

The revision of the genus *Fritillaria* L. (Liliaceae) in the Mediterranean region (Turkey)

Mehtap TEKŞEN^{1*}, Zeki AYTAÇ²

¹Aksaray University, Faculty of Arts and Science, Department of Biology, Aksaray - TURKEY

²Gazi University, Faculty of Arts and Science, Department of Biology, 06500, Teknikokullar, Ankara - TURKEY

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Abstract: This paper presents a systematic revision of *Fritillaria* L. (Liliaceae) in the Mediterranean region of Turkey. The genus used to contain 22 taxa in the Mediterranean region, but in this study it has been evaluated on the basis of 23 taxa. We concluded that *F. armena* Boiss. and *F. zagrica* Stapf are synonyms of *F. pinardii* Boiss. Phylogenetic orders of *F. forbesii* Rix and *F. kittaniae* Sorger in the *Flora of Turkey* were changed. *F. crassifolia* Boiss. & Huet. subsp. *crassifolia* was suggested as an Irano-Turanian element. Red list categories of endemic taxa of Mediterranean *Fritillaria* were revised according to IUCN Red List Categories.

Key words: Turkey, revision, Mediterranean, *Fritillaria*

Akdeniz bölgesi (Türkiye) *Fritillaria* L. (Liliaceae) cinsinin revizyonu

Özet: Bu çalışmada, Türkiye'nin Akdeniz bölgesinde dağılım gösteren *Fritillaria* L. (Liliaceae) türlerinin revizyonu yapılmıştır. Türkiye Florasına göre Akdeniz bölgesinde tür ve tür altı seviyede 22 taksonla temsil edilen *Fritillaria* cinsi üyeleri bu çalışmada 23 takson altında değerlendirilmiştir. *F. armena* Boiss. ve *F. zagrica* Stapf türlerinin *F. pinardii* Boiss. türünün sinonimleri olduğu tespit edilmiştir. *F. forbesii* Rix ve *F. kittaniae* Sorger türlerinin Türkiye Florasındaki filogenetik sırası değiştirilmiştir. *F. crassifolia* Boiss. & Huet. subsp. *crassifolia* alttürü İran-Turan fitocoğrafik bölge elementi olarak önerilmiştir. Akdeniz bölgesindeki endemik *Fritillaria* taksonlarının tehlike kategorileri IUCN Kategorilerine göre yeniden düzenlenmiştir.

Anahtar sözcükler: Türkiye, revizyon, Akdeniz, *Fritillaria*

Introduction

The species of the *Fritillaria* genus are distributed especially in the Mediterranean regions and eastern parts of Anatolia and Thrace, the Black Sea, and Central Anatolia in Turkey, and in Iran, Iraq,

Afghanistan, Russia, Syria, Lebanon, Palaestina, Jordan, Pakistan, China, Japan, Greece, Bulgaria, Italy, Spain, Portugal, North Africa, and California and Oregon in the USA (Jordanov, 1964; Lozina-Lozinskaya, 1968; Heywood, 1978; Tutin, 1980; Pignatti, 1982; Rix, 1984, 2001; Townsend, 1985;

* E-mail: m_teksen@yahoo.com

Meikle, 1985; Feinbrun-Dothan, 1986; Rechinger, 1990; Özhatay, 2000; Xinqi & Mordak, 2000; Wallis & Wallis, 2003; Özhatay & Kültür, 2006; Tekşen & Aytaç, 2004, 2008; Özhatay et al., 2009).

The species of the genus *Fritillaria* were first described in 1753, as *F. imperialis* L., *F. persica* L., *F. pyrenaica* L., and *F. meleagris* L. (Linnaeus, 1753, 1754).

Fritillaria is represented worldwide by 7 subgenera, 2 sections, and 165 taxa (Rix, 2001). The *Flora of Turkey*, Volume 8 and Volume 11, recognised 41 taxa within Turkey, 19 of which were considered endemic. Eighteen species and 4 subspecies are distributed in the Mediterranean region (Muğla, Antalya, İçel, Adana, Osmaniye, Hatay, Kahramanmaraş, and Gaziantep), 12 of which are endemic.

In this revision, detailed descriptions of the species of *Fritillaria*, illustrations of taxa, and distribution maps according to Davis's (Davis, 1964-1985) grid system were prepared. Keys are given for identification of the species in the flowering and fruiting stages of development.

Materials and methods

Research materials of the genus *Fritillaria* were collected from different parts of Turkey in February-July, both in the flowering and fruiting period, between 1998 and 2003. Specimens were collected from as many different parts of the existing distribution area of the genus as possible in order to study the variation patterns. The study area included Muğla, Antalya, İçel, Adana, Osmaniye, Hatay, Kahramanmaraş, and Gaziantep provinces. 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 were examined. The author's name of every species was written according to *Authors of Plant Names* (Brummitt & Powell, 2001).

A range of characteristics that were considered to be taxonomically important in the genus was investigated. These include the following: leaf number, measurements, and colour; inflorescence and flower colour; style shape of the apex and

structure, filament structure, anther colour, 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 a stereozoom microscope.

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

The abbreviations used in text: CR: Critically endangered, EN: Endangered, VU: Vulnerable, LC: Least concern, Fl.: Flowering time, fl.: flower specimen, fr.: fruit specimen.

Taxonomy

Fritillaria L. Sp. Pl. 303 (1753).

= *Petilium* L., = *Corona* Fisch et R.Grah, = *Imperialis* Adans, = *Amblirion* Rafin., = *Theresia* K.Koch, = *Rhinopetalum* Fisch., = *Sarana* Fisch., = *Liliorhiza* Kellogg, = *Monocodon* Salisb., = *Lyperia* Salisb., = *Eucrinium* Nuttall, = *Tozzettia* Parl, = *Korolkovia* Regel.

Bulbous, perennial. Bulb, globose, subglobose, ovoid, obovoid, spindle-shape, rarely united-2 reniform; with few tightly packed scales and thin, transparent tunic that usually disappears with increase in size. Basal leaves 1, dry before stem formed or rarely inflorescence. Stem erect; simple; leafy; with papillae at base and around lowest leaf or smooth. Leaves verticillate, opposite or alternate; bracts mostly 1-4 or more. Flowers 1-3 or inflorescence in umbels or raceme, nodding. Perigon broadly or narrowly campanulate, conic or saucer-shape; tepals one colour or tessellated and sometimes with a longitudinal stripe. Nectaries conspicuous, at base or at point of inflection of tepals. Filaments basifixed, with papillae or smooth; anthers yellow or purple. Style undivided, 3-fid or 3-lobed; with papillae or smooth; caducous; stigma entire or clavate. Fruit locoloid capsule, capsule erect, oblong, ovate, obovate, ovate-lanceolate, cuneate at base, sometimes stalked, truncate at apex, sometimes with 6 longitudinal wings. Seeds many, arranged with 2 lines in each septum, flat, orbicular to ovate; testa pale to dark brown, reticulate-faveolate or faveolate.

Key to the Turkish species of 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 umbella, perigon 40-55 mm, orange to red rarely yellow.....1. *F. imperialis*
- 2 - Leaves glaucous; inflorescence raceme; perigon 15-20 mm, purple.....2. *F. persica*
- 1 - Bulb up to 3 cm diam.; leaves 2-14; flower terminal, 1-4 (5)
- 3 - Perigon glaucous outside, yellowish-green inside, not tessellated; capsule winged
- 4 - Leaves green; style 2-4 mm diam., papillose8. *F. alfredae*
- 4 - Leaves glaucous; style 0.5-1 mm diam., smooth.....9. *F. bithynica*
- 3 - Perigon yellow, purple, tessellated, with stripe or blotch; capsule unwinged
- 5 - Perigon tessellated or with blotch
- 6 - Nectary linear, at least 5× as long as broad.....7. *F. crassifolia*
- 6 - Nectary ovate, ovate-lanceolate, ovate-oblong, rhomboid, 2× as long as broad
- 7 - Style papillose.....6. *F. hermonis*
- 7 - Style smooth
- 8 - Perigon yellow, slightly tessellated.....3. *F. aurea*
- 8 - Perigon green, tessellated or with blotch
- 9 - Stem smooth; leaves glaucous.....4. *F. acmopetala*
- 9 - Stem papillose; leaves shining green.....5. *F. whittallii*
- 5 - Perigon with striped or concolorous, not tessellated
- 10 - Perigon yellow, canary yellow, greenish-yellow
- 11 - Nectary brown
- 12 - Upper leaves twisted; perigon conic; filament smooth.....15. *F. serpenticola*
- 12 - Upper leaves not twisted; perigon campanulate; filament papillose.....14. *F. carica*
- 11 - Nectary green
- 13 - Leaves linear, linear-lanceolate
- 14 - Leaves green; perigon canary yellow; style undivided; stigma clavate.....11. *F. forbesii*
- 14 - Leaves glaucous; perigon greenish-yellow; style 3-fid, branches 1-2 mm; stigma entire
.....12. *F. mughlae*
- 13 - Leaves ovate-lanceolate, oblanceolate, elliptic-ovate, narrowly elliptic-lanceolate
- 15 - Style undivided13. *F. sibthorpiana*
- 15 - Style 3-fid.....16. *F. pinardii*
- 10 - Perigon purple, with green striped or purple with yellow apex or completely purple
- 16 - Style smooth
- 17 - Style undivided.....10. *F. milasense*
- 17 - Style 3-fid.....20. *F. latakiensis*
- 16 - Style papillose
- 18 - Style undivided; stigma clavate.....18. *F. assyriaca*
- 18 - Style 3-fid; stigma entire
- 19 - Perigon with green striped
- 20 - Leaves 4-10, linear, canaliculate19. *F. elwesii*
- 20 - Leaves 2-5, lanceolate, narrowly lanceolate, elliptic, not canaliculate....17. *F. kittaniae*
- 19 - Perigon sometimes yellow at apex, without green striped.....16. *F. pinardii*

1. *Fritillaria imperialis* L., Sp. Pl. 303 (1753).

Type: Described from cultivated material. In Persia? e Constantinopoli venit in Europam c. 1570 (Hb. Linn. 421 / 1, photo!) (Figures 1-2).

= *Imperialis canosa* Moench, Meth. 395.

= *Petilium imperiale* Jaume St.-Hil. Familles, i. 120.

= *F. aintabensis* Post in Bull. Herb. Boiss. 3. 164 (1895).

Type: C6 Gaziantep: nr. Aintab (Gaziantep), G. Post. s.n.

= *F. corona-imperialis* Gaertn. Fruct. i. 64, t. 17.

