

## The Revision of *Fritillaria* L. (Liliaceae) Genus in the Regions in Turkey Except the Mediterranean Region

<sup>1</sup>Mehtap Teksen and <sup>2</sup>Zeki Aytac

<sup>1</sup>Department of Biology, Faculty of Arts and Science, Aksaray University,  
68100 Aksaray, Turkey

<sup>2</sup>Department of Biology, Faculty of Arts and Science, Gazi University,  
06500 Teknikokullar, Ankara, Turkey

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**Abstract:** The revision of *Fritillaria* L. (Liliaceae) genera spread in the regions of Turkey, except the Mediterranean region was conducted in this study. The members of *Fritillaria* genera, represented with a total of 26 taxa consisting of species and subspecies spread in the flora of Turkey except the Mediterranean region were evaluated in 24 taxa (22 species and 2 subspecies). The diagnosis key, descriptions, distributions and drawings are supplied in this study. The danger categories of the endemic *Fritillaria* taxa were rearranged according to the new IUCN categories.

**Key words:** Revision, fritillaria, IUCN, subspecies, Turkey

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### INTRODUCTION

*Fritillaria* is a genus which is spread, especially in Northern Hemisphere has marvellous species and many of its species are used as ornamental plants. It is represented with many species in East Anatolia and with the most species in the Mediterranean. It is spread in Trace, Black sea and Central Anatolia but with a low density (Rix, 1984; Rix *et al.*, 2001; Ozhatay, 2000; Ozhatay *et al.*, 2011; Wallis and Wallis, 2003; Teksen and Aytac, 2004, 2008, 2011).

*Fritillaria* is represented with 165 taxa around the world (Rix *et al.*, 2001). In these species and sub-species taxa, there are 39 (33 species and 6 sub-species) in Turkey, 25 in Greece, 24 in China, 22 in Russia, 20 in California and 18 in Iran. These numbers show that *Fritillaria* genus is mostly widespread in Turkey (Lozina-Lozinskaya, 1968; Tutin, 1980; Pignatti, 1982; Townsend, 1985; Feinbrun-Dothan, 1986; Rechinger, 1990). About 18 of the total 41 taxa in Turkey are endemic.

The scope of this study covers 24 species and subspecies except those in the Mediterranean region. About 9 of these are endemic *F. imperialis*, *F. persica*, *F. aurea*, *F. crassifolia* ssp. *crassifolia*, *F. bithynica*, *F. carica*, *F. serpenticola* and *F. pinardii* among these are found in the Mediterranean region and were given by Teksen and Aytac (2011). Therefore, these species are given in the diagnosis key but their descriptions are omitted.

The diagnosis key, detailed descriptions, drawings and distribution maps according to Davis are given in this study.

### MATERIALS AND METHODS

The research covers the regions in Turkey except the Mediterranean region. The species of *Fritillaria* genera found in Mugla, Antalya, Icel, Adana, Osmaniye, Hatay, Kahramanmara and Gaziantep Provinces were given by Teksen and Aytac (2011).

*Fritillaria* species in these regions were collected in their blossomed and fruity period between March and July from 2001-2003.

The examined specimens out of the field of the species in the study area were also added among the specimens examined. In addition, type specimens and the collections of the herbaria AEF, ANK, BM, C, E, G, GAZI, GB, HUB, ISTF, ISTO, K, KNYA, RSA, OXF and S herbaria were examined.

A range of characteristics that were considered to be taxonomically important in the genus was investigated. These include the following: Leaf number, measurements and color, inflorescence, flower color, style shape of the apex and structure, filament structure, anther color and capsule wing. Measurements were obtained from at least 20 replicates for each of the 20 specimens and the average value of each characteristic was evaluated. The maximum and minimum values of the measurements of these parts

are given in the descriptions of the taxa. The seed surface was investigated under the stereozoom microscope (Teksen and Aytac, 2011).

Red list categories of endemic taxa *Fritillaria* were revised according to IUCN red list categories (IUCN, 2001).

## RESULTS

The taxonomy of *Fritillaria* genus and the morphological properties of the species spread in the Mediterranean region given in Teksen and Aytac (2011) are stated here. In this study, the diagnostic key and distribution maps of the species spread in the Mediterranean region are given but the morphological properties are not.

The species diagnostic key of the regions in Turkey except the Mediterranean region.

- 1-Bulb at least 4 cm diam; leaves (10-) 20-50, flower in an umbel or raceme (1-4) 6-30
- 2-Leaves shining green, inflorescence umbel, perigon 40-55 mm, orange to red rarely yellow ----- (1. *F. imperialis*)
- 2-Leaves glaucous, inflorescence raceme, perigon 15-20 mm, purple or greenish-yellow ----- (2. *F. persica*)
- 1-Bulb up to 3 cm diam, leaves 2-14, flower terminal, 1-4 (5)
- 3-Perigon yellow, yellowish-green, green, tessellated, tessellated at base and apex, striped with blotch or purple
- 4-Perigon green or outside purple and green striped, capsule winged
- 5-Style 3-branched, branches 1.5-7 mm ----- (5. *F. pontica*)
- 5-Style undivided
- 6-Leaves glaucous, perigon green, stigma entire ----- (10. *F. bithynica*)
- 6-Leaves green, perigon outside purple and green striped, stigma capitata ----- (11. *F. stribrnyi*)
- 4-Perigon yellow, yellowish-green, green, tessellated, tessellated at base and apex with blotch or purple, capsule not winged
- 7-Nectaries 8-13×1-2 mm ----- (7. *F. michailovskyi*)
- 7-Nectaries 1-7×0.5-2 mm
- 8-Filament smooth ----- (4. *F. aurea*)
- 8-Filament papillose
- 9-Flower conic, style 0.5 mm diam, minutely papillose ----- (15. *F. serpicicola*)
- 9-Flower campanulate, style 1-1.5 mm diam, coarsely papillose
- 10-Flower yellow, yellowish-green
- 11-Leaves shining green ----- (16. *F. minima*)
- 11-Leaves glaucous
- 12-Nectaries brown ----- (13. *F. carica*)
- 12-Nectaries green
- 13-Leaves 2 (-3) with purple veins or orange when dried ----- (14. *F. byfieldii*)
- 13-Leaves 3-8, yellow when dried ----- (20. *F. pinardii*)
- 10-Perigon glaucous or green, blotched at base and apex or purple with green or yellow striped
- 14-Style smooth ----- (12. *F. fleischeriana*)
- 14-Style papillose
- 15-Anther black ----- (21. *F. assyriaca*)
- 15-Anther yellow ----- (12. *F. fleischeriana*)
- 3-Perigon green and brown tessellated, perigon purple with or without tessellate; reddish-brown or purplish, pale to dark pink and perigon purple with yellow apex
- 16-Style smooth or sparsely papillose (if papillose, style undivided)
- 17-Style undivided
- 18-Stamens shorter than perigon ----- (18. *F. caucasica*)
- 18-Stamens longer than perigon ----- (19. *F. baskilensis*)
- 17-Style 3-branched
- 19-Perigon pink to pale pink or reddish-brown
- 20-Stem smooth, perigon pink to pale pink, filament 10-15 mm, style branches 1-2 mm ----- (9. *F. alburyana*)
- 20-Stem papillose around lowest leaves; perigon reddish-brown, filament 6-10 mm, style branches 2-5 mm ----- (17. *F. minuta*)
- 19-Perigon green with brown tessellated or purple, purplish-brown and tessellated or perigon purple, yellow at apex
- 21-Perigon 35-54 mm; outer segments 10-20 mm width, nectaries ovate-lanceolate, 3-5×1-2 mm ----- (3. *F. latifolia*)
- 21-Perigon 12-32 mm, outer segments 4-10 mm width, nectaries linear, 5.5-16×1-2 mm
- 22-Perigon green with brown tessellated ----- (6. *F. crassifolia*)
- 22-Perigon purple, purplish-brown 1/3 or 1/4 yellow at apex, not tessellated ----- (7. *F. michailovskyi*)
- 16-Style papillose
- 23-Nectaries linear, 8-12×1-2 mm ----- (8. *F. straussii*)
- 23-Nectaries ovate, linear-lanceolate, lanceolate, 1.5-6×0.5-5 mm
- 24-Leaves shining green, nectaries brown, style 3-4 mm diam ----- (22. *F. uva-vulpis*)

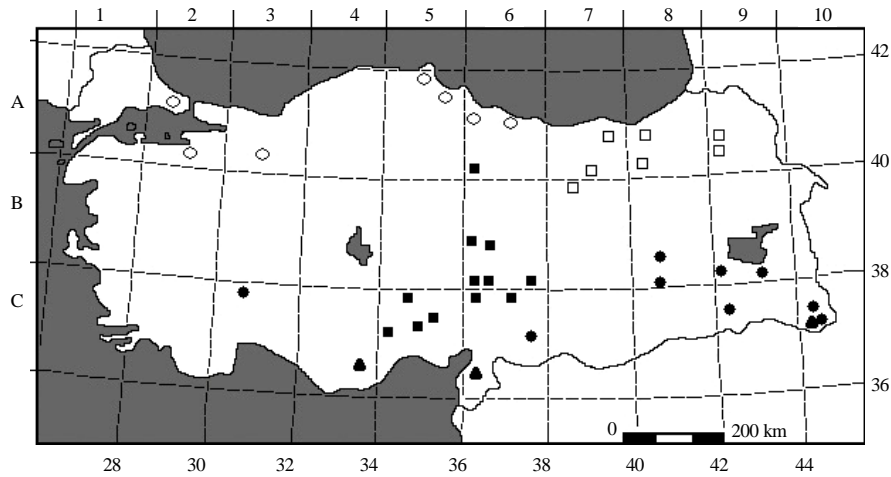


Fig. 1: ●) Distribution in Turkey *Fritillaria imperialis*; ▲) *F. persica*; □) *F. latifolia*; ■) *F. aurea*; ○) *F. pontica*

- 24-Leaves glaucous, nectaries green, style 1-2 mm diam
- 25-Lowest leaves linear, linear-lanceolate and canaliculate; stigma clavate ----- (21. *F. assyriaca*)
- 25-Lowest leaves narrowly or broadly lanceolate, elliptic, ovate or flat, stigma entire ----- (20. *F. pinardii*)
- *Fritillaria imperialis* L., sp. Pl. 303 (1753) (Teksen and Aytac, 2011) (Fig. 1)
- *Fritillaria persica* L., sp. Pl.: 304 (1753) (Teksen and Aytac, 2011) (Fig. 1)
- *Fritillaria latifolia* Willd., sp. Pl. 2 (1): 92 (1799)

**Synonyms:** *F. esculenta* Adam in F. Weber and D.M.H. Mohr (eds.), Beitr. Naturk. 1: 52 (1805), *F. lutea* var. *latifolia* (Willd.) Baker, J. Linn. Soc., Bot. 14: 259 (1874), *F. nobilis* Baker, Bot. Mag. 122: t. 7500 (1896), nom. illeg.

