Taxa of Turkey: *C. baytopiorum* C.D. Brickell. *Doğa-Tr J. of Botany*, 14: 1-11.
- Küçükler, O. 1990b. Studies on the Endemic *Colchicum* Taxa of Turkey: *C. lingulatum* Boiss. et Spruner. *Doğa-Tr J. of Botany*, 14: 178-189.
- Mabberly, D.J. 1997. *The plant-book: A Portable Dictionary of the Higher Plants*, Cambridge University Press, Cambridge, UK.
- Malyer, H. 1982. A chrological study of geophytes of Iridaceae in Diyarbakır region, *Doğa Bilim Derg.*, 6(1): 17-20.
- Mathew, B. 1984. *Crocus* L. In: *Flora of Turkey and the East Aegean Islands*, (Ed.): P.H. Davis, vol. 8: 413-438, Edinburgh University Press. Edinburgh.
- Mathew, B. 1988. *Crocus* L. In: *Flora of Turkey and the East Aegean Islands*, (Eds.): Davis, P.H., K. Tan and R.R. Mill, vol.10: 228, Edinburgh University Press. Edinburgh.
- Mathew, B. 1995. An interesting new Autumn-flowering *Crocus* from Turkey. *New Plantsman*, 2(3): 182-184.
- Mathew, B.F. 2000. *Crocus* L. In: *Flora of Turkey and the East Aegean Islands*, (Eds.) A. Güner, N. Özhatay, T. Ekim and K.H.C. Başer. Vol 11: 271-274. Edinburgh University Press. Edinburgh.
- Özdemir, C., Y. Akyol and E. Alçitepe. 2004. Morphological and Anatomical studies on two Endemic *Crocus* species of Turkey Area. *Pak. J. Bot.*, 36 (1): 103-113.
- Özhatay, N. and L. Üstün. 1986. Leaf Anatomy of two subspecies of "*Allium scorodoprasum* L. subsp. *scorodoprasum*, subsp. *rotundum* (L.) Stearn in Turkey. In: *Proceedings of 5th OPTİMA Meeting*, pp. 737-742. Istanbul, Turkey.
- Pasche, E. 1994a. A new *Crocus* (Iridaceae) from Turkey. *Herbertia*, 49(1-2): 67-75.
- Pasche, E. 1994b. Über einige *Crocus* and *Iris* Arten Anatoliens. *Stapfia*, 34: 89-102.
- Uysal, İ. 1992. Kazdağı (B1 Balıkesir) Endemik Bitkileri Üzerinde Morfolojik ve Ekolojik Araştırmalar I: *Allium flavum* L. subsp. *flavum* var. *minus* Boiss. ve *Mucisari latifolium* Kırk. *Doğa-Tr J. of Botany*, 16: 299-310.

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