Bulb ovoid, 2-8 × 2.5-8 cm, tunica thin and papery. Stem erect, 30-100 cm, smooth. Leaves 22-50, sessile, shining green. Lowest leaves 7-18 × 5-10 cm, verticillaster, lanceolate, ovate, ovate-lanceolate, acute. Median leaves 12-18 × 2-5.1 cm, verticillaster, lanceolate, ovate-lanceolate, acute. Bract 10-23, 6-12 × 0.5-2.5 cm, foliaceous, verticillaster, below tuft of flowers, lanceolate, linear, acuminate. Flowers 1-15. Perigon broadly campanulate, orange to red, inner yellowish-orange, tepals brownish-black at base. Outer segments 35-70 × 13-17 mm, lanceolate, oblanceolate, acute, ciliate-tufted at apex; inner segments 35-70 × 13-24 mm, oblanceolate, lanceolate, acute, ciliate-tufted at apex. Nectaries 5 mm diam., circular, white, at base of tepals. Filaments 25-50 mm, smooth, yellow, enlarged to base; anthers 10-17 mm, oblong,

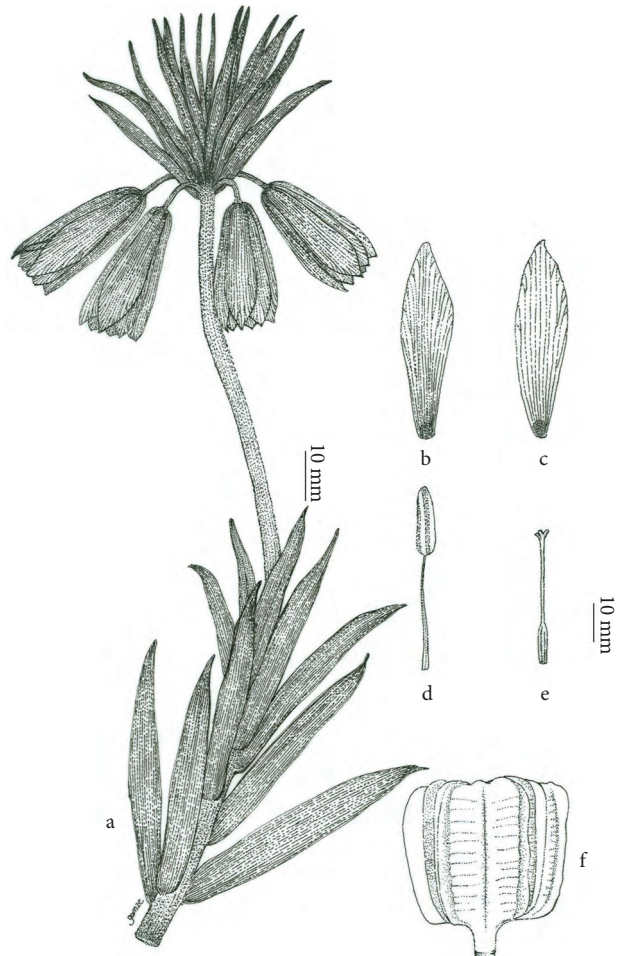


Figure 1. *Fritillaria imperialis*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

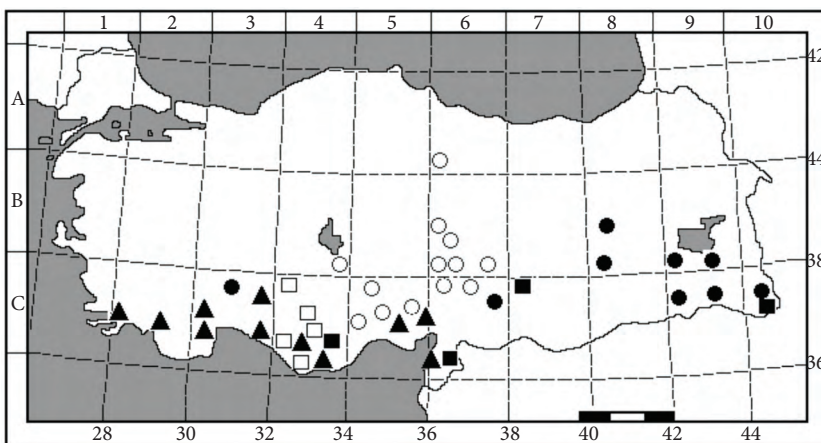


Figure 2. Distribution in Turkey of *Fritillaria imperialis* (●), *F. persica* (■), and *F. aurea* (○).

yellow, basifixed. Style 24-50 mm, 3-fid, branches 1-7 mm, smooth; stigma entire. Capsule 20-40 × 30-46 mm, oblong, ovoid, ellipsoid, 6-winged, wings 2-7.5 mm. Seeds 8-15 × 5-9 mm, flat, elliptic, oblong, oblanceolate, testa brown, reticulate-faveolate.

Fl: 3-5.

Habitat: Edge of fields, rocky slopes, stony places, scrub, 1000-2400 m.

Specimens examined: **B8** Muş: Çizmeburun, 1500 m, 14.4.1998, *Ekim* 7039 (GAZI); Siirt: Sason, cemetery of Seyhan (Erdemli) village, c. 1000 m, 29.III.1978, *A.Güner* 1628 (HUB). **C3** Isparta: Eğridir, Yukarı Gökdere, Küçük Kasnaklı, 1470 m, 22.06.1969, *Gökşin* (ISTO). **C9** Şırnak: 7 km from Eruh to Şırnak, 1700-1800 m, 12.05.2001, *M.Tekşen* 2052 (fl.) (GAZI); Hakkari: Sümbül Mt. (Mountain), 2400-2500 m, 12.05.2001, *M.Tekşen* 2054 (fl.) (GAZI). **C10** Hakkari: Yüksekova to Şemdinli, between Dara and Uzunsirt village, cemetery of Dara village, c. 2000 m, 13.05.2001, *M.Tekşen* 2053 (fl.) (GAZI); *ibid.*, 08.07.2001, *M.Tekşen* 2103 (fr.) (GAZI); Yüksekova-Şemdinli, Karabey to Korgan, Beyaz Mt, 1-2 km S. of Haruna pass, 37°26'417"N, 44°27'530"E, 2100 m, 13.05.2001, *M.Tekşen* 2055 (fl.) (GAZI); 27 km from Yüksekova to Şemdinli, 1850 m, 15.06.1966, *D. 45164* (E, ISTO); S. slope of Reşko Tepe, above Marta to İmdat Mt., 2450 m, *Trelawny & McPhail* 2505 (E).

Distribution: Turkey, Iran, Iraq, Afghanistan, Pakistan, Kashmir. Irano-Turanian element.

F. imperialis is the only species of the genus in Turkey with flowers in an umbel and surmounted by tuft, with many leaves and bulbs up to 8 cm in diameter, stems up to 100 cm, many shining leaves, and with circular nectaries. Therefore, it can be easily distinguished from the other species.

Because *F. imperialis* has showy flowers it is cultivated and its bulbs are exported, especially to Holland and many other Europe countries. It grows naturally around Kahramanmaraş, Bitlis, Siirt, Şırnak, Muş, Van, and Hakkari. In spite of what is stated in the Flora of Turkey, i.e. that this species grows in Gaziantep, it is cultivated from Şanlıurfa to west Anatolia. The bulbs are diuretic, emollient, resolvent, and a cardiac poison. The fresh plant contains the toxic alkaloid 'imperialine'. Bulbs are regarded as a natural resource in the medicine sector

because they contain steroids, which are effective substances (Bingöl et al., 1996).

2. *Fritillaria persica* L., Sp. Pl. 304 (1753).

Type: Described from cultivated material. In Persia? e Susis venit in Europam 1573 (L!) (Figures 2 & 3).

= *Theresia persica* K.Koch, Linn. XXII. 233 (1849).

= *Theresia libanotica* Boiss., Diagn. Ser 1 (13): 20 (1853).

= *F. libanotica* (Boiss.) Baker in J. Linn. Soc. (Bot.) 14: 270 (1874).

= *F. eggeri* Bornm. in Feddes Rep. 27: 340 (1930).

Bulb spindle-shaped, 2.5-6 × 2.5-5 cm; tunica thin and papery. Stem erect, 20-100 cm, smooth. Leaves 10-70, sessile, and glaucous. Lowest leaves 4.4-15 × 1-3 cm, alternate, sometimes subopposite, narrowly lanceolate, lanceolate, acute. Median leaves 5.1-10 × 0.5-1.1 cm, alternate, linear-lanceolate, acuminate. Bract one pair or absent, 1.6-6.5 × 0.4-0.5 cm, linear-lanceolate, acuminate. Inflorescence raceme, 3-28. Perigon narrowly campanulate, dark or pale purple, greenish-purple rarely greenish-yellow, outside glaucous. Outer segments 10-20 × 5-8 mm, lanceolate, ovate-lanceolate, obtuse, ciliate-tufted at apex; inner segments 10-20 × 5-9 mm, lanceolate, ovate, oblanceolate, obtuse, ciliate-tufted at apex. Pedicels usually longer than tepals. Nectaries 1.5-3 × 1.5-3.5 mm, triangular, purple, 0.5-2 mm above base of tepals. Filaments 5-10 mm, smooth, yellow; anthers 1.5-4 mm, elliptic, brownish or purple, basifixed. Style 5.5-10 mm, undivided, smooth; stigma entire. Capsule 10-30 × 10-30 mm, obovoid, 6-winged, wings 1.5-3 mm. Seeds 6-10 × 4-6 mm, flat, obovate, testa brown, reticulate-faveolate.

Fl: 3-5.

Habitat: Edge of fields, rocky slopes, *Quercus* scrub, stony places, 600-1873 m.

Specimens examined: **C4** İçel: Aydınçık to Gülnar, 600-700 m, 29.05.1993, *Koyuncu* 9821 (AEF); Gülnar to Aydınçık, 1 km from Boğaziçi, 700-800 m, 22.04.1982, *Koyuncu* 4894 (AEF); Gülnar, 07.06.1950, *A.Atilla* 10366 (ISTF); Gülnar, between Bozağaç and Eskiörük village, S. of Ahrini, 700 m, 19.05.2000, *M.Tekşen* 1991 (fr.) (GAZI); Aydınçık to Gülnar, 2 km from Bozağaç, 760 m, 25.03.2001, *M.Tekşen*

2025 (fl.) (GAZI). C5 İçel: Mersin, Gülnar, Bozağaç to Ahırini, between Gülnar and Gilindere, 700 m, 14.04.1956, D. 26024 & Polunin (ANK). C6 Hatay: Hassa, Acielma, Amanos Mt., c. 1200 m, 15.04.1967, Akman 33 (ANK).

Distribution: Turkey, Syria, Lebanon, Jordan, Palaestina, Iran, and Iraq. Irano-Turanian element.

F. persica is a well known and frequently used ornamental plant (Mancuso & Peruzzi, 2010). *F. persica* is the only species of the genus in Turkey with inflorescence in raceme, stems up to 100 cm, many glaucous leaves, and with triangular nectaries. Therefore, it can be easily distinguished from the other species. It is stated in a footnote in the *Flora of Turkey* that the form named *F. eggeri* Bornm. with greenish flowers occurs west of Rezaiyeh, Iran, and so is also likely to be found in the easternmost part of Anatolia. Specimens from "C10 Hakkari: Şemdinli-Yüksekova, Şapatan pass, above Altınsu village, 37°20'815"N, 44°31'875"E, 1873 m, 09.05.2007, *Quercus* scrub, M. Tekşen 2218 & M. Aslay" are a new record and location for *F. persica*. The *F. persica* species, which were previously collected at a maximum elevation of 1200 m, were collected from Hakkari at an elevation of 1873 m.

3. *Fritillaria aurea* Schott in Öst. Bot. Wochenbl. 4: 137 (1854).

Type: Turkey, C5 İçel: in Tauro, 1836, *Kotschy* 507 (holo. W) (Figures 2 & 4).

= *F. bornmuelleri* Hausskn. in Öst. Bot. Zeitschr. 40: 393 (1890).

Type: A6 Sivas: Yıldız Da., 2400 m, *Bornm.* 1890: 1647.

= *F. cilicico-aurica* Hausskn. & Bornm. in Mitt. Thür. Bot. Ver. n.s. 20: 46 (1905).

Type: C5 İçel: Cilician Taurus above Bulgar Da., 2400 m, *Siehe* 1898: 14.