**Type:** Described from cultivated material from caucasus (holo and iso. Hb. B.-Willd. 6536) (Fig. 1 and 2). Bulb ovoid, 0.8-1.9×0.7-2 cm, tunica thin and papery. Stem erect, 4-35 cm, smooth. Leaves 5-9, sessile, shining green. Lowest leaves 3.5-9×0.5-2.5 cm opposite or subopposite, ovate-lanceolate or elliptic, acute. Median leaves 3.9-6.5×0.5-1.1 cm, linear-elliptic, linear-lanceolate, lanceolate, acuminate. Bracts 1-3, 2.6-6.6×0.2-0.5 cm, linear or narrowly lanceolate, acuminate. Flower 1: Perigon broadly campanulate, outer brownish or reddish-purple tessellated, inner yellowish-green or reddish-purple tessellated. Outer segments 35-54×10-20 mm, ovate, ovate-lanceolate, lanceolate or oblanceolate, obtuse, ciliate-tufted at apex, inner segments 35-54×12-20 mm, narrowly obovate, obtuse, ciliate-tufted at apex. Nectaries 3-5×1-2 mm, ovate-lanceolate, lanceolate, green, 10-12 mm above base

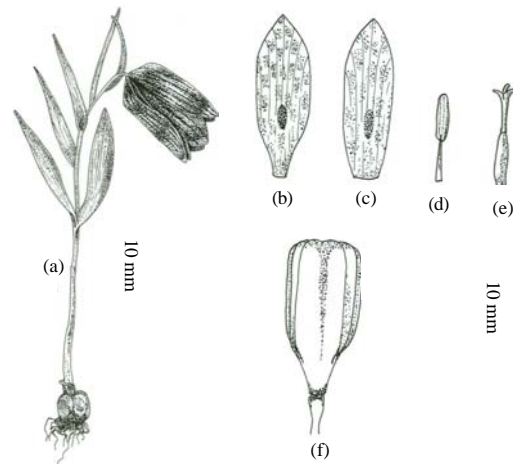


Fig. 2: *Fritillaria latifolia*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

of tepals, corners of bell. Filaments 10-15 mm, enlarged to base, smooth, yellow; anthers 6-9 mm, elliptic, apiculate, yellow, basifixed. Style 10-15×2 mm, 3-fid, branches 2-5 mm, smooth; stigma entire. Capsule 13-42×8-18 mm, oblanceolate, oblanceolate-orbicular, truncate at apex, cuneate at base, not winged. Seeds 4-7.5×4-6 mm, flat, obovate, testa brown and reticulate-faveolate. Fl (Flowering time): 5-7.

**Habitat:** Grassy places in Pinus zone and above, volcanic rocks, rocky igneous, mountain steppe and alpine meadows by late snow patches, 1750-3000 m.

**Specimens examined:** A7 Gumushane: Baolanbasy, Camlykoz, Komgel-Zaryfly, 1700-2200 m, 04.06.1976, A. Guner 1419 (HUB). A8 Rize: Ykizdere-yspir, Ovit Mt.

(Mountain) (GAZI); Camlyhemsin, Ortayayla village, Vercenbek Mt., 2400-2850 m, 05.08.1981, A. Guner 3913 (ANK); Kars, Ziyaret Mt., Yalnyzcam, c. 2250 m, 29.06.1957, Davis and Hedge 30301 (ANK). A9 Coruh (Artvin): Ardanuc, Kordevan Mt. (Yalnyzcam Mt.), 2700 m, 28.06.1957, Davis and Hedge 30382 (ANK); Ardanuc above Urundere Castle, 2300 m, 12.06.1976, A. Guner 1432; savsat, Ilyca-Arsiyan Mt., around the pond, 1750-3000 m, 30.06.1986, Demirkus 3735 (HUB). B7 Erzincan: Erzincan-Refahiye, Alacatly Village, Kurtlutepe location, 2100-2300 m, 25.05.2002, Teksen 2139 (GAZI); *ibid.*, 06.07.2001, Teksen 2098 (fr. (fruit specimen)) (GAZI).

**Distribution:** Turkey, Caucasus, Iran. Euxine (mt.) element. *F. latifolia* is distinct from other species in that it has bright green leaves, wide campanulate and perigon properties of brownish or reddish-purple tessellation outside, yellowish-green and reddish-purple tessellation inside. *F. latifolia* shows affinity to *F. aurea* which is spread around the provinces of Sivas, Kayseri, Niode, Erzincan, Malatya, Kahramanmaraş and Icel. *Fritillaria aurea* Schott in Ost. Bot. Wochenbl. 4: 137 (1854) (Teksen and Aytac, 2011) (Fig. 1). *Fritillariapontica* Wahlenb in J. Berggren, Resor. 2 (Bih.): 27 (1826). Synonym: *F. olympica* K. Koch in Linnaea 22: 232 (1849).

**Type:** Turkey, A2 (E) Istanbul: In nemorosis inter colles supra Buyukdere, *J. Berggren* s.n. (holo. UPS!) (Fig. 1-3).

Bulb globose, 0.7-0.9×0.8-1.5 cm, tunica thin and papery. Stem erect, 12-45 cm, smooth. Leaves 5-9, sessile, green. Lowest leaves 3.7-11×0.3-3.2 cm, opposite or subopposite, lanceolate or ovate-lanceolate, acute or obtuse. Median leaves 3.8-8.1×0.5-1.6 cm, opposite or alternate, lanceolate, acute. Bracts 2-5, 3.2-11×0.2-1.6 cm whorled, lanceolate, linear-lanceolate or ovate-lanceolate, acute or acuminate. Flowers 1-2: Perigon broadly campanulate, green, purple apex and base of tepals, inside yellowish-green and purple at apex. Outer segments 22-45×7-16 mm, lanceolate, oblong, acute or obtuse, ciliate-tufted at apex; Inner segments 22-45×8-20 mm, oblanceolate, obovate-lanceolate, obtuse, ciliate-tufted at apex. Nectaries 2-4×3-5 mm, circular or ovate, brown, 5-7 mm above base of tepals. Filaments 9-12 mm, enlarged to base, papillose, yellow; anthers 4.5-9 mm, elliptic, apiculate, yellow, basifixed. Style 9-15 mm, 3-fid, branches 3-7 mm, smooth; stigma entire. Capsule 17-43×15-21 mm, obovoid-oblong, truncate at apex, cuneate at base, 6-winged, wings 1.5-2 mm. Seeds 4.5-7×3.5-5 mm, flat, obovate or narrowly obovate, testa brown, reticulate-faveolate. Fl: 4-5. Habitat: Open woods and scrub, roadsides, 30-1500 m.

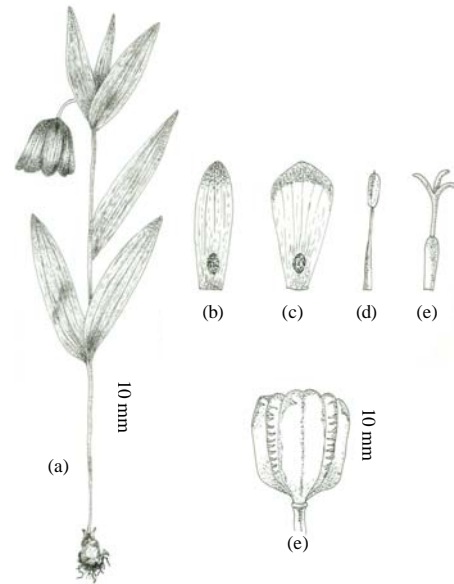


Fig. 3: *Fritillaria pontica*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

**Specimens examined:** A2 (A) Bursa: Uludao, National Park, c. 1100 m, 19.05.1976, Quezel 9320 (ANK); Uludao, Uludao-Aras, 16.05.1944, M. Basarman ISTF 2883 (ISTF); Uludao, Uludao-Aras, 03.07.1944, M. Basarman ISTF 3970 (ISTF); Uludao, Karabelen, 27.04.1937, Krause 5057 (HUB); Uludao, below Karabelen, 17.05.1953, A. Berk 1582 (HUB); Ystanbul: Yalova, 02.05.1942, A. Heilborn and M. Basarman ISTF 1512 (ISTF); Saryyer, Bahcekoy-Kemberburgaz, Buyukbend junction, Belgrad Forest, H. Demiriz ISTF 21989 (ISTF). A2(E) Ystanbul: Belgrad Forest, 07.05.1940, B. Kasaplygil s.n. (ANK); Yalova, 06.06.1943, M. Basarman ISTF 2316 (ISTF). A3 Bolu: Abant, around Abant Lake, 1330 m, 27.05.2001, M. Teksen 2095 (GAZI); *ibid.*, 12.08.2001, M. Tekpen 2112 (fr.) (GAZI); *ibid.*, 11.05.2002, E.D. Guner 1642 (GAZI); Kale, Kyrykyayla, 1500 m, 08.06.1990, Y. Kylync 1116 (GAZI); around Abant Lake, 1300 m, 18.04.1974, K. Karamanoolu 5169 (AEF); Cepni yolu, 25.04.1947, A. Heilborn and M. Basarman ISTF 6829 (ISTF). B3 Bilecik: Bozhuyuk-Bilecik, 15 km to Bilecik, 700-870 m, 02.05.1993, Z. Aytac 5754 and Ekici, F.A.K. (GAZI, HUB).

**Distribution:** Turkey, Balkans. Euro-Siberian element. *F. pontica* is distinct from the other species in that it has leaves with 2-4 bracts, wide campanulate, green, purple tip and base of tepals, yellowish-green inside, purple tips properties and winged capsule. While, morphologically, it is not a common plant among campanulate flowered species, it shows affinity to *F. alfredae* and *F. bithynica* which have campanulate flowers with 3 bracts winged,

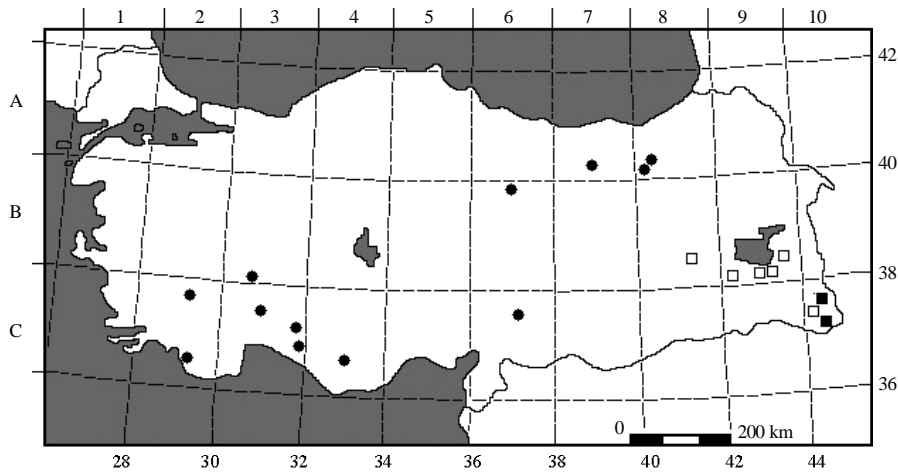


Fig. 4: ●) Distribution in Turkey *Fritillaria crassifolia*, *Crassifolia*; □) *Kurdica*; ■) *Hakkarensis* ssp.

green perigon and winged capsule. *Fritillaria crassifolia* Boiss and Huet in Boiss, Diagn. ser. 2 (4): 103 (1859).

Bulb globose or obovoid, 0.7-2.0×0.7-3 cm, 1-3 or with many bulblets, tunica thin and papery. Stem erect, 2.5-15 cm, entire. Leaves 3-7 (-10), sessile, glaucous or shining green. Lowest leaves 2.0-12.5×0.4-3.2 cm, subopposite or alternate, broadly or narrowly lanceolate, elliptic, narrowly ovate, acute or acuminate. Median leaves 1.5-11.5×0.1-1.6 cm, alternate, rarely opposite, linear or linear-lanceolate, acute or acuminate. Bracts 1-2, 9-75×1-4 mm, opposite, linear, linear-lanceolate, lanceolate and acuminate. Flowers 1-4. Perigon broadly campanulate, green, inside and outside brownish-purple tessellated or brownish-purple markings, yellowish-green stripe on the floor. Outer segments 12-28×4-10 mm, lanceolate, acute or obtuse, ciliate-tufted at apex; inner segments 12-28×5-12 mm, oblanceolate or spatulate, acute or obtuse, ciliate-tufted at apex. Nectaries 8-16×1-2 mm, linear, green, 3-5 mm above base of tepals. Filaments 5-10 mm, smooth or papillose, yellow; anthers 3-11 mm, elliptic or oblong, yellow, basifixed. Style 5-13 mm, 3-fid, branches 1-6 mm, reflexed, smooth; stigma entire. Capsule 12-45×10-23 mm, globose or obovoid, truncate at apex, cuneate at base, glaucous, not winged. Seeds 5-7×4-5.5 mm, flat, obovate, testa pale orange-brown, faveolate.