Bulb ovoid, 0.7-1.1 × 0.9-2 cm, with one or many bulblets, tunica thin and papery. Stem erect, 4-24 cm, smooth. Leaves (3-) 4-8, sessile, glaucous and alternate, rarely opposite at base. Lowest leaves 3.4-8 × 0.5-2.2 cm, lanceolate to ovate-lanceolate, acute. Median leaves 3-7.7 × 0.2-0.7 cm, linear, acuminate. Bract 1, 1.8-5.4 × 0.1-0.25 cm, linear, acuminate. Flowers 1-2. Perigon broadly campanulate, yellow,

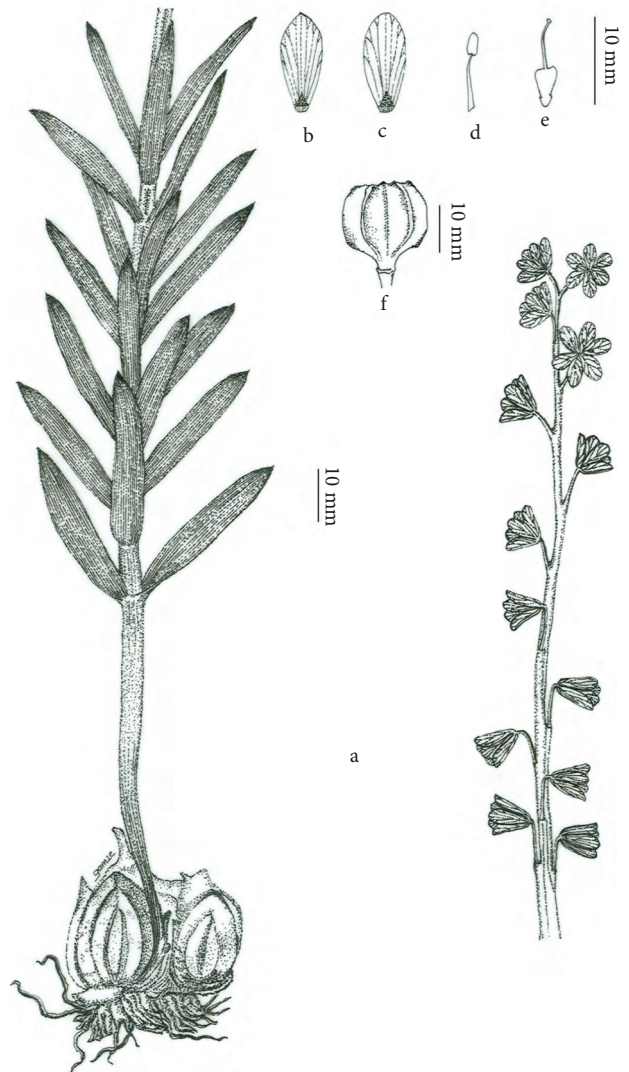


Figure 3. *Fritillaria persica*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

pale reddish-brown tessellated. Outer segments 20-48 × 5-10.5 mm, lanceolate, ovate to oblong, acute, ciliate-tufted at apex; inner segments 20-48 × 9-15 mm, lanceolate, obtuse, ciliate-tufted at apex. Nectaries 2-2.5 × 1-2 mm, ovate, green, 5-7 mm above base of tepals. Filaments 9-14 mm, enlarged to base, smooth; anthers 4-8 mm, elliptic, apiculate, yellow, basifixed. Style 8-13 mm, 3-fid, branches 1-3 mm, smooth; stigma entire. Capsule 20-35 × 12-18 mm, not winged, oblong-obovoid. Seeds 6-7 × 5-5.5 mm, flat, obovate, testa pale brown, faveolate.

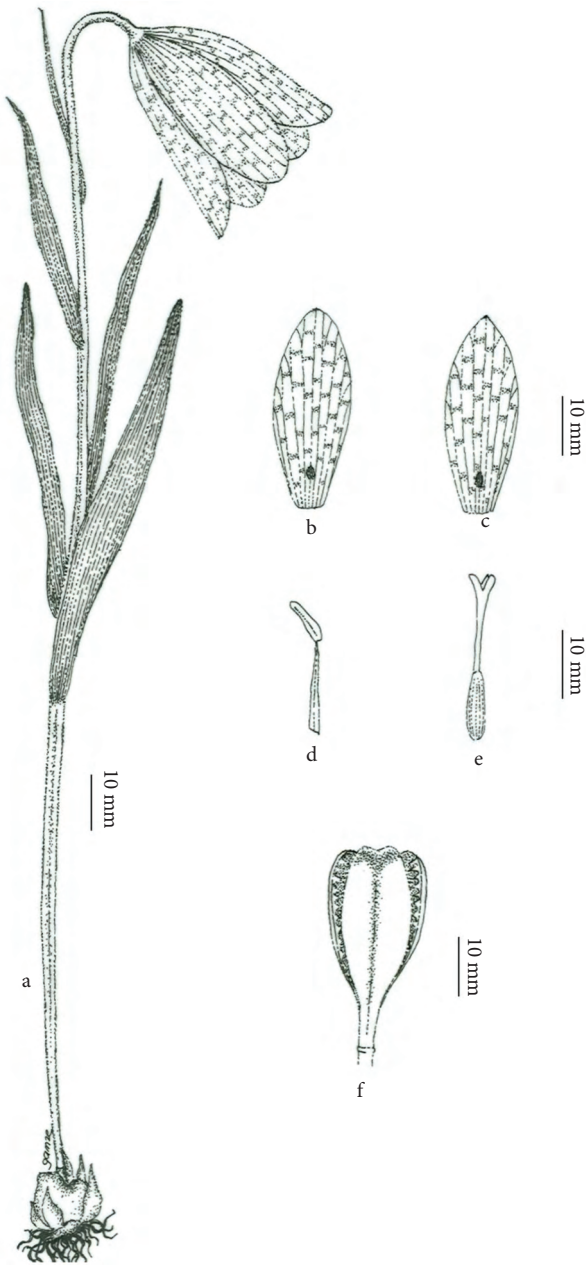


Figure 4. *Fritillaria aurea*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

Fl: 3-5.

Habitat: *Juniperus* forest, N-facing rock ledges, usually on limestone, 1650-3000 m.

Specimens examined: B6 Kayseri: Sarız, Binboğa Mt., Yalak, 1700-1900 m, 07.05.1991, Z.Aytaç 3702 & H.Duman (AEF, HUB, GAZI); Pınarbaşı, Eğrisöğüt village, Şirvan Mt., 1900-2000 m, 25.07.2003,

M.Tekşen 2204 (fr.) (GAZI); 24 km S. of Pınarbaşı, 1800-1900 m, 24.05.1965, *Coode & Jones* 1423 (ISTO, E, ISTF); Pınarbaşı, Eğrisöğüt-Beyçayır villages, around Kumuk Adil, c. 1700 m, 17.04.2001, *A.M.Özkan* (AEF), Pınarbaşı to Gürün, Ziyaret hill, 2000 m, 23.05.1965, *Coode & Jones* 19810 (ISTF); Sivas: Pınarbaşı to Gürün, 2000 m, 26.05.1960, *Stainton & Henderson* 5179 (E, RSA); Kahramanmaraş: Göksun, Berit Mt., 2000 m, 19.06.1981, *B.Yıldız* 3005 (HUB); Göksun, Binboğa Mt., above Karlı plateau, 2700 m, *D.* 20024 (E). C5 İçel: Toros, *Siehe* 216 (ANK); Niğde: Ala Mt., SW (south-west) Flank of Demir Kasık, 2400-2800 m, *Parry* 170 (E); Aladağ, 2700 m, 24.06.1964, *Wood & Gibson* 106 (E); Aladağ, Tekneli plateau, 2700 m, 15.06.1979, *R.Carle & H.Kürschner* 79-433 (RSA); Adana: Seyhan, Pozanti, Armutoluk, E of Hondu, 12.5.1952, *İ.Akkaş* 11873 (ISTF). C6 Kahramanmaraş: Göksun, between Püren pass and Değirmendere village, Kartallık, 37°56'603"N, 36°30'767"E, 1700-1800 m, 21.05.2000, *M.Tekşen* 1994 (fr.) (GAZI); *ibid.*, 22.04.2001, *M.Tekşen* 2049 (fl.) (GAZI); *ibid.*, 09.07.2001, *M.Tekşen* 2104 (fr.) (GAZI); *ibid.*, 24.05.1993, *Ekici* 1275 (GAZI).

Conservation status: LC.

Distribution: Endemic. Irano-Turanian element.

F. aurea differs from the *F. acmopetala* with always yellow and few tessellated flowers (not green, brown markings, purple of apex or perigon green and purple tessellated, rarely perigon yellow).

4. *Fritillaria acmopetala* Boiss., *Diagn. ser. 1* (7): 104 (1846) *sensu lato*.

Bulb globose, 0.5-1.3 × 0.8-3 cm, with one or many bulblets, sometimes absent, tunica thin and papery. Stem erect, 9.5-54 cm, smooth. Leaves 4-11, sessile, glaucous. Lowest leaves 4.7-16 × 0.25-3 cm, alternate, linear, narrowly or broadly lanceolate, acute, acuminate. Median leaves 4.6-16.5 × 0.2-1 cm, alternate, linear, narrowly lanceolate, acuminate. Bract 1-2 (-3), 2.9-10.5 × 0.1-0.5 cm, verticillate, linear, acuminate, rarely uppermost with a tendril-like apex. Flowers 1-2. Perigon broadly campanulate, green, brown markings, purple of apex or perigon green and purple tessellated, rarely perigon yellow. Outer segments 19-47 × 6-14 mm, lanceolate, obtuse, ciliate-tufted at apex; inner segments 19-47 × 7.5-18.5 mm, obovate-oblancheolate, oblancheolate, spatulate,

truncate or retuse, usually broadly apiculate, ciliate-tufted at apex. Nectaries 2-12 × 2-8 mm, ovate, lanceolate, green, greenish-brown, 3-6 mm above base of tepals. Filaments 6-13 mm, enlarged at base, smooth or papillose, yellow, yellowish-green; anthers 4-13 mm, elliptic, apiculate, yellow, greenish-yellow, basifixed. Style 6.5-12 mm, 3-fid, branches 1.5-6 mm, smooth or papillose; stigma entire. Capsule 15-33 × 5-10 mm, oblong, cuneate at base, not winged. Seeds 4.5-7.5 × 3-6.5 mm, flat, obovate-orbicular, obovate, testa pale brown or reddish-brown, faveolate.

1. Leaves 5-11, linear, 0.4-1.2 cm broad; tepals tessellated or marked.....subsp. **acmopetala**

1. Leaves 4-7, lanceolate, 1-3 cm broad; tepals not tessellated.....subsp. **wendelboi**
subsp. **acmopetala**.

Type: (Turkey, C6 Hatay) in monte Amanos Syriae supra Baylan (Belen), *Aucher* 2181 (holo. G! iso. K) (Figures 2 & 5).

= *F. lycia* Boiss. & Heldr. in Boiss., *Diagn. ser. 1* (13): 20 (1853).

= *F. sororum* J.Persson & K.Persson, *The New Plantsman*, 114-116, June 1998. **syn. nov.**

Type: Turkey, İçel: Taurus mountains, 500 m, meadow fragments adjoining brook ravine in *Pinus brutia* forest, on limestone, coll. 30.04.1987, cult. 20.05.1995, J.Persson & K.Persson 87-99 (holo. GB).

Fl: 3-5.

Habitat: Forest, *Populus nigra* opens, *Pinus brutia* forest, scrub, 10-1500 m.

Specimens examined: C2 Muğla: Köyceğiz, Hamitköy to Ekincik, 36°54'869"N, 28°37'284"E, 120-150 m, 25.03.2000, *M. Tekşen* 1970 (fl.) (GAZI); Köyceğiz to Gökova, 100 m, 17.04.1992, *Koyuncu* 9020 (AEF); Fethiye, Kalkan, 30 m, 30.03.1956, *D.* 25514 (ANK); Marmaris, 03.1937, 1400 m, *Mark* 339 (ANK); Köyceğiz, Hamitköy, Topalak hill, 140 m, *Vural* 5748 (GAZI, HUB); Köyceğiz, 2 km from Hamitköy to Ekincik, 13.04.1999, 50 m, *A. Duran* 4470 (GAZI); Fethiye-Çameli, 13 km north of Üzümlü, 36°47'509"N, 29°11'115"E, 1030 m, 27.04.2008, *A. Güner* 14615 (GAZI). C3 Antalya: 6 km from Termessos Milli Park entrance, 36°59'860"N, 30°28'816"E, 700-750 m, 26.03.2000, *M. Tekşen* 1973 (fl.) (GAZI); 1-2 km from Termessos Milli Park

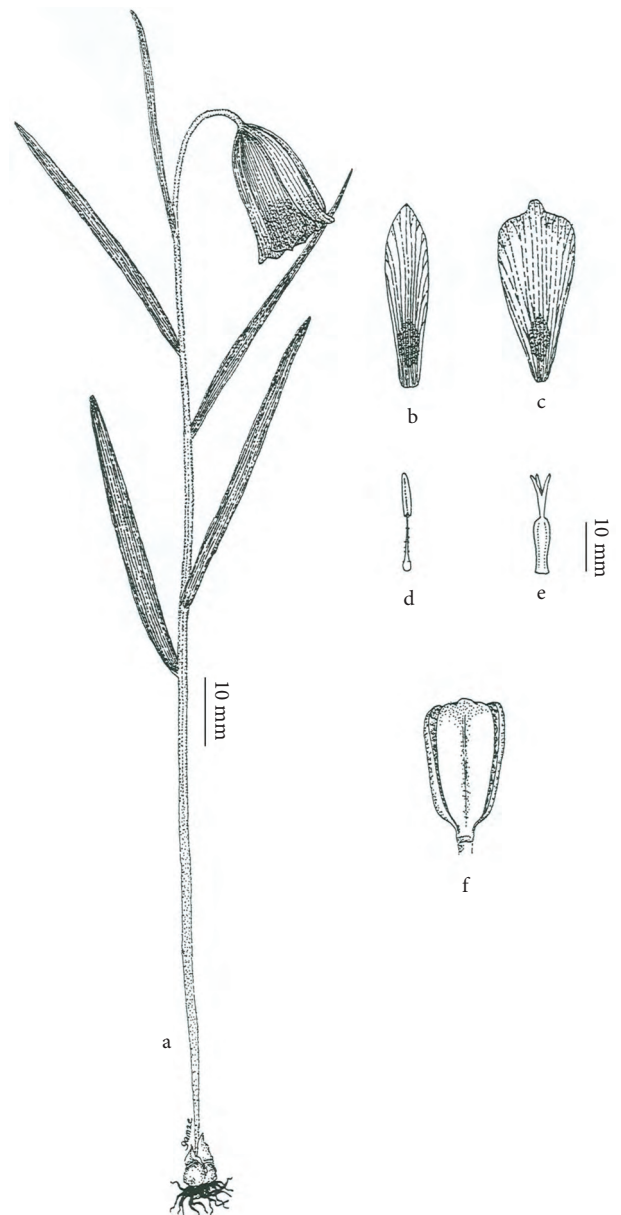


Figure 5. *Fritillaria acmopetala* subsp. *acmopetala*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

entrance, 36°59'860"N, 30°28'816"E, 200-300 m, 19.04.2000, *M. Tekşen* 1976 (fl.) (GAZI); Konyaaltı, 10 m, 28.3.1983, *Koyuncu* & *Erik* 3389 (AEF); Manavgat, Başlar village, Kızıldağ, Güzle plateau, 1200 m, 08.05.1982, *Koyuncu* 5254 (AEF); Kemer, Olympos to Adrasan, 1 km from Çayalanı, 130 m, 23.03.1979, *Peşmen* 4234 & *Güner* (ANK, HUB, AEF); Güllük Mt., 800 m, 28.04.1985, *J. Archibald* 6011 (RSA); Konya: Seydişehir, Tınaz Mt.-Çatmakaya, 1500 m,

19.05.1982, *H.Ocakverdi* 1377 (KNYA, ANK). **C4** İçel: Aydıncık-Gülnar, 2 km from Bozağaç, 730-760 m, 24.03.2001, *M.Tekşen* 2026 (GAZI). **C5** İçel: Anamur to Ermenek, 25 km, 470-500 m, 24.03.2001, *M.Tekşen* 2019 (GAZI); *ibid.*, 11.07.2001, *M.Tekşen* 2108a (fr.) (GAZI); Anamur to Ermenek, 31 km, 36°12'201"N, 32°54'580"E, 880 m, 24.03.2001, *M.Tekşen* 2021 (fl.) (GAZI); *ibid.*, 11.07.2001, *M.Tekşen* 2108 (fr.) (GAZI); Adana: Osmaniye, Zorkun plateau, Olukbaşı, 800 m, 25.04.1971 *Koyuncu s.n.* (AEF), Pozantı-Adana, Gülek gorge, 1150 m, 19.05.1999, *A.Duran* 5024 (GAZI); Seyhan, Pozantı, SE of Bürücek, Katran Sekisi, c. 1600 m, 20.05.1952, *İ.Akkaş* 11957 (ISTF). **C6** Hatay: Belen, Güzelyayla-Bardak villages, 950 m, 08.05.1999, *M.Tekşen* 1953 (fr.) (GAZI); Belen, Belen-Güzelyayla, c. 4 km from Güzelyayla, 36°29'671"N, 36°10'168"E, 500 m, 29.03.2001, *M.Tekşen* 2036 (fl.) (GAZI); *ibid.*, 10.07.2001, *M.Tekşen* 2106 (fr.) (GAZI); Belen, Karlık hill, above Soğukoluk, 900-1000 m, 23.04.1957, *D. 27037 & Hedge* (AEF); İskenderun, Arsuz, Meşelik, Amanos Mt., ca. 840 m, 10.6.1967, *Akman* 39 (ANK); Dört Yol, Kuzucuk to Büke on forest road, c. 1000 m, 04.05.1965, *Coode & Jones* (ISTF 19344); Adana: Zorkun plateau, Amanos Mt., ca. 700 m, 13.04.1968, *Akman* 7889 (ANK); Osmaniye: Nurdağı, Arapçukuru, 750 m, 16.04.1977, *A.Güner* 1509 (HUB).

Distribution: Cyprus, Lebanon, Syria. East Mediterranean element.

subsp. *wendelboi* Rix in Notes R.B.G. Edinb. 41: 52 (1983).

Type: Turkey, C3 Antalya: mountains NE of Akseki, 1700 m, 1972, *Wendelbo* 447 (holo. GB!) (Figures 2 & 6).

Fl: 4-6.

Habitat: *Cedrus* forest, *Juniperus* openings, limestone rocky slopes, stony places, 1600-2020 m.

Specimens examined: **C4** Konya: Taşkent-Alanya, around Çukurkent pass, 24.04.1999, 1800-1850 m, *H.Duman* 6903 (GAZI); Hadim, Aladağ-Kartaltepe, SW of hillside, around fire tower, 2150 m, 08.06.1987, *M.Serin* 1268 (KNYA); Merkez, Kızılören Mt., 1700 m, 19.05.1990, *A.Tatlı* 9479 & *B.Eyce*, *M.Serin* (KNYA); Hadim, Kandevir plateau, Yukarıkızılkaya, 1700 m, 17.05.1984, *S.Erik* 3663 & *B.Yıldız* (HUB); Karaman: Bayır-Ermenek, 30 km

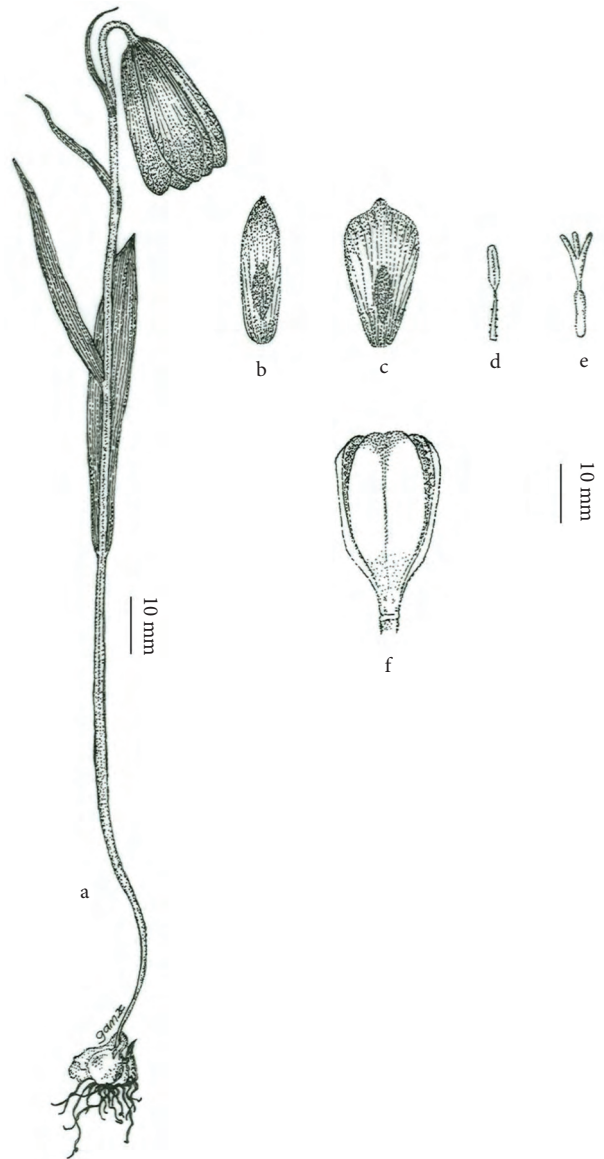


Figure 6. *Fritillaria acmopetala* subsp. *wendelboi*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

from Ermenek, 36°50'N, 32°55'E, 15.05.1999, 1900 m, *FAK* 2613 (GAZI); İçel: Anamur, 45 km from Anamur to Ermenek, Kaşyaylası, 1600 m, 20.04.2000, *M.Tekşen* 1980 (fl.) (GAZI); Anamur-Ermenek, around Suolmaz pass, 1600 m, 19.05.2000, *M.Tekşen* 1989 (fl.) (GAZI); *ibid.*, 11.07.2001, *M.Tekşen* 2109 (fr.) (GAZI); d. Anamur, Kaşyaylası, 1600 m, *Markgraf* 11180 (ANK); Antalya: Alanya, Cedevet plateau, Çanakpınarı, 1150 m, 19.04.1989, *Ekim* 9278 (GAZI); Gazipaşa, Çayıryakası plateau, 1750 m,

20.05.1983, *H.Sümbül* 1870 (HUB, ANK); Gazipaşa, Cimbiti plateau, 1650 m, 18.05.1983, *H.Sümbül* 1823 (HUB); Karaman: Ermenek-Karaman, north of Yellibel, 36°49'419"N, 32°55'412"E, 2030 m, 01.05.2008, *A.Güner* 14735 (GAZI).

Conservation status: EN B2b (iii).

Distribution: Endemic. East Mediterranean element.

F. acmopetala can be easily distinguished from the similar species by usually purple spots at perigon apex and base, sometimes green and purple tessellated. Subsp. *wendelboi* does not have tessellated individuals as subsp. *acmopetala*. It is smaller than subsp. *acmopetala* and it grow at higher altitude (1600-2020 m vs. 10-1500 m). While the flowering period is between March and May in subsp. *acmopetala*, it is April-June in subsp. *wendelboi*.