- 1-Lowest leaves 2.5-3×as long as broad, ovate-lanceolate ----- (*crassifolia* ssp.)
- 1-Lowest leaves 4-7×as long as broad, linear-lanceolate, elliptic
- 2-Leaves glaucous; inner segments obtuse ----- (*kurdica* ssp.)
- 2-Leaves shining green; inner segments acute----- (*Hakkarensis* ssp.)

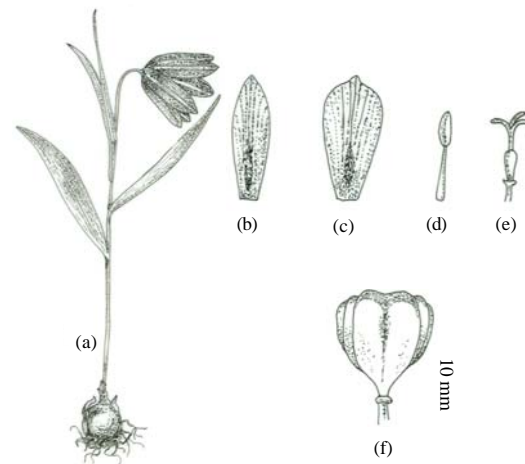


Fig. 5: *Fritillaria crassifolia* ssp. *kurdica*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

- 6a-ssp. *crassifolia* (Teksen and Aytac, 2011) (Fig. 4)
- 6b-subsp. *kurdica* (Boiss and Noe) Rix in Kew Bull. 29: 638 (1975)

**Synonyms:** *F. kurdica* Boiss and Noe in Boiss., Diagn. Ser. 2 (4): 103 (1859); *F. racemosa* Grossh. Fl. Kauk. 1 (1928) 221, non Ker.-Gawl; *F. wanensis* Freyn in Bull. Herb. Boiss. 2, 1: 287 (1901); *F. karadaghensis* Turrill in Gard. Chron. Ser. 3, 85: 242 (1929); *F. foliosa* Bornm. in Feddes, Report. Sp. Nov. 27: 338 (1930); *F. grossheimiana* Los.-Lozinsk. in Komarow, Fl. URSS 4 (addendum 3) 739 (1935).

**Type:** Turkey, B9 Van: in subalpinis prope Van, Noe 5 (holo. G) (Fig. 4 and 5). Fl. 4-7.

**Habitat:** Rocky and stony slopes, steppe, alpine meadows, 1500-3500 m.

**Specimens examined:** B9 Van: Erek Mt., above Deoirmenkoy 38°30'148"N, 43°31'097"E, c. 2500 m, 22.04.2002, M. Teksen 2125 (GAZI); *ibid.*, 26.05.2002, M. Teksen 2151 (GAZI); *ibid.*, 17.05.2003, M. Teksen 2187 (GAZI); Bahcesaray, Yukary Narlyca-Bahcesaray, 2400-2500 m, 15.05.2001, M. Teksen 2063 (GAZI); Gevas-Tatvan, Gorundu-Altynsac, 1700-1800 m, 15.05.2001, M. Teksen 2069 (GAZI); *ibid.*, 07.07.2001, M. Teksen 2102 (fr.) (GAZI); Gevas, Artos Mt., c. 2900 m, 16.07.1954, Davis and Polunin 22780 (ANK); Bitlis: Adilcevaz, Suphandaoy, Sute plateau, 2000 m, 04.06.1993, Y. Altan 4799 (GAZI). B10 Van: Ozalp, Yukary Tulgaly-Iran border, Kyractepe location, 38°46'007"N, 44°16'419"E, 2550 m, 26.05.2002, M. Teksen 2154 (GAZI).

**Distribution:** Turkey, Transcaucasia, Iran, Iraq. Irano-Turanian element. *F. crassifolia* genus is distinct from other species in that it has glaucous leaves, perigon with bright green and wide campanulate and striped *Nectarium* ssp. *Kurdica* is different from ssp. *Crassifolia*, as it has longer and thinner leaves and its nectarium has a distinctive back. It is different from ssp. *Hakkarensis* as it has glaucous leaves and its inner segments are obtuse. The 6c. subsp. *hakkarensis* Rix in Kew Bull. 29: 641, f. 1 (1975).

**Type:** Turkey, C10 Hakkari: Sat Daoy, N.W. of Sat Lake, 2900-3000 m by melting snow, 28 vi 1966, Davis 45682 (holo. E, iso. K) (Fig. 4-6). Fl: 5-7.

**Habitat:** Rocky and stony slopes, steppe by late snow patches, 1500-2500 m.

**Specimens examined:** B9 Van: Gevas-Tatvan, Gorundu-Altynsac, 1700-1800 m, 15.05.2001, M. Teksen 2071 (fr.) (GAZI). C10 Hakkari: Yuksekova-pemdinli, Beyaz Mt., 1 km from Haruna pass, 37°26'417"N, 44°27'530"E, 2200-2300 m, 19.04.2002, M. Teksen 2117 (GAZI); *ibid.*, 17.05.2003, M. Teksen 2180 (GAZI).

**Distribution:** In Turkey, Iraq, Irano-Turanian element. Subsp. *Hakkarensis* is different from as it has longer, thinner and brighter leaves compared to ssp. *Crassifolia* and its nectarium also has a distinctive back as ssp. *Kurdica*. Its difference from ssp. *Kurdica* is that its leaves are bright green and its inner segment is acute. *Fritillaria michailovskyi* Fomin, Vestn. Tiflissk. Bot. Sada 1: 18 (1905).

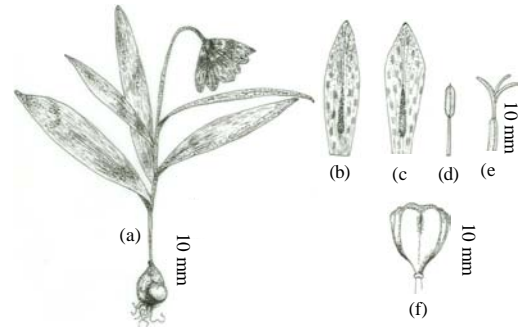


Fig. 6: *Fritillaria crassifolia* ssp. *Hakkarensis*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

**Type:** Turkey, A9 Kars: in regione alpino montis Askjar-dagh, S.J. Michailovsky s.n. (holo TBI) (Fig. 7 and 8).

Bulb ovoid, 0.6-1.5×0.7-2 cm, sometimes 1-3 bulblets, tunica thin and papery. Stem erect, 4-24 cm, smooth. Leaves 4-16, sessil and glaucous. Lowest leaves 2.9-10×0.4-1.5 cm, alternate or subopposite, lanceolate, acute. Median leaves 2.2-6.2×0.2-0.7 cm, alternate, lanceolate, linear-lanceolate, acute or acuminate. Bract 1, 1.3-4.6×0.15-0.4 cm, linear, linear-lanceolate, acuminate. Flowers 1-4. Perigon broadly campanulate, purplish-brown, sometimes outside greenish, apical 1/4-1/3 yellow, inside yellow, tepals recurved at apex, rarely perigon yellow. Outer segments 16-32×5-10 mm, lanceolate, acute or obtuse, ciliate-tufted at apex; inner segments 16-32×6-15 mm, oblanceolate, obtuse, ciliate-tufted at apex. Nectaries 8-13×1-2 mm, linear, yellowish-green, yellow, brownish-purple at base, 3-5 mm above base of tepals. Filaments 6-9 mm, smooth or sparsely papillose, narrow to base, yellow; anthers 3-5.5 mm, oblong, yellow, purple before dehiscence, basifixed. Style 6-10 mm, 3-fid, branches 1.5-3 mm, smooth; stigma entire. Capsule oblong or obovoid, truncate at apex, cuneate at base, dead tepals remaining attached to base, 11-23×10-20 mm, not winged. Seeds 5-6.5×3.5-5.5 mm, flat, obovate or narrowly obovate, testa brown, reticulate-faveolate. Fl: 5-6.

**Habitat:** Stony slopes, steppe, 2000-3000 m. Conservation status: LC (Least concern).

**Specimens examined:** B9 Agri: Tahir, Tahir Mt., around theradar station, 2500 m, 16.05.2001, M. Teksen 2076 (GAZI); *ibid.*, 07.07.2001, M. Teksen 2099 (fr.) (GAZI); *ibid.*, 25.05.2002, M. Teksen 2148 (GAZI).

**Distribution:** Endemic. Irano-Turanian element. *F. michailovskyi* is distinguished from other plants, as its leaves are glaucous, it has wide campanulate and



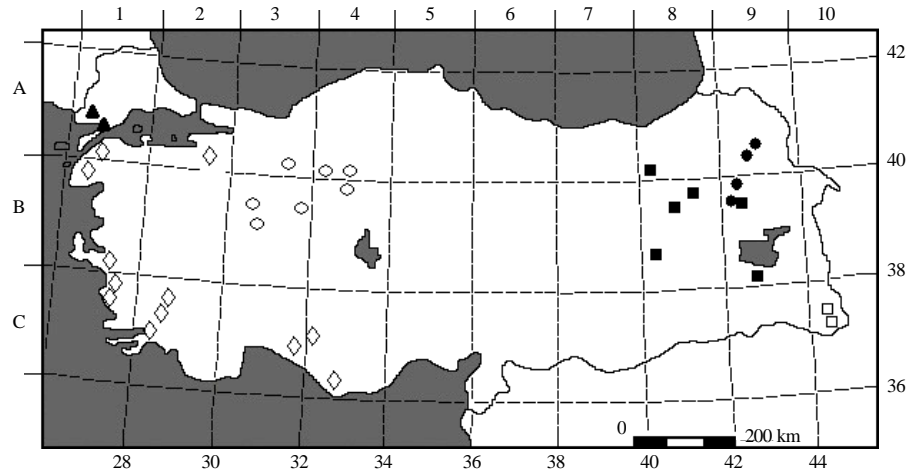


Fig. 7: ●) Distribution in Turkey *Fritillaria michailovskyi*; □) *F. straussii*; ■) *F. alburyana*; ◇) *F. bithynica*; ▲) *F. stribrnyi*; ○) *F. fleischeriana*

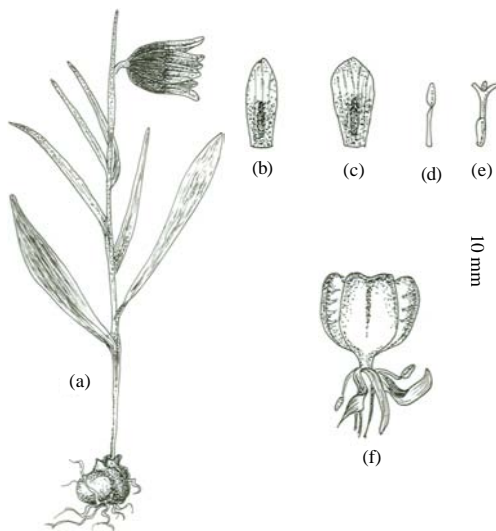


Fig. 8: *Fritillaria michailovskyi*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

purplish-brown, sometimes greenish outside, 1/4 or 1/3 yellow on tepal tip yellow inside perigon, tepal tips curling backwards, rarely yellow perigon, striped nectarium. *F. michailovskyi* which is the only *Fritillaria* species which has the feature of having permanent tepals under the capsule is easy to distinguish from other species even in fruity period. With its linear nectarium, it has affinity to *F. crassifolia* and *F. straussii*, as stated in the Flora of Turkey. The most distinctive difference is the perigon colour. *Fritillaria straussii* Bornm., Mitth. Thuring. Bot. Vereins, n.f., 20: 45 (1905).