F. sororum was described by J.Persson & K.Persson in 1998. It is stated in the *Flora of Turkey* that *F. sororum* differs from *F. acmopetala* subsp. *acmopetala* with a tessellated perigon, smooth filaments, and uppermost leaves often with a tendril-like apex. *F. sororum* specimens observed in the field lacked the cirrhose tips to the leaves. This characteristic was also stated in the literature (Archibald & Archibald, 2003). The similarity between *F. acmopetala* subsp. *acmopetala* and *F. sororum* was noted during the field study. The *F. sororum* specimens (*M.Tekşen* 2019, 2021, 2108) were compared with *F. acmopetala* subsp. *acmopetala* specimens (in the GAZI, HUB, and AEF

herbaria). The *F. acmopetala* subsp. *acmopetala* specimens collected in the field have many individuals with tessellated perigon and smooth filaments. These flower features are very well-matched with *F. sororum*. *F. sororum* differs from *F. acmopetala* subsp. *acmopetala* by the uppermost leaves often with a tendril-like apex. This diagnostic character does not distinguish *F. sororum* from *F. acmopetala* subsp. *acmopetala*. The topotype specimens of *F. sororum* do not have tendril leaves (*M.Tekşen* 2019, 2021, 2108). All the characteristics fall within the variation of *F. acmopetala* subsp. *acmopetala*. Consequently, *F. sororum* is evaluated as a synonym of *F. acmopetala* subsp. *acmopetala*.

5. *Fritillaria whittallii* Baker in Gard. Chron. ser. 3, 13: 506 (1893).

Type: Turkey, C?: from the western end of the great Taurus range, (vii.1891), a collector for E.Whittall (holo. K!) (Figures 7 & 8).

Bulb ovoid, as united 2 reniform-like, 0.5-1.0 × 1-1.5 cm, sometimes with many bulblets, tunica thin and papery. Stem erect, 10-35 cm, at margins and around lower leaves papillose. Leaves 5-11, sessile, shining green. Lowest leaves 8-15.3 × 0.4-1.0 cm, alternate, linear, linear-lanceolate, acuminate. Median leaves 9-12.4 × 0.4-0.8 cm, alternate, linear, linear-lanceolate, acuminate. Bract 1-3, 6.3-9.3 × 0.1-0.4 cm, whorls or alternate, linear, acuminate. Flowers 1-2. Perigon broadly campanulate, green, inside and outside brown tessellated. Outer segments 25-32 ×

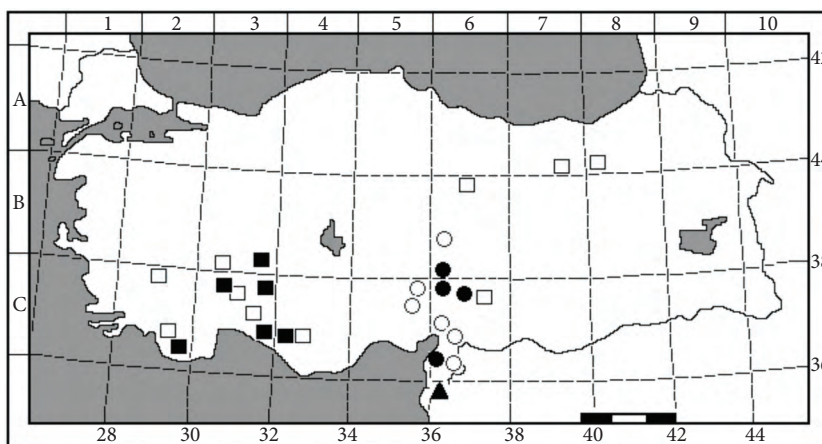


Figure 7. Distribution in Turkey of *Fritillaria whittallii* (■), *F. hermonis* subsp. *amana* (●), *F. crassifolia* subsp. *crassifolia* (□), *F. alfredae* subsp. *platyptera* (▲), and *F. alfredae* subsp. *glaucoviridis* (○).

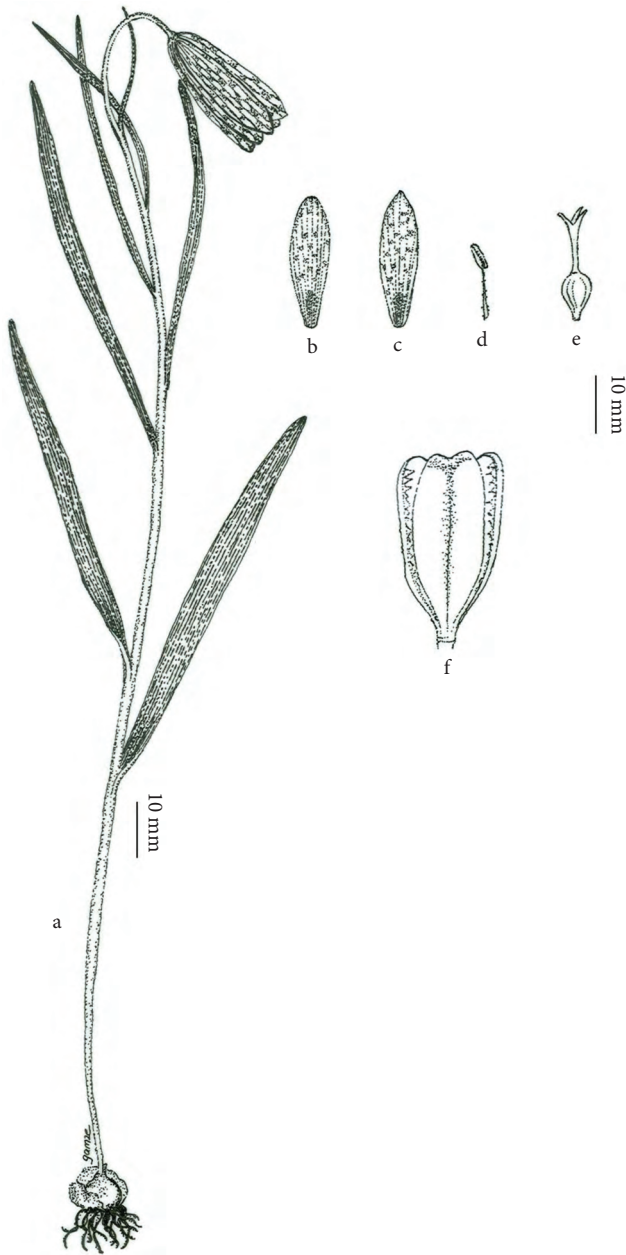


Figure 8. *Fritillaria whittallii*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

5-13 mm, lanceolate, acute or obtuse, ciliate-tufted at apex; inner segments 25-32 × 8-13 mm, oblanceolate, lanceolate, acute or obtuse, ciliate-tufted at apex. Nectaries 3 × 6 mm, ovate, green, 3-5 mm above base of tepals, at corner of bell. Filaments 8-10 mm, papillose, yellow; anthers 4-10 mm, elliptic, yellow, basifixed. Style 6-11 mm, 3-fid, branches 1-5 mm, smooth; stigma entire. Capsule 25-35 × 8-18 mm, oblong, cuneate at base, not winged. Seeds 3.5-5 ×

4-6.5 mm, flat, obovate, narrowly obovate, testa pale brown, reticulate-faveolate.

Fl: 4-6.

Habitat: Rocky slopes, stony places, *Pinus*, *Juniperus*, and *Cedrus libani* forest, scrub, 1200-2100 m.

Specimens examined: B3 Isparta: Şarkikaraağaç, Kızıldağ Milli Parkı, N side of Küçüksivri, 1250 m, 23.04.1994, *B.Mutlu* 330 (HUB); Şarkikaraağaç, Kızıldağ Milli Parkı, N side of Kızıldağ, 1400-1500 m, 11.05.1995 *B.Mutlu* 1357 (HUB). C4 Konya: Hadim, Gevne valley, Tosmur plateau-Beyreli, 10.06.1999, 1980 m, 36°53'75"N, 32°18'12"E, *H.Duman* 6977 (GAZI). C3 Isparta: Şarkikaraağaç-Yenişarbademli, Gedikli village-Çiçekdağı, 1750-1850 m, 05.06.1999, *A.Duran* 4570 (GAZI); Çiçekdağı, Gedikli, 1700 m, 31.05.2002, 37°52'904"N, 31°17'699"E, *FAK* 3255 (GAZI), Eğirdir, Yaka village, Kapız river, 1500-1700 m, 01.07.1974, *H.Peşmen* & *A.Güner* 1538a (HUB); Eğirdir, Kopuz Mt., 2 km S of Yaka village, c. 1800 m, 20.05.1973, *H.Peşmen* 3536 & *Pamukçuoğlu*, *Erik* (HUB); Eğirdir, Yaka village, above cemetery of Melikler, 1300-2100 m, 19.05.1973, *H.Peşmen* 3487 & *Pamukçuoğlu*, *Erik* (HUB); Eğirdir, Yukarı Gökdere village, Kasnak forest, 37°44'166"N, 30°49'507"E, 1507 m, 28.04.2008, *A.Güner* 14640 (GAZI); Antalya: Akseki-Geyran plateau, S slopes of Kocaoluk, 13.05.1995, 1500 m, *Duran* 2336 (GAZI); Akseki, Akseki-Güzelsu arası, Sadıklar village, Geyran plateau, S slopes of Kocaoluk, 36°55'262"N, 31°51'126"E, 1450-1500 m, 18.05.2000, *M.Tekşen* 1988 (fl.) (GAZI); ibid, 08.06.2002, *M.Tekşen* 2161 (fr.) (GAZI); Akseki, Güzelsu, Salamut plateau, 1600 m, 09.05.1982, *Koyuncu* 5270 (AEF); Akseki-Çimi plateau, 1450 m, 19.05.1984, *Koyuncu* 6883 (AEF); Manavgat, Kızıldağ village, Güzle plateau, 1200 m, 08.05.1982, *Koyuncu* 5255 (AEF); Konya: Beyşehir-Akseki, Küpe Mt., 1600 m, 19.05.1984, *M.Koyuncu* 6872 (AEF); Beyşehir, Kurucaova, Suludere, 1500-2000 m, 08.06.1975, *H.Peşmen* & *A.Güner* 2200 (HUB); Beyşehir, Kurucaova village, Kuzgun hill, 24.04.1974, 1350-1500 m, *H.Peşmen* & *A.Güner* 1034 (HUB).

Conservation status: VU B2b (iii).

Distribution: Endemic. East Mediterranean element.

F. whittallii differs from the *F. acmopetala* by shining green leaves (not glaucous), papillose stem (not smooth).

6. *Fritillaria hermonis* Fenzl in Kotschy, Pl. Syr. Exsicc. (1855). subsp. *amana* Rix in Kew Bull. 29: 647, f. 2 (1975).

Type: Turkey, C6 Maraş: Zeytun, Kuru Dag, limestone screen and turf, 1678 (as 1700) m, 10 v 1934, Balls 1034 (holo. E, iso. BM, K) (Figures 7 & 9).

Bulb globose, 0.6-1.3 × 0.9-3 cm, with one or many bulblets, with stolon, tunica thin and papery. Stem erect, 8-35 cm, entire. Leaves 4-9, sessile,

shining green, alternate. Lowest leaves 4-13.5 × 0.65-2.7 cm, narrowly or broadly lanceolate, oblong, acute. Median leaves 4-13.5 × 0.3-2.2 cm, narrowly or broadly lanceolate, acute. Bract 1, 2.0-8.3 × 0.1-0.7 cm, linear, acuminate. Flowers 1-2 (-3). Perigon broadly campanulate, green, reddish-brown tessellated or yellow, brown tessellated or striped, markings, rarely perigon yellow. Outer segments 22-35 × 7-12 mm, oblong, obtuse, ciliate-tufted at apex; inner segments 22-35 × 8-15 mm, oblanceolate, spatulate, obtuse, ciliate-tufted at apex. Nectaries 1.5-4 × 2.5-5 mm, ovate, greenish-brown, 4-7 mm above base of tepals. Filaments 8-10 mm, papillose, yellowish-green, yellow; anthers 4-10 mm, elliptic, apiculate, yellow, basifixed. Style 8-12 mm, 3-fid, branches 1-4 mm, papillose. Capsule 27-42 × 12-17 mm, oblong, not winged. Seeds 4-7 × 3-5 mm, flat, obovate, testa pale brown, reticulate-faveolate.

Fl: 4-5.

Habitat: Rocky and stony places, *Cedrus libani* forest openings, 1400-2400 m.

Specimens examined: **B6** Kahramanmaraş: Göksun, Çardak, Fındık village, Bostan river, 800 m, 14.05.1978, *B.Yıldız* 1730 (HUB). **C6** Kahramanmaraş: Göksun, Tünel-Değirmendere, Püren pass, Angıtkayası, 37°56'N, 36°30'E, 1630-1800 m, 09.05.1999, *M.Tekşen* 1954 (fl.) (GAZI); *ibid.*, 21.05.2000, *M.Tekşen* 1992 (fl.) (GAZI); *ibid.*, 09.07.2001, *M.Tekşen* 2105 (fr.) (GAZI); *ibid.*, 17.05.1993, *Ekici* 1280 (GAZI); *ibid.*, 22.04.2001, *M.Tekşen* 2048 (fl.) (GAZI); *ibid.*, 23.04.1994, *Ekici* 1793 (GAZI); Engizek Mt., Akpınar-Büyükyeşil, 2200-2300 m, 01.04.1988, *H.Duman* 3976 (GAZI); Süleymanlı, Berit Mt., Sarıgöl, 2000-2400 m, 11.06.1978, *B.Yıldız* 2042 (HUB).

Distribution: Turkey, Lebanon. East Mediterranean element.

F. hermonis subsp. *amana* is distinguished from *F. crassifolia* subsp. *crassifolia*, which is a similar species, by its shining green leaves (not glaucous), ovate nectaries (not linear), and papillose style (not smooth). It differs from *F. whittallii* by its smooth stem (not at margin and around lower leaves papillose) and papillose style (not smooth).

7. *Fritillaria crassifolia* Boiss. & Huet in Boiss, Diagn. ser. 2 (4): 103 (1859).

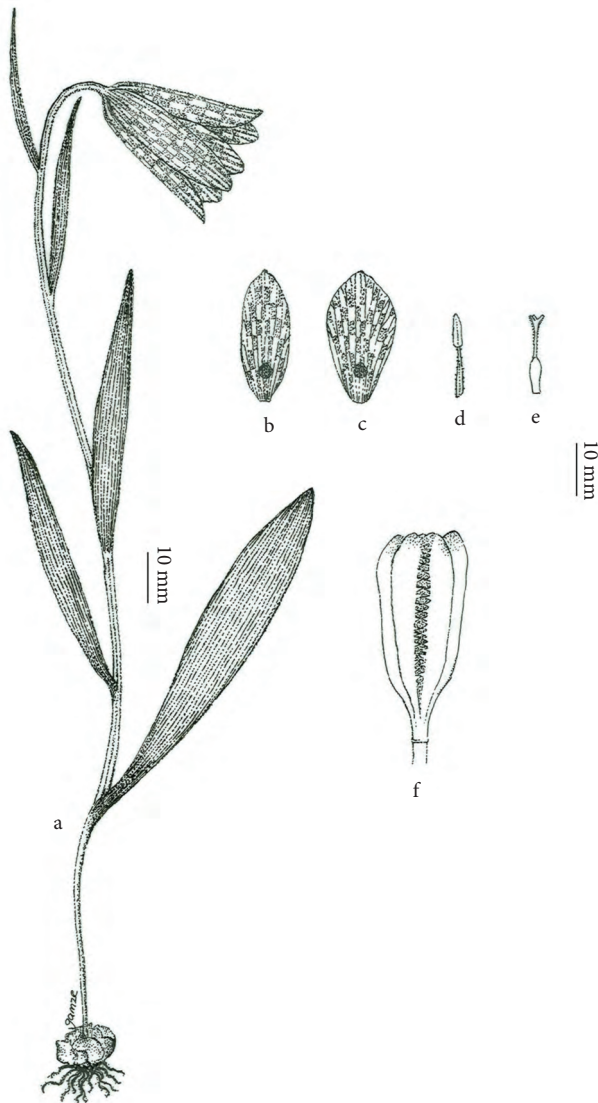


Figure 9. *Fritillaria hermonis* subsp. *amana*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

subsp. *crassifolia*.

Type: B8 Erzurum: in lapidosis montis Techdagh (Palandöken Da.) prope Erzeroum, 1800-2100 m, vi.1853, *Huet du Pavilion* (lecto. G! isolecto. K) (Figures 7 & 10).

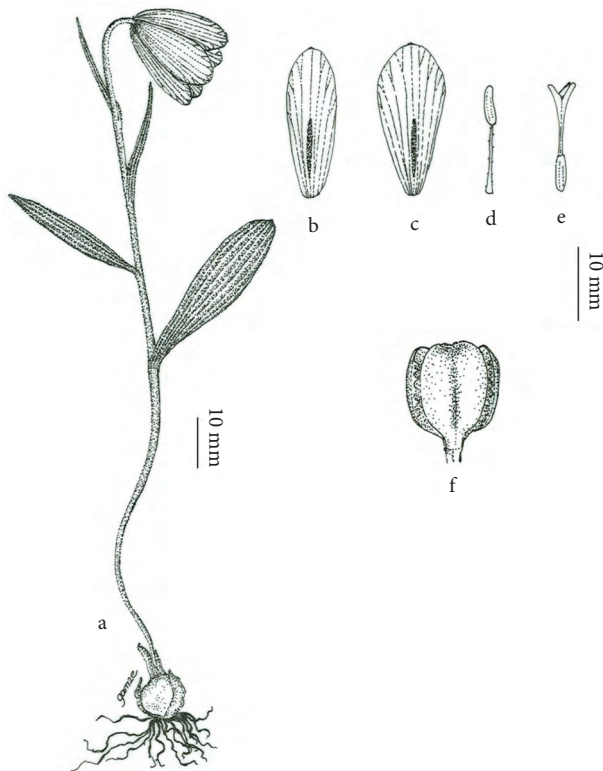


Figure 10. *Fritillaria crassifolia* subsp. *crassifolia*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

= *F. ophioglossifolia* Freyn & Sint. in Bull. Herb. Boiss. 4:183 (1896).

Type: Turkey, A7 Gümüşkane: in glareosis montis Argyridagh, *Sintenis* 5535 (A7)

Gümüşane: Argyridagh (12 km S.W. of Gümüşane) 1894, *Sint.* 5535) (G! E!).

Bulb globose or obovoid, 0.8-1.8 × 0.9-3 cm, with many bulblets, tunica thin and papery. Stem erect, 3-10 cm, entire. Leaves 3-7 (-8), sessile, glaucous. Lowest leaves 20-68 × 5.5-20 mm, alternate, broadly lanceolate or elliptic, narrowly ovate, acute or acuminate. Median leaves 15-50 × 1-7 mm, alternate,

linear, narrowly lanceolate, acute or acuminate. Bracts 1-2, 9-37 × 1-3 mm, opposite, linear, narrowly lanceolate, lanceolate, acuminate. Flowers 1-2. Perigon broadly campanulate, green, inside and outside brownish-purple tessellated or with brownish-purple markings. Outer segments 12-28 × 5-10 mm, lanceolate, acute, or obtuse, ciliate-tufted at apex; inner segments 12-28 × 6-12 mm, oblanceolate or spatulate, obtuse, ciliate-tufted at apex. Nectaries 8-16 × 1-2 mm, linear, green, 3-5 mm above base of tepals. Filaments 6-10 mm, smooth or papillose, yellow; anthers 3-6.5 mm, oblong, yellow, basifixed. Style 5-13 mm, 3-fid, branches 1.5-6 mm, reflexed, smooth; stigma entire. Capsule 15-30 × 15-19 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.

Fl: 4-6.

Habitat: Rocky and stony slopes, serpentine, scrub, open *Pinus nigra* forest, 1000-2600 m.

Specimens examined: A7 Gümüşhane: Argyridagh (12 km SW of Gümüşhane) *Sint.* 1894: 5535 (G! E!). A8 Gümüşhane: in Armeniae collibus agillosis prope Baibout (Bayburt), *Aucher* 5376 (G). B7 Erzincan: Erzincan-Refahiye, Alaçatlı village, Kurttepesi, 2100-2300 m, 25.05.2002, *M. Tekşen* 2141 (fr.) (GAZI). C3 Antalya: Akseki-Seydişehir, S of Tinaztepe recreation service area, 02.04.1999, 1450 m, *H. Duman* 6883 (GAZI); Akseki-Seydişehir, 25 km to Seydişehir, 500 m from Tinaztepe recreation service area, N 37°14'485"N, 31°55'720"E, 1570 m, 21.04.2001, *M. Tekşen* 2041 (fl.) (GAZI); Akseki, Güzelsu-Gündoğmuş, Pınarbaşı-Güneyyaka village, around Kızıldere, 36°53'344"N, 31°56'243"E, 1170 m, 21.04.2001, *M. Tekşen* 2047 (fl.) (GAZI); Isparta: Anamas Mt., 04.06.1955, 2400 m, A. & T. *Baytop* 4383 (HUB); Sütçüler, Çobanisa village, Sarp Mt., 1450-1850 m, 26.05.1974, *Peşmen* & *Güner* 1139 (HUB). C6 Kahramanmaraş: Ahır Mt., Yalnızardıç shoulder, 1000-1300 m, 23.04.1992, *Aytaç* 4519 & *H. Duman* (GAZI); Ahır Mt., Sulu Tarla shoulder, 1200-1300 m, 22.04.1992, *Aytaç* 4499 & *H. Duman* (GAZI).

Conservation status: LC.

Distribution: Endemic. Irano-Turanian element.

F. crassifolia subsp. *crassifolia* can be easily distinguished from *F. hermonis* subsp. *amana* by its

glaucous leaves, linear nectarines, and smooth style. It differs from *F. alfredae* by its green, inside and outside brownish-purple tessellated or brownish-purple markings flowers (not green, inside yellowish-green), smooth style (not papillose) unwinged capsule (not 6-winged). *F. crassifolia* subsp. *crassifolia* was suggested to be an Irano-Turanian phytogeographical element, because of its distribution in Gümüşhane, Erzurum, Erzincan, Konya, Isparta, Kahramanmaraş, Muğla, and Antalya.

8. *Fritillaria alfredae* Post in Mem. Herb. Boiss. 18: 101 (1900).

Bulb 0.6-1.2 × 1.0-3 cm, globose or ovoid, without bulblets; tunica thin and papery. Stem erect, 10-63 cm, entire. Leaves 5-19, sessile, green. Lowest leaves 4.6-17 × 0.3-3.3 cm, alternate, opposite or subopposite, linear, linear-lanceolate, oblanceolate-ovate, acute or acuminate. Median leaves 3-15.6 × 0.2-1.3 cm, alternate, linear, linear-lanceolate, acute or acuminate. Bracts 1-5, 2.2-10.1 × 0.1-0.6 cm, opposite, linear, acuminate. Flowers 1-2 (-3). Perigon narrowly campanulate, glaucous, inside yellowish-green. Outer segments 15-33 × 4-8 mm, oblong, lanceolate, obtuse, ciliate-tufted at apex; inner segments 15-33 × 5-9 mm, spatulate, narrowly obovate, obtuse, ciliate-tufted at apex. Nectarines 3.5-6 × 1-2 mm, narrowly ovate, linear-lanceolate, green, 1 mm above base of tepals. Filaments 5.5-10 mm, papillose, papillae decreasing to base, greenish yellow; anthers 3.5-9.5 mm, oblong, yellow, basifixed. Style 5-10 mm, 2-4 mm diam, undivided or 3-lobed at apex, lobes 0.5-1 mm, densely papillose; stigma entire. Capsule 25-47 × 14-33 mm, obovoid or narrowly obovoid, oblong, truncate at apex, cuneate at base, 6-winged, wings 1.5-5 mm. Seeds 3.5-7 × 4-6 mm, flat, obovate, obovate-orbicular, testa yellowish-brown or greyish-brown, reticulate-faveolate.