**Type:** Iran, Kermanshah in montosis Kuh-Sefid, 2 v 1903, Th. Strauss s.n. (holo. JE) (Fig. 7-9). Bulb globose or

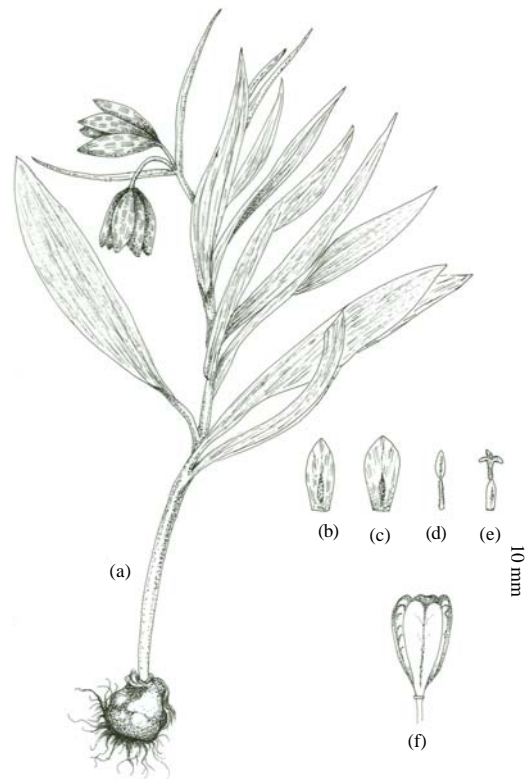


Fig. 9: *Fritillaria straussii*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

obovoid, 0.8-2×0.9-2.5 cm, 1-2 bulblets, tunica thin and papery. Stem erect, 8-20 cm, smooth. Leaves 5-24, sessil and shining green. Lowest leaves 4-12.5×1-3.5 cm, opposite or in whorls of 3, broadly lanceolate or elliptic, acute or acuminate. Median leaves 6-11.5×0.6-1.6 cm, opposite or subopposite, rarely alternate, lanceolate,

linear-lanceolate, acute or acuminate. Bracts 1-3, 5-7.5×0.2-0.3 cm, opposite, linear, acuminate. Flowers 1-6. Perigon broadly campanulate, green when young, often maturing to outside and inside dark reddish-purple, purple, tessellated. Outer segments 20-27×7-9 mm, lanceolate, acute or obtuse, ciliate-tufted at apex; inner segments 20-27×9-12 mm, oblanceolate, obtuse, ciliate-tufted at apex. Nectaries 8-12×1-2 mm, linear, green, 3-5 mm above base of tepals. Filaments 6-10 mm, papillose, enlarged to base, yellow; anthers 4.5-8 mm, oblong, yellow, basifixed. Style 6-8 mm, 3-fid, branches 3-5 mm, papillose; stigma entire. Capsule 15-33×13-20 mm, orbicular, oblanceolate, obovoid, sometimes short stalked, truncate at apex, cuneate at base not winged. Seeds 5-7.5×4-6 mm, flat, orbicular, obovate, testa pale brown, faveolate. Fl: 5-6.

**Habitat:** Umbelliferae and Astragalus steppe, Quercus scrub, rocky slopes, 1800-2400 m.

**Specimens examined:** C10 Hakkari: Yuksekova-pemdinli, Beyaz Mt., 1 km from Haruna pass, 37°26'41.7"N, 44°27'53.0"E, 2200-2300 m, 19.04.2002, M. Teksen 2119 (GAZI); ibid., 17.05.2003, 1800-2200 m, M. Teksen 2181 (fr.) (GAZI).

**Distribution:** Turkey, Iran. Irano-Turanian element. *F. straussii* is very distinct from other plants with shining green leaves, lower leaves opposite each other or in groups of 3, tessellation with wide campanulate, green in early time, dark reddish-purple or purple inside and outside perigon. It is like *F. crassifolia* ssp. *hakkarensis*, as its perigon is green in early time, reddish-purple or purple when matured tessellation and its nectarium are linear. The species is known from Beyaz Mountain and Mor Mountain with one locality on each and it is spread in North of Zagros Mountain in Iran. *Fritillaria alburyana* Rix, Notes Roy. Bot. Gard. Edinburgh 31 (1): 128 (1971).

**Synonyms:** *F. erzurumica* Phytologia 22: 1 (1971); *F. erzurumica* var. *abortivus* Kasapliligil, Phytologia 22: 3 (1971).

**Type:** Turkey, B8 Erzurum: pass between Erzurum and Cat, c. 2000 m, 19 v. 1970 (Rix *et al.*, 2001) (holo. E, iso. K) (Fig. 7-10).

Bulb globose or obovoid, 0.8-1.7×1-2 cm, many bulblets, tunica tunica thin and papery. Stem erect, 3-10 cm, smooth. Leaves 3-9, sessile and green. Lowest leaves 3.9-9×0.8-2.5 cm, alternate or subopposite, broadly lanceolate, acute or acuminate. Median leaves 3-8.2×0.3-0.7 cm alternate, linear, linear-lanceolate,

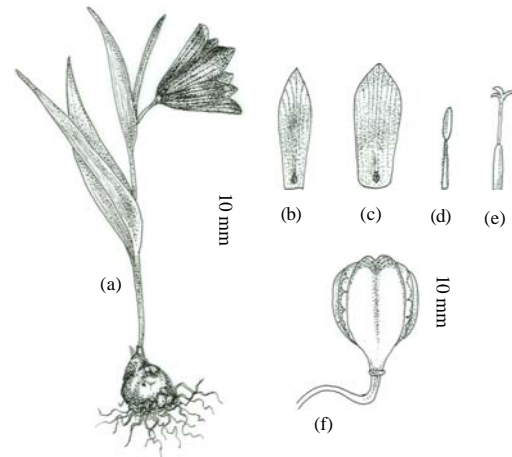


Fig. 10: *Fritillaria alburyana*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

acuminate, sometimes curled towards to apex. Bracts 1-2, 2.2-4.2×0.1-0.3 cm, opposite, linear, acuminate, sometimes curled towards to apex. Flowers 1-2: Perigon broadly campanulate, erect, horizontal or nodding, outside and inside pale pink to purplish-pink, slightly tessellated. Outer segments 17-32×5-15 mm, oblanceolate, oblong, acute or obtuse, ciliate-tufted at apex; inner segments 17-32×6-15 mm, oblanceolate or oblong, acute or obtuse, ciliate-tufted at apex. Nectaries 1-2×1-2 mm, elliptic, green, 1 mm above base of tepals. Filaments 10-15 mm, sparsely papillose, yellow; anthers 3-7 mm, oblong, purple before dehiscence, basifixed. Style 7.5-15 mm, 3-fid, branches 1-2 mm, curved, smooth; stigma entire. Capsule 17-35×11-19 mm, obovate, orbicular, oblanceolate, pedicel oblique, short stalked or sessile, truncate at apex, cuneate at base not winged. Seeds 5.5-7×4.5-5.5 mm, flat, obovate, testa pale brown, faveolate. Fl: 5-7.

**Habitat:** By late snow patches, stony and rocky places, alpine steppe, meadow, 2000-2900 m. Conservation status: VU (Vulnerable) B2b (iii).

**Specimens examined:** A8 Erzurum/Bayburt: Apkale-Bayburt, Kop Mt., Kop Mt. pass, around the tower of Military buyers, 40°01'200"N, 40°29'942"E, 2500 m, 17.05.2001, M. Teksen 2084, 2085, 2086 (GAZI); ibid., 18.05.2003, M. Teksen 2147 (fr.) (GAZI); Bayburt-Apkale, Kop Mt. pass, 2400 m, 13.06.1981, M. Koyuncu 4450 (AEF); Kop Mt., around the bell tower, 2400 m, 27.05.1971, S. Ozyurt and Y. Balta (ISTF), Kop Mt., S. slopes, 2400 m, 13.06.1981, R. Cetik 8029 (KNYA). B9 Erzurum: Hynys, Bingol Mt., 2550 m, 15.06.1981, M. Koyuncu 4509 (AEF).



**Distribution:** Endemic. Irano-Turanian element. *F. alburyana* species is distinguished from other plants with wide campanulated perigon, straight, horizontal or downwards, perigon colour changing from light pink to purplish-pink from inside to outside, slightly tessellation. There is no species affiliated to it in the Flora of Turkey as its flower can be straight or horizontal. During the flowered period, capsules and pedicel in all species of *Fritillaria* are straight but the pedicel in this species is leaning. *F. bithynica* Baker, J. Linn. Soc., Bot. 14: 264 (1874) (Teksen and Aytac, 2011) (Fig. 7). *Fritillaria stribnyi* Velen., Sitzungsber. Konigl. Bohm. Ges. Wiss., Math.-Naturwiss. Cl. 1892: 61 (1893).

**Type:** Bulgaria in dumosis regionis inferioris calidae ad Nova Mahala (distr. Philippop.), 1892, Stribny s.n. (holo. PRC) (Fig. 7-11).

Bulb subglobose, ovoid, 0.7-1.5×0.9-2 cm, 1-3 bulblets, tunica thin and papery. Stem erect, 10-30 (-80) cm, smooth. Leaves 7-14, sessile, green, alternate. Lowest leaves 2.8-10×0.45-2 cm, broadly oblong-lanceolate to linear, obtuse. Median leaves 2-7.9×0.2-0.5 cm linear, obtuse. Bracts 1-3, 1.2-5.6×0.1-0.3 cm, opposite or whorled, linear, acute. Flowers 1-3. Perigon narrowly campanulate, tepals outside purple and green striped or glaucous, edged purple, inside yellowish, edged purple. Outer segments 17-29×4-6 mm, oblong-lanceolate, acute, ciliate-tufted at apex; inner segments 17-29×5-11 mm, oblanceolate, obovate, obtuse, ciliate-tufted at apex. Nectaries 2-4×1-1.5 mm, narrowly lanceolate, green at base of tepals. Filaments 7-9 mm, papillose, greenish-yellow; anthers 5-6 mm, oblong, apiculate, yellow, basifixed. Style 7.5-10 mm, undivided, smooth; stigma capitate. Capsule 17-23×12-13 mm, oblanceolate, oblong, short stalked, obtuse at apex, cuneate at base, 6-winged, wings 2.5-3 mm. Seeds 4-4.5×3-3.5 mm, flat, obovate, testa pale brown, reticulate-faveolate. Fl: 4-5. Habitat: Woods, scrub and grassy places, 700-1000 m.

**Specimens examined:** A1 (E) Edirne: Kesan-Enez, 7 km from Kesan, Kylycbey village-Enez arasy, 13.04.2002, M. Teksen 2114 (GAZI); *ibid.*, 25.05.2003, M. Teksen 2200 (fr.) (GAZI).

**Distribution:** Turkey, Bulgaria. Euxine element. *F. stribnyi* is different from other species with green leaves, 3 bracts, narrow campanulated perigon, tepals purple and green grooved outside or purple glaucous, sides green, yellow inside purple sides, winged capsule. It is affiliated to *F. bithynica* with thin stylus without papilla, thin filament without papilla and winged capsule. It is affiliated to *F. milasense* with purple and green grooved tepals. Plant height is longer and leaves are thinner compared to

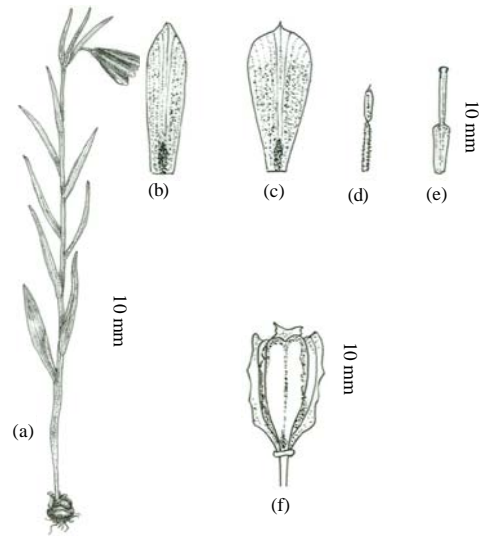


Fig. 11: *Fritillaria stribnyi*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

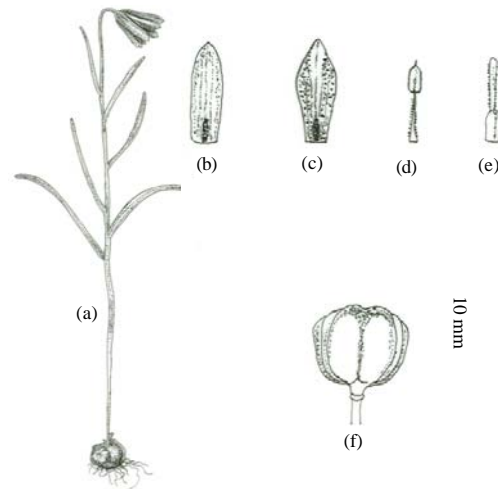


Fig. 12: *Fritillaria fleischeriana*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

*F. bithynica*. *Fritillaria fleischeriana* Steudel and Hochst ex Schultes and Schultes fil., Syst. Veg. 7: 388 (1829).

**Synonyms:** *F. fleischeri* Steud and Hochst. ex Kunth, Enum. Pl. 4: 248 (1843), nom. nud.; *T. fleischeriana* (Steud and Hochst. ex Schult and Schult. f.) Klatt, Hamburger Garten-Blumenzeitung 16: 439 (1860); *F. sibthorpiana* var. *fleischeri* Nyman, Consp. Fl. Eur.: 722 (1882).

**Type:** Turkey, B1 Yzmir: prope Smyrnem (Yzmir) in collibus argillosis sylvaticis, ii (1827) *D. Fleischer* s.n. (holo. M!, iso. CGE, E!, K) (Fig. 7-12).

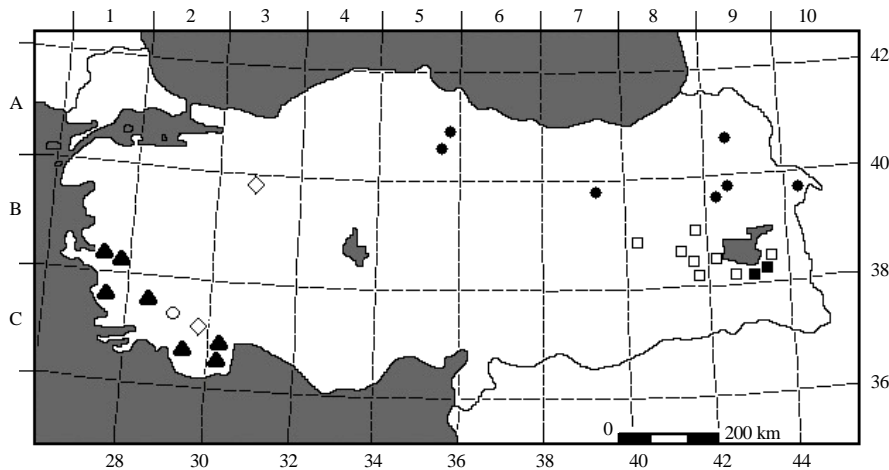


Fig. 13: Distribution in Turkey *Fritillaria carica* (▲), *F. byfieldii* (○), *F. serpenticola* (◇), *F. minima* (■), *F. minuta* (□) and *F. caucasica* (•)

Bulb subglobose, 0.6-1.2×0.9-1.5 cm, bulblet absent, tunica thin and papery. Stem erect, 4-17 cm, smooth. Leaves 5-11, sessile, glaucous, canaliculate. Lowest leaves 1.5-5.3×0.2-0.5 cm, alternate, opposite or subopposite, linear, obtuse. Median leaves 2.2-5.1×0.1-0.2 cm, alternate, rarely opposite, linear, obtuse. Bracts 1-3, 1.4-4.6×0.1 cm, linear, obtuse. Flowers 1-3. Perigon narrowly campanulate, tepals purplish-brown, green striped, glaucous. Outer segments 10-22×3.5-0.5 mm, ovate-lanceolate, oblanceolate, acute, ciliate-tufted at apex; inner segments 10-22×4-7 mm, ovate-lanceolate, oblanceolate, obtuse, ciliate-tufted at apex. Nectaries 2.5-4 ×1 mm, linear, green, at base of tepals. Filaments 7-11 mm, papillose, yellowish-green; anthers 2.5-5.5 mm, oblong or elliptic, apiculate, yellow, basifixed. Style 7-10 mm, undivided, smooth or sparsely papillose; stigma capitate; sometimes style exceeding perigon. Capsule 9-19×9-20 mm, obovoid-orbicular, orbicular, truncate at apex, cuneate at base, unwinged. Seeds 4-6×3-5.5 mm, flat, obovate, obovate-orbicular, testa brown, reticulate-faveolate. Fl: 2-5.

**Habitat:** Clay hills, stony steppe ve scrubs, 490-1000 m. Conservation status: NT (Near threatened).

**Specimens examined:** A3 Ankara: Beypazary, Cayrhan-Nallyhan, Davutoolan Village, 500-600 m, 30.03.2002, M. Teksen 2113 (GAZI); *ibid.*, 18.05.2001, M. Teksen 2096 (fr.) (GAZI); Beypazary, 5 km to Beypazary, 600-700 m, 01.05.93, Z. aytac 5703 (GAZI); Cayrhan-allyhan, Nallyhan Kus Cenneti, Tosunkayasy location, 510-650 m, 15.03.1998, E. dooan 1005 and H. duman, M.B. guner (GAZI); *ibid.*, 490-600 m, 05.04.1998, E. dooan 1034 (GAZI). B4 Ankara: Eryaman, 14.04.1996, Koyuncu and A. guvenc 19558 (AEF)-yncesu, 05.05.1942,

H. Baoda 740 (ANK); Dikmen, c. 1000 m, 23.04.1945, Baki Kasaplygil ISTF 5051 (ISTF).

**Distribution:** Endemic. Irano-Turanian element. *F. fleischeriana* is distinctively different from other species with glaucous, canaliculate linear leaves, thin campanulate perigon for 1 or 3 bracts, purplish-brown green striped glaucous tepals. With its morphological, palynological and cytological properties, *F. pinardii*, stated to be affiliated to *F. fleischeriana* in the Flora of Turkey, demonstrates characteristics between *F. stribrnyi* and *F. forbesii*. It is located between *F. stribrnyi* with thin filament with papilla, thin style with or without papilla and purplish-brown tepals and *F. forbesii* with linear leaves and wingless capsule. *F. carica* Rix, Kew Bull. 30 (1): 156 (1975) (Teksen and Aytac, 2011) (Fig. 13). *F. byfieldii* N. Ozhatay (2000) and Rix Fl. Turkey 11: 323.

**Type:** Turkey, C2 Denizli: N slopes Bozdao, Berberis scrub, subalpine limestone rocks, *Pinus nigra*, 28.05.1995, Ozhatay and al. Yter-Anat. 95/118, ISTE 70400 (holo. ISTE, iso. K) (Fig. 13 and 14).

Bulb globose or obovoid, 0.6-1.2×0.7-1.5 cm, tunica thin and papery. Stem erect, 3.5-18 cm, smooth. Leaves 2-6, sessile, glaucous. Lowest leaves 1.9-9.0×0.7-2 cm, subopposite or alternate, obovate, oblanceolate, ovate-lanceolate, ovate, acute. Median leaves 1.7-6.8×0.1-0.7 cm lanceolate, linear-lanceolate, acuminate. Bract 1, 1.6-5.7×0.1-0.2 cm, linear, acuminate. Flower 1: Perigon narrowly campanulate, outside greenish-yellow, inside yellow to orange-yellow, tepal veins prominent, dark when dried. Outer segments 10.5-22×3-7 mm, lanceolate, obtuse, ciliate-tufted at apex; inner segments 10.5-22×3-7 mm, ovate-lanceolate, obtuse, recurved, ciliate-tufted at apex. Nectaries 2-4×1 mm,

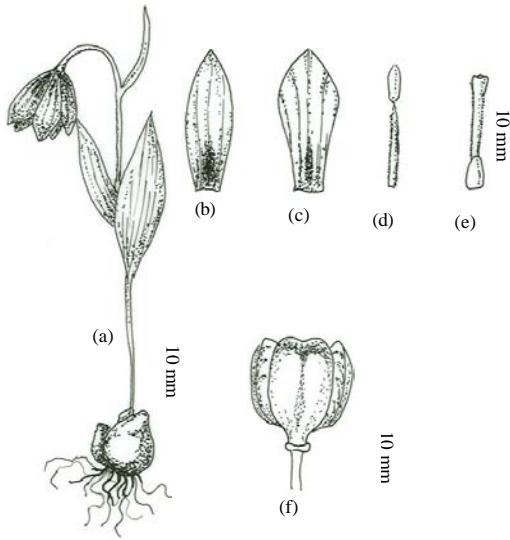


Fig. 14: *Fritillaria byfieldii*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

linear-lanceolate, brown-greenish, 1 mm above base of tepals. Filaments 7-9 mm, papillose, yellow; anthers 2-4 mm, oblong-elliptic, yellow, basifixed. Style 5.5-8 mm, 3-lobed, lobes 1 mm, densely papillose; stigma entire. Capsule 11-24×13-19 mm, obovoid, orbicular, truncate at apex, cuneate at base, unwinged. Seeds 4-7.5×3-6.5 mm, flat, obovate, testa shining, brown, faveolate. Fl: 4-6.

**Habitat:** Stony places, loose and mobile limestone screes, Pinus nigra forest, Berberis scrubs, 1500-1900 m. Conservation status: EN (Endangered) B2ab (iii).

**Specimens examined:** C2 Denizli: Acypayam, Kelekci, Olukbasy village, Geyran Plateau, N slopes of Bozdao, 37°14'55.3"N, 29°11'19.0"E, 1500-1700 m, 04.05.2003, M. Teksen 2171, 2172 (GAZI); ibid., 1600 m, 11.05.2002, M. Teksen 2137; ibid. 27.05.2003, M. Teksen 2201 (fr.) (GAZI).

**Distribution:** Endemic. East Mediterranean element. According to the Flora of Turkey, *F. byfieldii* is distinguished from other plants with its waxy greenish-yellow 2 (-3) leaves and its flowers going dark when dried. It is known in the Flora of Turkey that it is affiliated to *F. carica*. It is distinct from that species with its 2-3, 3 branched style and greenish-yellow flowers going dark when dried. It is distinct from *F. serpenticola* in that its leaves are not twisted and less in number (2-3 in *F. byfieldii* and 3-4 in *F. serpenticola*), wider and its stylus is thick. *Fritillaria serpenticola* (Rix) (Teksen and Aytac, 2011), Israel J. Pl. Sci. 52: 351 (2004) (Fig. 13). *Fritillaria minima* Rix, Notes Roy. Bot. Gard. Edinburgh 31: 127 (1971).