1. Lowest leaves alternate, linear, linear-lanceolatesubsp. **platyptera**

1. Lowest leaves opposite or subopposite, oblanceolate-ovate.....subsp. **glaucoviridis**
subsp. **platyptera** (Samuelsson) Rix in Kew Bull. 33: 96, f. 3 (1979).

Type: Turkey, C6 Hatay/Syria: Mons Cassius, in regione pinifera, prope transitum ad Ain el Aramie, solo schist.-gneiss., in *Querceto Cerris*, 600 m, 9.vi.1933, *Samuelsson* 5864 (holo. S!) (Figures 7 & 11).

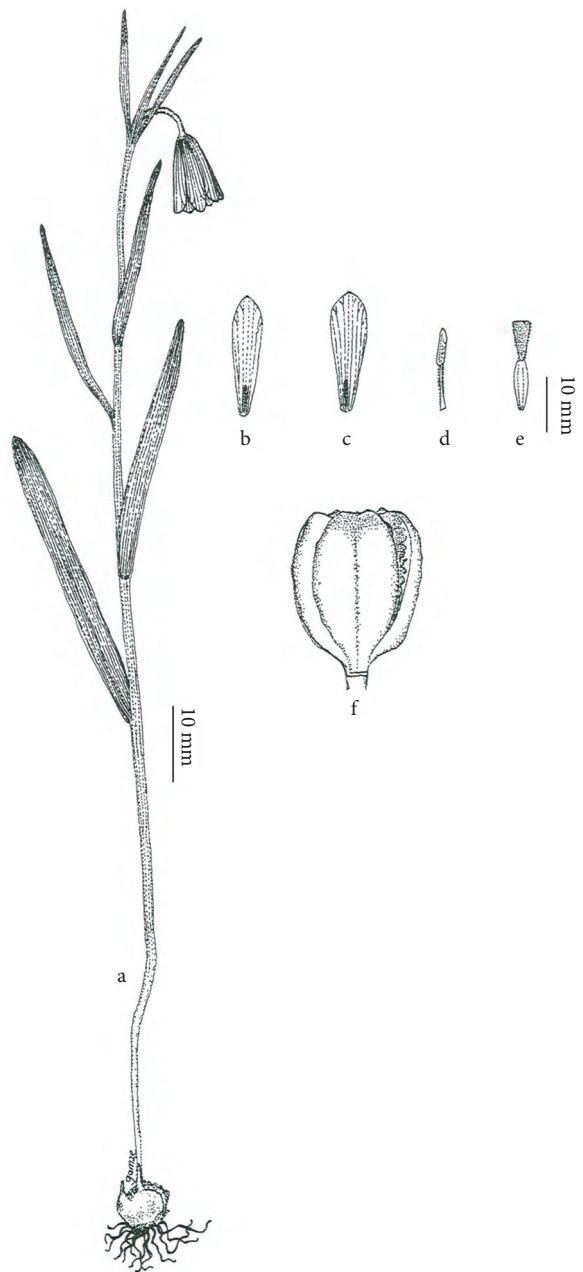


Figure 11. *Fritillaria alfredae* subsp. *platyptera*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

≡ *F. platyptera* Samuelsson apud. Rech. Fil. in Ark. Bot. ser. 2, 1(5): 303 (1949).

Type: Syria, Latakia, Mt. Cassius (Yayla Da.), near the crossing at Ain el Aramie, in *Quercetum cerris*, 1933, *Samuelsson* 5864 (holo. S!).

Fl: 4-5.

Habitat: *Quercus* forest, *Quercus coccifera* scrub, 500-800 m.

Specimens examined: C6 Hatay: Yayladağ, road junction of Kışlak-Çabala, 4.5-5 km from Yayladağ, 700-750 m, 22.04.2000, *M. Tekşen* 1981 (fl.) (GAZI); *ibid.*, 09.06.2002, *M. Tekşen* 2164 (fr.) (GAZI).

Distribution: Turkey, Syria. East Mediterranean element.

subsp. **glaucoviridis** (Turrill) Rix in Kew Bull. 33: 598, f. 3 (1979).

Type: Turkey, C5 İçel: described from plants cultivated at Glasnevin (Ireland) from bulbs received from W. Siehe, who collected it from the Mersina district of Southern Asia Minor (Cilicia) (holo. K!) (Figures 7 & 12).

= *F. glaucoviridis* Turrill in Gard. Chron. ser. 3, 93: 3 34 (1933).

Type: Turkey, locality unknown: described from plants cultivated as Glasnevin from bulbs received from W. Siehe (holo. K!).

= *F. haradjianii* Briq. ex Rech. fil in Ark. Bot. ser. 2, 5 (1): 8 (1959).

Type: Turkey, Adana: Amanus, Hasanbeyli, 1908, *Haradjian* 2219, fruit (holo. W).

Fl: 4-5.

Habitat: *Quercus* and *Fagus* forest and scrub, *Quercus coccifera* scrub, 500-1600 m.

Specimens examined: C6 Hatay: Belen, Güzelyayla village, 10.04.1999, 850-900 m, *M. Tekşen* 1929 (fl.) (GAZI); *ibid.*, 29.03.2001, *M. Tekşen* 2107 (fl.) (GAZI); *ibid.*, 10.07.2001, *M. Tekşen* 2107 (fr.) (GAZI); Fevzipaşa, 12.04.1934, *Balls* 761 (ANK); Osmaniye to Fevzipaşa, 14.04.1935, *Balls* 2122 (ANK); Osmaniye, Zorkun plateau, Amanos Mt., 1000 m, 14.04.1968, *Akman* 5007 (ANK); Kahramanmaraş: Engizek Mt., around Aksu district, c. 1000 m, 04.06.1988, *Duman* 4020 (GAZI); *ibid.*, 25.4.1988, *Duman* 3859 (GAZI). C5 Adana: Kozan to Feke, 10 km from Kozan, 550 m, 11.04.1957, *D.* 26586 (ANK); Feke, Belen village, 650 m, 21.05.1993, *M. Vural* 6399 & *Koyuncu* (HUB). C6 Adana: Osmaniye to Fevzipaşa, Nurdağı pass, 09.04.1986, 1110 m, *Max Nydegger* (HUB).

Conservation status: VU B2b (iii).

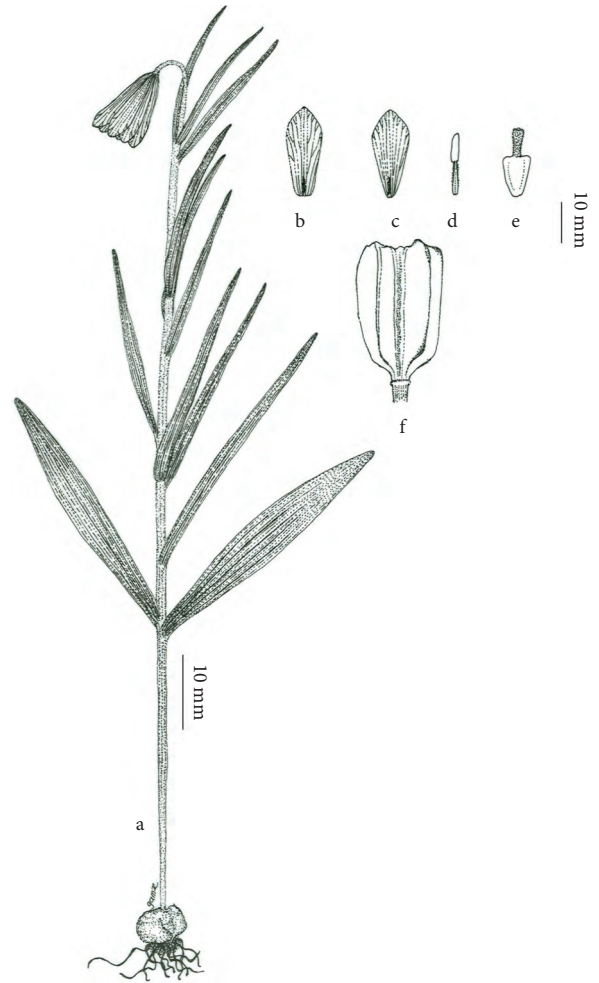


Figure 12. *Fritillaria alfredae* subsp. *glaucoviridis*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

Distribution: Endemic. East Mediterranean element.

F. alfredae differs from *F. bithynica*, which is a similar species, by its glaucous leaves (not green), smooth style (not papillose). *F. alfredae* subsp. *platyptera* can be distinguished from subsp. *glaucoviridis* by its alternate and linear to linear-lanceolate lowest leaves, not opposite or subopposite and oblanceolate-ovate.

9. ***Fritillaria bithynica*** Baker in J. Linn. Soc. (Bot.) 14: 264 (1874).

Type: Turkey, A2 (A) Bursa: Bithynia in Monte Olympo (Ulu Da.), c. 1850, *Noe* (lecto. K!) (Figures 13-14).

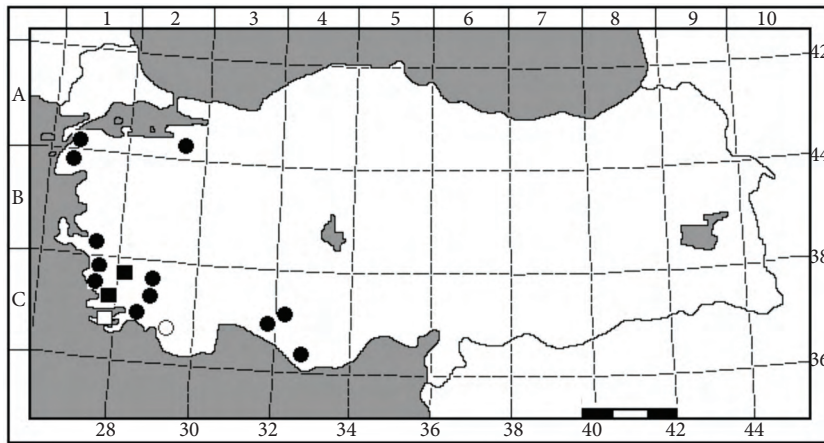


Figure 13. Distribution in Turkey of *Fritillaria bithynica* (●), *F. milasense* (■), *F. forbesii* (○), and *F. mughlae* (□).

= *F. dasyphylla* Baker in Gard. Chron. ser. 2, 3: 653 (1875).

Type (Turkey): between Muğla and Aydın, *Elwes s.n.* (lecto. K).

= *F. schliemannii* Sint ex Rodigos in III. Hort. 31: 106 (1884).

Type: Turkey, Çanakkale: Erenköy, 1883, *Sintenis* 82 (iso. BM, E, G, K, P, ZU).

= *F. citrina* Baker in Gard. Chron. ser. 3, 13: 538 (1893).

Type: Turkey, 'Tauros', cultivated specimen (K).

= *F. pineticola* O. Schwarz in Feddes Rep. 36: 69 (1934).

Type: Turkey, İzmir: Mahmut Dağ near Armutlu, Schwarz 464 (holo. B, iso. ANK!).