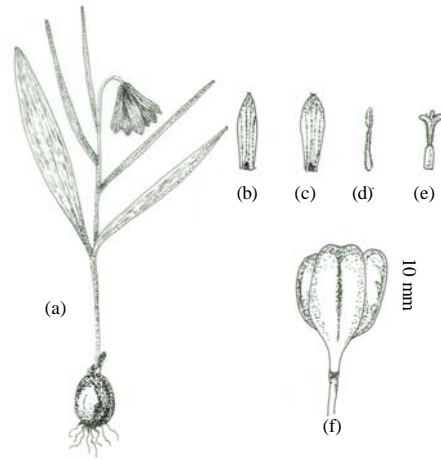


Fig. 15: *Fritillaria minima*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

**Type:** Turkey, B9 Van: Gevas, Artos Da., 2895 (as 3000) m, by melting snow, 16 vii 1954, Davis and Polunin 22795 (holo. E!, iso. BM, K) (Fig. 13-15).

Bulb globose or obovoid, 1.0-1.3×1.3-1.5 cm, usually many bulblets, tunica thin and papery. Stem erect, 4-16 cm, usually papillose below stem and on margins of leaf base. Leaves 4-8, sessile, shining green. Lowest leaves 5-10×0.5-5 cm, alternate or subopposite, lanceolate, acute or obtuse, papillose on margins to leaf base. Median leaves 4.4-8×0.3-0.5 cm, alternate or subopposite, linear, obtuse. Bract 1, 2.1-5.6×0.1-0.15 cm, linear, acuminate. Flowers 1-2. Perigon narrowly campanulate, yellow, fading to purplish-red. Outer segments 12-23×3-8 mm, lanceolate, obtuse, ciliate-tufted at apex; inner segments 12-23×3-8 mm, oblanceolate or lanceolate, obtuse, ciliate-tufted at apex. Nectaries 1×0.5-1 mm, ovate, yellowish-brown, brown at base of tepals. Filaments 6-11 mm, papillose, yellow; anthers 3-8 mm, elliptic, yellow, basifixed. Style 5-8 mm, 3-fid, branches 1-2 mm, recurved, papillose; stigma entire. Capsule 20-26×11-16 mm, obovoid-orbicular, truncate at apex, cuneate at base, unwinged. Seeds 3-6×3-6.5 mm, flat, obovate, testa pale brown, faveolate. Fl: 5-7.

**Habitat:** By late snow patches, alpine steppe, stony places, 2400-3300 m. Conservation status: EN B2a (iii).

**Specimens examined:** B9 Van: Bahcesaray, Yukary Narlyca village-Bahcesaray, 2400-2500 m, 15.05.2001, M. Eksen 2061, 2065 (GAZI); ibid., 07.07.2001, M. Eksen 2101 (fr.) (GAZI).

**Distribution:** Endemic. Irano-Turanian element. *F. minima* is distinct from other plants as it has bright green leaves, yellow perigon going purplish-red when faded,

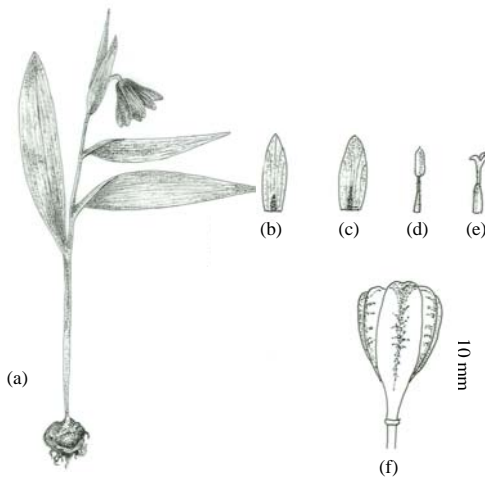


Fig. 16: *Fritillaria minuta*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

3 branched style. Its closest species is *F. minuta*. It is confused with *F. minima* which has reddish-brown perigon when its flowers fade. However, *F. minima* has a style with papilla and is easy to distinguish from *F. minuta* whose style lacks papilla. *Fritillaria minuta* Boiss and Noe in Boiss., Diagn. Ser. 2 (4): 104 (1859).

**Type:** Turkey, B9 Van: cum praecedenti (*F. kurdica*) in subalpinis Kurdistaniae, Noe s.n. (holo. G!, iso. LE) (Fig. 13-16). *F. carduchorum* Rix in Notes R.B.G. Edinb. 31:125, f. 1A (1971).

**Type:** B8 Bitlis: Kambos Mt., above Hurmuz, 2500 m, Davis 23464. Bulb globose or obovoid, 0.5-1.3×0.7-3 cm, many bulblets, tunica thin and papery. Stem erect, 7-20 cm, usually papillose below stem and around of lowest leaves. Leaves 3-10, sessile, shining green. Lowest leaves 5.2-11.2×0.5-3 cm, alternate or subopposite, lanceolate, linear-lanceolate, elliptic, acute or acuminate. Median leaves 4.8-10.1×0.3-1 cm alternate, lanceolate, linear-lanceolate, acute or acuminate. Bracts 1-3, 3.5-7.8×0.2-0.5 cm, opposite, linear, linear-lanceolate, acute or acuminate. Flowers 1-3: Perigon narrowly campanulate, purplish-yellow or reddish-brown, not tessellate, sometimes blotched. Outer segments 14-28×4-8 mm, lanceolate, acute, ciliate-tufted at apex; inner segments 14-28×4-8 mm, obtuse, ciliate-tufted at apex. Nectaries 1-4×1 mm, lanceolate, green at base of tepals. Filaments 6-10 mm, enlarged to base, smooth or papillose, yellow; anthers 3-10 mm, elliptic, oblong, yellow, basifixed. Style 4-10 mm, 3-fid, branches 2-5 mm, recurved, smooth; stigma entire. Capsule 32-36×15-22 mm, oblanceolate, oblong, truncate at apex, cuneate at base, unwinged. Seeds 4.5-6×3.5-5 mm, flat, obovate, testa pale brown, reticulate-faveolate. Fl: 4-8.

**Habitat:** Deciduous Quercus scrub by late snow patches, rocky and stony places, sandy open slopes, alpine steppe, 1800-3500 m.

**Specimens examined:** C9 Hakkari: Karadao, 3300 m, 16.08.1954, Davis and Polunin 24335 (ANK). C10 Hakkari: Yuksekova-Semdinli, Beyaz Mt., 1 km from Haruna pass 37°26'41"N, 44°27'53"E, 2200-2300 m, 19.04.2002, M. Teksen 2118 (GAZI); ibid., 27.05.2002, M. Teksen 2157 (fr.) (GAZI); ibid., 1900-2000 m, 17.05.2003, M. Teksen 2179 (GAZI). B9 Van: Erek Mt, above Deoirmenkoy, 38°30'148"N, 43°31'097"E, c. 2500 m, 26.05.2002, M. Teksen 2153 (fr.) (GAZI); Bahcesaray, Yukary Narlyca village-Bahcesaray, 2400-2500 m, 15.05.2001, M. Teksen 2062 (GAZI); Gevas-Tatvan, Gorundu-Altynsac village, 1700-1800 m, 15.05.2001, M. Teksen 2070 (GAZI); Bitlis: Kambos Mt., above Hurmuz, 2300 m, 31.06.1954, Davis and Polunin 23464 (ANK). B10 Bitlis: Tatvan, E of Nemrut Lake doosu, 2050-2150 m, 24.5.1972, A. taty 58 (KNYA).

**Distribution:** Turkey, Iran. Irano-Turanian element. *F. minuta* is easily distinguished with its bright green leaves and purplish-yellow or reddish-brown perigon. Its closest species is *F. minima*. *F. minuta* is different from this species as it has purplish-yellow or reddish-brown perigon, stylus without papilla and slightly longer body. These 2 species mostly live in different localities; *F. minima* is endemic and *F. minuta* is spread in Iran. *Fritillaria caucasica* Adam in F. Weber and D.M.H. Mohr (eds.), Beitr. Naturk. 1: 51 (1805).

**Synonyms:** *F. racemosa* Mill., Gard. Dict. ed. 8: 7 (1768), nom. rej.; *F. tulipifolia* M. Bieb., Fl. Taur.-Caucas. 1: 270 (1808); *F. parviflora* Mart., Hort. Reg. Monac. (1838); *Theresia tulipifolia* (M. Bieb.) Klatt, Hamburger Garten-Blumenzeitung 16: 438 (1860); *F. armena* var. *lucida* Hausskn. and Bormm., Mitth. Thüring. Bot. Vereins, n.s., 20:47 (1905); *F. lucida* (Hausskn. and Bormm.) Bormm., Repert. Spec. Nov. Regni Veg. 27: 345 (1930).

**Type:** USSR ad thermal constantinmontanas (in promontoris, caucasi borealis), Mussin-Puschkin s.n. (holo. LE, iso. BM) (Fig. 13-17).

Bulb globose or ovoid, 0.7-1.1×0.6-2.0 cm, tunica thin and papery. Stem erect, 7-20 cm, smooth. Leaves 2-4 (-6), sessile, alternate, glaucous. Lowest leaves 2.7-10×0.5-2 cm, ovaet-lanceolate to lanceolate, linear-lanceolate, elliptic-lanceolate, acute or obtuse. Median leaves 1.4-8.5×0.15-0.8 cm, linear, linear-lanceolate, acuminate. Bract 1, 1.0-6.0×0.15-4 cm, linear, linear-lanceolate, acuminate. Flower 1: Perigon narrowly

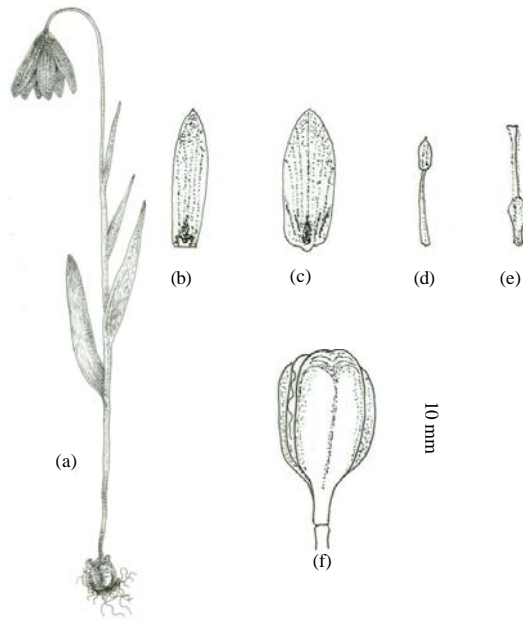


Fig. 17: *Fritillaria caucasica*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

campanulate, rounded, often constricted at mouth, reflexed at apex, outside and inside dark purplish-brown, sometimes inside greenish, outside usually glaucous. Outer segments 13-30 (-37)×4-12 mm, ovate, lanceolate, acute, ciliate-tufted at apex; inner segments 13-30 (-37)×6-14 mm, oblanceolate, obtuse, ciliate-tufted at apex. Nectaries 3-5×1 mm, linear-lanceolate, greenish at base of tepals. Filaments 6-18 mm, smooth or sparsely papillose, usually purple; anthers 3.5-8 mm, elliptic, yellow, purple before dehiscence, basifixed. Style 9-17 mm, smooth or sparsely papillose, purplish; stigma entire. Capsule 15-30×13-17 mm, obovoid, truncat at apex, cuneate at base, unwinged. Seeds 4-7.5×3-6.5 mm, flat, obovate, testa brown, faveolate. Fl: 4-6.

**Habitat:** Alpine steppe, meadows, clearings in coniferous forest, rocky slopes, grassy places by late snow patches, 1700-2900 m.

**Specimens examined:** A5 Amasya: Galatia, Maniss. 1150 (ANK). A9 Kars: Arpacay, K. Kale village, Karayatak location, c. 1900 m, 12.04.1984, *H. ocakverdi* 2694/1682 (GAZI); Sarykamys, 1.5 km SW of Sarykamys, 2200 m, 21.05.1968, *E. ozhatay* ISTF 23143 (ISTF); Sarykamys, Sarykamys-Karakurt, 3-4 km from Karakurt, 2150 m, 01.06.1968, *E. ozhatay* ISTF 23245 (ISTF). B7 Erzincan: Erzincan-Refahiye, Alacatly village, Kutlutepe location, 2100-2300 m, 25.05.2002, M. Teksen 2142 (fr.) (GAZI). B8

Erzurum: Palandoken Mt., N. slopes of Sultan hill, 2300 m, 24.04.1970, *S. ozyurt* and *M. balta* ATA 846 (ISTF). The B9 Aory: Tahir, Tahir Mt., around the radar sitation, 2500 m, 16.05.2001, M. Teksen 2075 (GAZI); Bitlis: Adilcevaz, Suphan Mt., Sute Plateau, 2000 m, 04.06.1993, Y. Altan 4801 (GAZI). B10 Van: Ozalp, Yukary, Tolgaly village-Iran border, Kyraçtepe location, 38°46'007"N, 44°16'419"E, 2200-2500 m, 26.05.2002, M. Teksen 2155 (GAZI); *ibid.*, 01.06.1997, 2100 m. *F. ozgovce* 3039 (GAZI).

**Distribution:** Turkey, S. Russia, Caucasia, Iran. Hyrcano-Euxine (mt.) element. *F. caucasica* is distinct from other plants as it has narrow campanulated perigon, round, narrowing on mount, tips curling backwards, purplish-brown on the inside and outside, sometimes greenish on the outside and generally glaucous tepal colour on the outside, generally purple filament and style. *Fritillaria baskilensis* Behçet, Bull. Pure Appl. Sci., Modinagar, B 17: 35 (1998).

**Type:** Turkey, B7 Elazyo: Baskil, Yukary Kulusagi village, Selil mountain, Yukary mahalle, 1300 m, stony places, 22.04.1997, Behçet 5540 (holo. VANF!, iso. GAZI!) (Fig. 18 and 19).

Bulb subglobose, globose, ovoid, 0.5-1.5×0.7-1.4 cm, bulblets 1 or many; tunica thin and papery. Stem erect, 4-12 cm, smooth. Leaves 3-5, sessile, glaucous. Lowest leaves 2.2-5.6×0.4-1.5 cm, subopposite, narrowly lanceolate, acute. Median leaves 1.4-3.5×0.15-0.9 cm, alternate, linear, narrowly lanceolate, acuminate. Bract 1, 1.1-2×0.1-0.3 cm, linear, linear-lanceolate, acuminate. Flowers 1-2. Perigon narrowly campanulate, outside and inside dark purple and glaucous. Outer segments 7-15×2-5 mm, ovate to lanceolate, acute, ciliate-tufted at apex; inner segments 7-15×2-4 mm, lanceolate, obtuse, ciliate-tufted at apex. Nectaries 1.5-6×0.5-1.5 mm, linear-lanceolate, green, 1 mm above tepal base. Filaments 9-16 mm, slender, enlarged to base, papillose, usually yellow, sometimes greenish-purple; anthers 2-4 mm, oblong, apiculate, purple, basifixed. Style 9-17 mm, undivided, smooth or sparsely papillose; stigma entire. Capsule 11-15×11-15 mm, obovoid-oblong, truncate at apex, cuneate at base, not winged. Seeds 3-5×3-4 mm, flat, obovate, obovate-orbicular, testa pale brown, reticulate-faveolate. Fl: 4-6.

**Habitat:** Rocky hillsides, stony places, 1300-1500 m. Conservation status: CR (Critically endangered) B1b (iii, iv).

**Specimens examined:** B7 Elazyo: Baskil, Yukary Kulusaoy village, Selil Mt., Yukary mahalle, 1300 m, 22.04.1997,



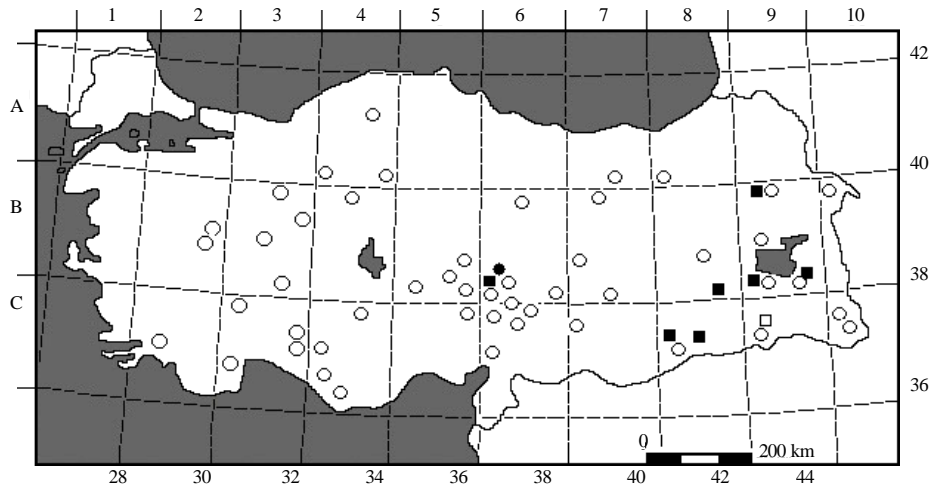


Fig. 18: Distribution in Turkey *Fritillaria baskilensis* (●), *F. pinardii* (○), *F. assyriaca* subsp. *assyriaca* (■) and *F. uva-vulpis* (□)

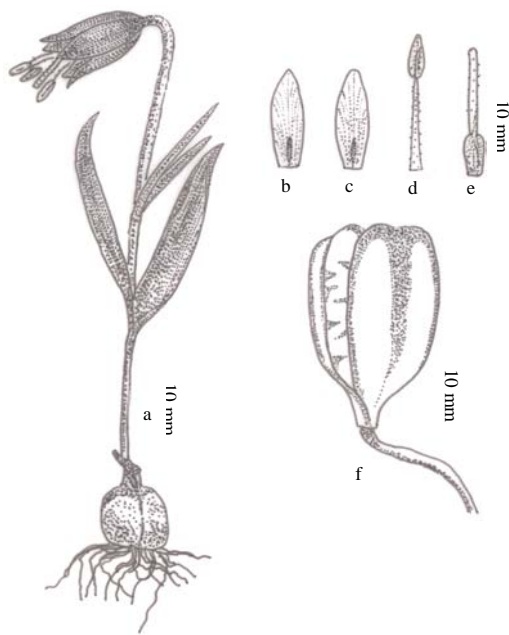


Fig. 19: *Fritillaria baskilensis*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

Behcet 5540 (GAZI); *ibid.*, 1500 m, 11.05.2001, M. Teksen 2051 (fr.) (GAZI); *ibid.*, 04.05.2002, M. Teksen 2130 (fr.) (GAZI); *ibid.*, 19.04.2003, M. Teksen 2167 (GAZI).

**Distribution:** Endemic. Irano-Turanian element. *F. baskilensis* is distinctly distinguished from other plants with its anther and style outside perigon. *Fritillaria pinardii* Boiss., *Diagn. ser. 1* (7): 106 (1846) (Teksen and Aytac, 2011) (Fig. 18). *Fritillaria assyriaca* Baker, *J. Linn. Soc., Bot.* 14: 265 (1874). subsp. *assyriaca*.

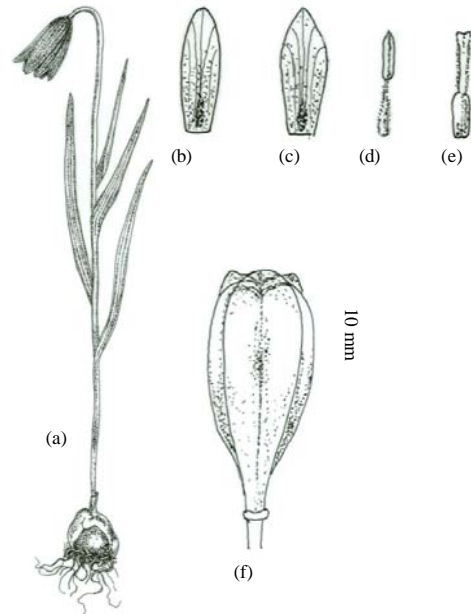


Fig. 20: *Fritillaria assyriaca* subsp. *assyriaca*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

**Synonyms:** *F. canaliculata* Baker, *Gard. Chron.*, 3, 7: 288 (1890); *F. viridis* Hort ex Besant, *Gard. Chron.*, 3, 87: 432 (1930).

**Type:** Turkey, C8 Mardin: Assyria in dumetis supra Terek (Derik), 1867, Haussknecht 932 (holo. K, iso. BM!) (Fig. 18-20).

Bulb globose or obovoid, 0.5-2×0.6-3 cm, united 2-kidney form, usually with stolons or few or many bulblets; tunica thin and papery. Stem erect, 3-25 cm,



elongating to c. About 35 cm in fruit, smooth or usually papillose below. Leaves 3-6 (-12), sessile, canaliculate, glaucous. Lowest leaves 1.6-11.2×0.2-1.9 cm, alternate or subopposite, linear, linear-lanceolate, acute or acuminate. Median leaves 1.7-9.5×0.1-0.7 cm, alternate, linear, acuminate. Bracts 1 (-3), 1.2-6.3×0.1-0.2 cm, opposite, linear, acuminate. Flowers 1-2 (-5). Perigon narrowly campanulate, outside purplish-brown, inside yellowish or greenish or outside and inside purple, green striped. Outer segments 11-25×3-7 mm, lanceolate or linear-lanceolate, acute or obtuse, ciliate-tufted at apex; inner segments 11-25×2.5-9 mm, oblanceolate, acute or obtuse, ciliate-tufted at apex. Nectaries 2-5×1 mm, linear-lanceolate, green, 1 mm above tepal base. Filaments 5-11 mm, papillose, papilla decreased toward base, yellow; anthers 2.5-7 mm, elliptic, yellow or blackish-purple, basifixed. Style 5-10 mm×1.5-2 mm, undivided or 3-lobed, lobes 0.5-1 mm, papillose; stigma clavate. Capsule 11-38×11-17 mm, obovoid, truncate at apex, cuneate at base not winged. Seeds 4-7.5×3-6.5 mm, flat, obovate, testa pale brown, faveolate. Fl: 3-5.

**Habitat:** Alpine steppe, rocky places, cultivated fields, deciduous Quercus scrubs, 1100-2500 m.

**Specimens examined:** B9 Van: Ereğ Mt., above Deoimenkoy, 38°30'148"N, 43°31'097"E, 2500 m, 27.04.2002, M. Teksen 2124 (GAZI); *ibid.*, 26.05.2002, M. Teksen 2150 (fr.) (GAZI); *ibid.*, 17.05.2003, M. Teksen 2191 (fr.) (GAZI).

**Distribution:** Turkey, Iran, Iraq. Irano-Turanian element. *F. assyriaca* is different with its linear canaliculate leaves, purple and green or purple flowers, clavate stigma. *F. assyriaca* subsp. *assyriaca* is morphologically different from subsp. *melananthera* with 5 mm wider and obtuse tepals (inner tepals acute and thinner than 5 mm in subsp. *melananthera*), purple and yellow inside (purple perigon with green stripes and blackish inside in subsp. *melananthera*) and yellow anthers (purple in subsp. *melananthera*). While subsp. *melananthera* is spread in Icel and Karaman provinces at 0-700 m, subsp. *assyriaca* is spread in Mardin, Bitlis, Siirt, Malatya, Arı and Van provinces in Easter Anatolia Region at 1100-2500 m. *F. uva-vulpis* Rix, Kew Bull. 29: 651 (1975).

**Synonym:** *F. assyriaca* sensu Turill in Hook. Ic. Pl. 39: 157, t. 3831 (1980) non Baker in J. Linn. Soc. (Bot.) 14: 265 (1874).

**Type:** Iraq, Rowanduz: Haji Omran in cultivated ground and cornfields, 2100 m, 14 iv 1958, *O. Polunin* 5059 (holo. E, iso. K) (Fig. 18-21).

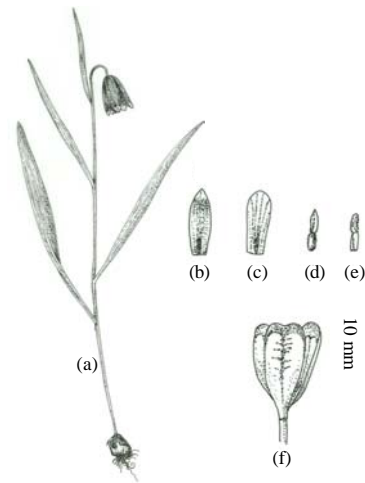


Fig. 21: *Fritillaria uva-vulpis*: a) Habit; b) Outer tepals; c) Inner tepals; d) Stamen; e) Pistil; f) Capsule

Bulb globose or ovoid, 0.6-1.6×0.9-3.0 cm, 2-5 bulblets; tunica thin and papery. Stem erect, 8-20 cm, smooth. Leaves 3-5, sessile, alternate, shining green. Lowest leaves 8-16×0.9-2.0 cm, linear-lanceolate, lanceolate, acute. Median leaves 7.0-9.5×0.4-0.65 cm, linear-lanceolate, acuminate. Bract 1, 4.6-5.6×0.2 cm, linear, acuminate. Flower 1: Perigon narrowly campanulate, usually rounded, outside purplish-grey, yellow at tepal apex, glaucous, inside yellowish. Outer segments 14-28×4-7 mm, ovate, ovate-lanceolate, lanceolate, acute or obtuse, ciliate-tufted at apex; inner segments 14-28×5-12 mm, obovate, obtuse, ciliate-tufted at apex. Nectaries 4-5×1-1.3 mm, lanceolate, brown, 1 mm above tepal base. Filaments 5-9 mm, papillose, swollen, greenish-yellow; anthers 4-7 mm, oblong, yellow, basifixed. Style 5-7 mm×3-4 mm, papillose; stigma entire. Capsule 23-28×12-14 mm, narrowly obovoid, orbicular, truncate at apex, cuneate at base, not winged. Seeds 4-5.5×3-4.5 mm, flat, obovate, testa pale brown, faveolate. Fl: 3-4 (-7). Habitat: Cultivated fields, grassy places, 900-2100 m.

**Specimens examined:** C9 Sürmene: Center, Cumhuriyet district, 37°32'114"N, 42°27'391"E, 2100 m, 19.04.2002, M. Teksen 2116 (GAZI); *ibid.*, 27.05.2002, M. Teksen 2159 (fr.) (GAZI).

**Distribution:** Turkey, Iran, Iraq. Irano-Turanian element. *F. uva-vulpis* is distinct from other plants with its bright green leaves, narrow campanulated perigon, generally round, purplish-grey outside, glaucous, tepal tips yellow, yellow inside, swollen filament, style as wide as 4 mm diameter. This species was known from only one locality

in Turkey and one from Iran but it has recently been discovered that it also grows in Western Iran. It is also known in a few localities in Iraq. It was stated by Rix that this species could be confused with *F. assyriaca* but it is easy to differentiate in live samples. While *F. assyriaca* has narrow waxy canaliculate leaves, perigon widening in mouth, *F. uva-vulpis* has wider and brighter leaves, perigon narrowing in mouth and round. Also, the flower colour is purplish-grey in *F. uva-vulpis* with yellow tepal tips but *F. assyriaca* has purplish-brown or purple green striped.

### CONCLUSION

Researchers have come to the following conclusions from the morphological studies on a wide range of herbarium material from a number of herbaria and from material collected in the wild. Conclusions and comments on each species were given under the descriptions of the species.

The previous study (Teksen and Aytac, 2011) included descriptions, distributions and drawings of 23

taxa spread in the Mediterranean region. According to the Flora of Turkey, there are 22 taxa expect those in the Mediterranean Region but Teksen and Aytac (2001) accepted that *F. armena* and *F. zagrica* spread in the Eastern Anatolia are synonyms of *F. pinardii*. Therefore, there are 22 species and 2 subspecies in this study. Also, because *F. imperialis*, *F. persica*, *F. aurea*, *F. crassifolia* subsp. *crassifolia*, *F. bithynica*, *F. serpenticola* and *F. pinardii* are spread apart from the Mediterranean region, they are given in the diagnosis key. 9 of these taxa are endemic, 7 of 16 Irano-Turanian taxa are endemic, 2 of 4 taxon is East Mediterranean and endemic, 1 taxon is Euro-Siberian, 2 taxon is Euxine and 1 taxon in a Hyrcano-Euxine element. As a result, there are 35 species and 6 subspecies, a total of 35 taxa, 18 of which are endemic. The endemism rate of the genus is 44%.

The descriptions of the species were extended according to the data acquired for this study and the deficiencies in the Flora of Turkey are completed. These differences are given in Table 1.

Table 1: Comparison of the descriptions provided by Rix (1984) and in the present study for the species of *Fritillaria*

Species	The characteristics in the Flora of Turkey	The finding at the end of this study
<i>F. latifolia</i>	Lowest leaves 3.5-8×0.7-2.5 cm Outer segments 35-50×10-15 mm Inner segments width 15-20 mm	3.5-9×0.5-2.5 cm 35-54×10-20 mm 35-54×12-20 mm
<i>F. pontica</i>	Stem 15-45 cm Lowest leaves 5-11×0.3-1.0 cm Bracts 3 Outer segments 24-45×8-10 mm Inner segments width 10-15 mm Filaments 12-15 mm Style 12-15 mm Style brances 5-7 mm	12-45 cm 3.7-11×0.3-3.2 cm 2-4 22-45×7-16 mm 8-20 mm 9-12 mm 9-15 mm 3-7 mm
<i>F. crassifolia</i>	Stem 3-10 cm Leaves 4-8 Tepals 15-28 mm Filaments 5-9 mm Style 5-8 mm Style brances 2-4 mm	2.5-15 cm 3-7 (-10) 12-28 mm 5-10 mm 5-13 mm 1-6 mm
<i>F. michailovskyi</i>	Stem 6-24 cm Leaves 5-9 Lowest leaves 5-9×1.0-1.5 cm Perigon purplish-brown, sometimes outside greenish Outer segments 20-32×9-10 mm Inner segments width 10-15 mm Nectaries 10-13×1-2 mm Style 7-9 mm Style brances 2-3 mm	4-24 cm 4-16 2.9-10×0.4-1.5 cm Purplish-brown, sometimes outside greenish, rarely yellow 16-32×5-10 mm 6-15 mm 8-13×1-2 mm 6-10 mm 1.5-3 mm
<i>F. straussii</i>	Stem c. 10 cm Leaves 5-10 Lowest leaves 4-8×1-3.5 cm Flowers 1-2 Outer segments 25-27×8-9 mm Nectaries 10×2 mm Filaments c. 10 mm Style 8 mm Style brances up to 4 mm	8-20 cm 5-24 4-12.5×1-3.5 cm 1-6 20-27×7-9 mm 8-12×1-2 mm 6-10 mm 6-8 mm 3-5 mm
<i>F. alburyana</i>	Stem 4-10 cm Leaves 3-4	3-10 cm 3-9

Table 1: Continue

Species	The characteristics in the Flora of Turkey	The finding at the end of this study
<i>F. stribrnyi</i>	Lowest leaves 5-8×1-2.5 cm	3.9-9×0.8-2.5 cm
	Outer segments 20-30×5-15 mm	17-32×5-15 mm
	Inner segments width 5-15 mm	6-15 mm
	Nectaries 1 mm	1-2×1-2 mm
	Style 9-15 mm	7.5-15 mm
	Lowest leaves 4-10×0.5-2 cm	2.8-10×0.45-2 cm
	Bracts 3	1-3
	Outer segments 20-28×4-6 mm	17-29×4-6 mm
	Inner segments 7-11 mm	5-11 mm
	Nectaries 2×1 mm	2-4×1-1.5 mm
<i>F. fleischeriana</i>	Style 10 mm	7.5-10 mm
	Stem 6-15 cm	4-17 cm
	Lowest leaves 1.5-3.5×0.3-0.5 cm	1.5-5.3×0.2-0.5 cm
	Outer segments 13-19×0.5 mm	10-22×3.5-0.5 mm
	Inner segments width 7 mm	4-7 mm
	Nectaries 3 mm	2.5-4×1 mm
	Filaments 8-11 mm	7-11 mm
	Style 8-9 mm	7-10 mm
	Stem c. 13 cm	3.5-18 cm
	Leaves 2- (3)	3-6
<i>F. byfieldii</i>	Lowest leaves 3-4.5×1.5-2 cm	1.9-9.0×0.7-2 cm
	Outer segments to c. 20×6 mm	10.5-22×3-7 mm
	Inner segments width 7 mm	3-7 mm
	Nectaries 4×1 mm	2-4×1 mm
	Filaments c. 7 mm	7-9 mm
	Style c. 8 mm	5.5-8 mm
	Stem 4-8 cm	4-16 cm
	Leaves 4-7	4-8
	Lowest leaves 5-9×0.6-1.5 cm	5-10×0.5-1.5 cm
	Outer segments 13-20×3-8 mm	12-23×3-8 mm
<i>F. minima</i>	Nectaries 1×0.5 mm	1×0.5-1 mm
	Style brances 2 mm	1-2 mm
	Stem 10-20 cm	7-20 cm
	Leaves 4-10	3-10
	Lowest leaves 7-10×1-3 cm	5.2-11.2×0.5-3 cm
	Outer segments 16-22×c. 7 mm	14-28×4-8 mm
	Inner segments width c. 8 mm	4-8 mm
	Nectaries 2-4×1 mm	1-4×1 mm
	Style 4-7 mm	4-10 mm
	Style brances 2-4 mm	2-5 mm
<i>F. caucasica</i>	Stem 10-20 cm	7-20 cm
	Lowest leaves 3-10×0.8-2 cm	2.7-10×0.5-2 cm
	Outer segments 22-30 (-37)×5-12 mm	13-30 (-37)×4-12 mm
	Nectaries 4-5×1 mm	3-5×1 mm
	Filaments 10-18 mm	6-18 mm
	Stem 4-20 cm	3-25 cm
	Leaves 4-6 (-12)	3-6 (-12)
	Lowest leaves 3-9×0.3-1.9 cm	1.6-11.2×0.2-1.9 cm
	Tepals 12-25 mm	11-25 mm
	Nectaries 2-4×1 mm	2-5×1 mm
<i>F. uva-vulpis</i>	Stem 10-20 cm	8-20 cm
	Lowest leaves 8-12×1-2 cm	8-16×0.9-2 cm
	Outer segments 20-28×6-7 mm	14-28×4-7 mm
	Inner segments 6-12 mm	5-12 mm
	Nectaries 4×1.3 mm	4-5×1-1.3 mm
	Filaments 6-9 mm	5-9 mm
	Style 3-4 mm diam.	1-4 mm

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