Bulb 0.5-1.1 × 0.9-2 cm, subglobose, ovoid, without bulblets or 1-3, tunica thin and papery. Stem erect, 7-35 cm, entire. Leaves 5-17, sessile, glaucous. Lowest leaves 2-8 × 0.5-2.6 cm, opposite or subopposite, broadly oblanceolate-ovate, narrowly lanceolate, elliptic, acute. Median leaves 2.5-6 × 0.2-0.7 cm, alternate, linear, narrowly lanceolate, acute or acuminate. Bracts (1-) 3 (-4), 1.5-3.9 × 0.15-0.4 cm, verticillate, linear, linear-lanceolate, acuminate. Flowers 1-4. Perigon narrowly campanulate, outside glaucous, inside greenish-yellow, shining. Outer segments 16-26 × 4-9 mm, lanceolate, oblong, acute or obtuse, ciliate-tufted at apex; inner segments 16-26

× 5-12 mm, oblanceolate or obovate, obtuse, ciliate-tufted at apex. Nectaries 3-5 × 1-1.5 mm, lanceolate or narrowly lanceolate, green or yellowish-brown, at base of tepals. Filaments 5-9 mm, papillose, creamy anthers 3-5 mm, oblong or elliptic, yellow, basifixed. Style 7-10.5 mm, undivided, smooth; stigma entire. Capsule 13-28 × 10-18 mm, obovoid, truncate at apex, cuneate at base, 6-winged, wings 2-6 mm. Seeds 4-6.5 × 4-6 mm, flat, obovate, orbicular, oblanceolate, testa brown, reticulate-faveolate.

Fl: 3-5.

Habitat: *Pinus brutia* forest and *Quercus coccifera* scrub, rocky and stony places, 40-1800 m.

Specimens examined: **A2** Bursa: Uludağ, Aras road, 16.05.1944, *M. Başarman* (ISTF). **C2** Muğla: Marmaris, Değirmenyani, around Kargıcak castle, 36°49'619"N, 28°09'955"E, 50-100 m, 23.03.2000, *M. Tekşen* 1961 (fl.) (GAZI); *ibid.*, 14.07.2001, *M. Tekşen* 2114 (fr.) (GAZI); Marmaris, Değirmenyani, İçmeler road, Kabasakız, E side, 36°49'545"N, 28°10'300"E, 50-70 m, 24.03.2000, *M. Tekşen* 1962 (fl.) (GAZI); *ibid.*, 18.04.2000, *M. Tekşen* 1984 (fl.) (GAZI); Marmaris, Değirmenyani, to Kargıcak castle, 36°49'578"N, 28°09'698"E, 40-60 m, 24.03.2000, *M. Tekşen* 1963 (fl.) (GAZI); Marmaris, Gökçe-Çetibeli, 23 km from Marmaris, 37°00'761"N, 28°19'924"E, 150 m, 01.03.2001, *M. Tekşen* 1995 (fl.) (GAZI); Marmaris-Köyceğiz, 20.04.1995, *Koyuncu* (AEF); Yılanlıdağı, 750-1000 m, 11.04.1981, *A. Güner* 3445 & *B. Yıldız* (HUB); 5 km from Muğla to Fethiye,

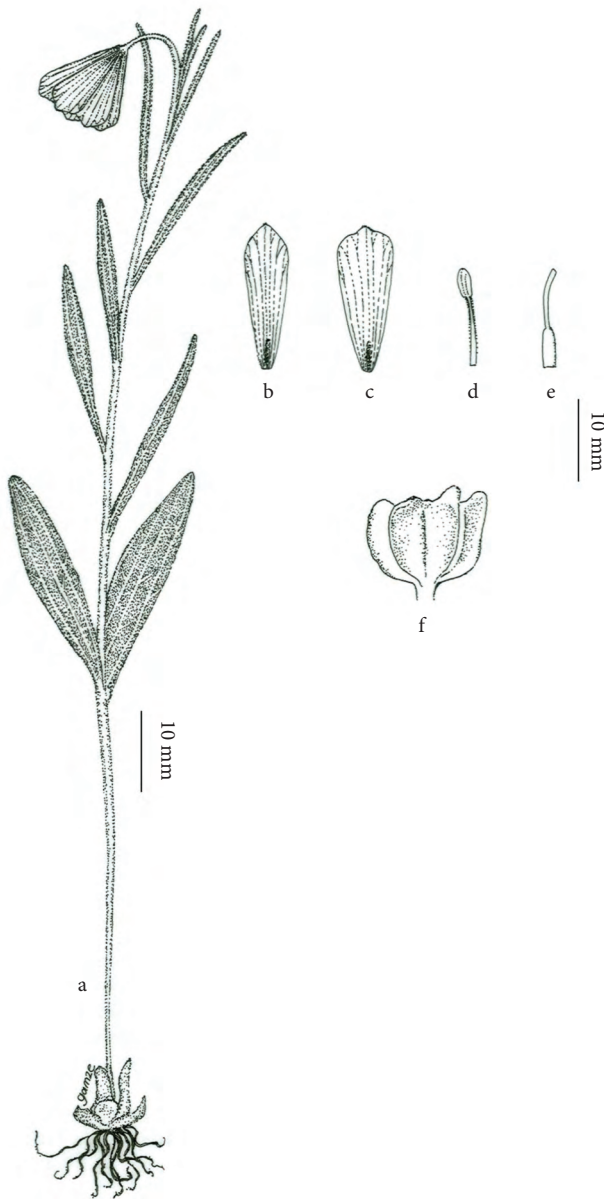


Figure 14. *Fritillaria bithynica*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

c. 700 m, 10.04.1981, A. Güner 3405 & B. Yıldız (HUB).
C3 Antalya: Gündoğmuş, 1200 m, 14.05.1971, Çetik 3945 (ANK). **C4** Konya: Bozkır, Haydar Mt., 1800 m, 15.06.1968, R. Çetik, T. Ekim, E. Yurdakulol 68 (KNYA);
 İçel: Anamur, 25 km E of Anamur, 100 m, 20.05.1976, R. Çetik, M. Vural, M.H.Khan 4608 (KNYA).

Distribution: Turkey and East Aegean Islands.
 East Mediterranean element.

F. bithynica differs from the other species by its mostly verticillate bracts 3 (rarely 1 or 4 bracts), glaucous flowers, slender; smooth and undivided style and winged capsule. *F. bithynica* differs from the *F. alfredae*, which is a similar species, by its green leaves (not glaucous), papillose style (not smooth).

10. ***Fritillaria milasense*** M. Tekşen & Aytaç in Isr. J. Plant Sci. 52: 347 (2004).

Type: Turkey. C2 Muğla: Yatağan-Milas, Turgut, Katrancı village, 22.03.2001, 700 m, edge of *Pinus pinea* forest, sandy soil, M. Tekşen 1999 (holo. GAZI, iso. ANK, ISTF, HUB) (Figures 13 & 15).

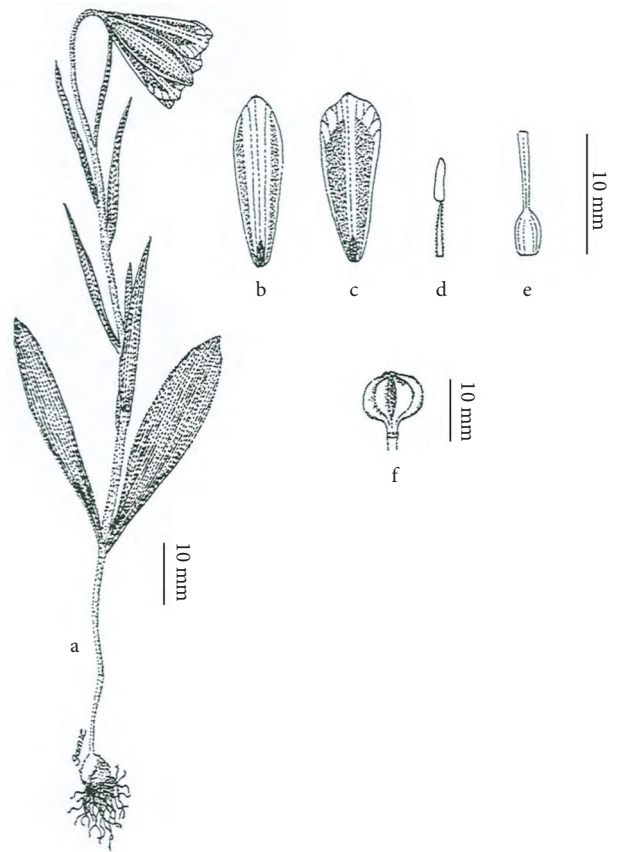


Figure 15. *Fritillaria milasense*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

Bulb subglobose, ovate, 0.5-1.0 × 0.4-1.1 cm, tunica thin and papery. Stem erect, 5-18.5 cm, usually papillose below. Leaves 4-14, sessile, green. Lowest leaves 1.9-6.6 × 0.4-2.1 cm, opposite, subopposite to

alternate, narrowly lanceolate, broadly oblanceolate to obovate, elliptic, spathulate, acute. Median leaves $1.1-5.4 \times 0.1-0.45$ cm, opposite or alternate; linear, acuminate. Bract 1 (-2), $0.9-3.4 \times 0.1-0.25$ cm, opposite; linear, acuminate. Flowers 1-3. Perigon narrowly campanulate; segments purple with a clear yellow stripe or yellow with purplish-brown stripe and outside with a yellowish apex. Outer segments $12-23 \times 3.5-7$ mm, lanceolate or oblanceolate, oblong, acute or obtuse, ciliate-tufted at apex; inner segments $12-23 \times 4-8.5$ mm, oblanceolate-obovate, obovate, apiculate, ciliate-tufted at apex. Nectaries $3-5 \times 1-1.5$ mm lanceolate to narrowly lanceolate, green, at base of tepals. Filaments $5-7.5$ mm, papillose, yellow; anthers $3-7$ mm, oblong or elliptic, yellow, basifixed. Style $4-10$ mm, undivided and smooth; stigma entire. Capsule $9-11 \times 10-12$ mm, obovoid-orbicular, truncate at apex, cuneate at base, unwinged. Seeds $3.5-5 \times 3-4.5$ mm, flat, obovate, triangular, oblanceolate, testa brown, reticulate-faveolate.

Fl: 3-5.

Habitat: In the screen of *Pinus pinea* L. forest, on sandy soil, *Quercus* scrub, 700-760 m.

Specimens examined: C2 Muğla: Yatağan-Bozdoğan, between Çamlıyurt and Yeşilköy village, 7 km, 22.03.2001, 730 m, *M. Tekşen* 2002 (fl.) (GAZI); Yatağan-Bozdoğan, Çamlıyurt village, 22.03.2001, 760 m, *M. Tekşen* 2004 (fl.) (GAZI); *ibid.*, 14.07.2001, *M. Tekşen* 2116 (fr.) (GAZI).

Conservation status: CR B1b (iii, iv).

It is stated in a footnote in the *Flora of Turkey* that, in the southern part of the distribution of the *F. bithynica* species, populations with unwinged capsules exist. Morphologically, these specimens differ from *F. bithynica* by their glaucous leaves (not green); bracts 1 (-2) [not (1-) 3 (-4)]; flowers purple with a clear yellow stripe outside and inside or yellow with purplish-brown stripe and with a yellowish apex outside (not outside glaucous, inside yellowish-green, shining green), capsule $9-11 \times 10-12$ mm, unwinged (not $13-28 \times 10-18$ mm, 6-winged).

11. *Fritillaria forbesii* Baker in J. Linn. Soc. (Bot.) 14: 264 (1874).

Type: Turkey, C2 Muğla: Lycia 'in dumetis rupestribus ad Macri' (Fethiye), s.l.-1000 m, 1842, *E. Forbes* 626 (lecto. K!) (Figures 13 & 16).

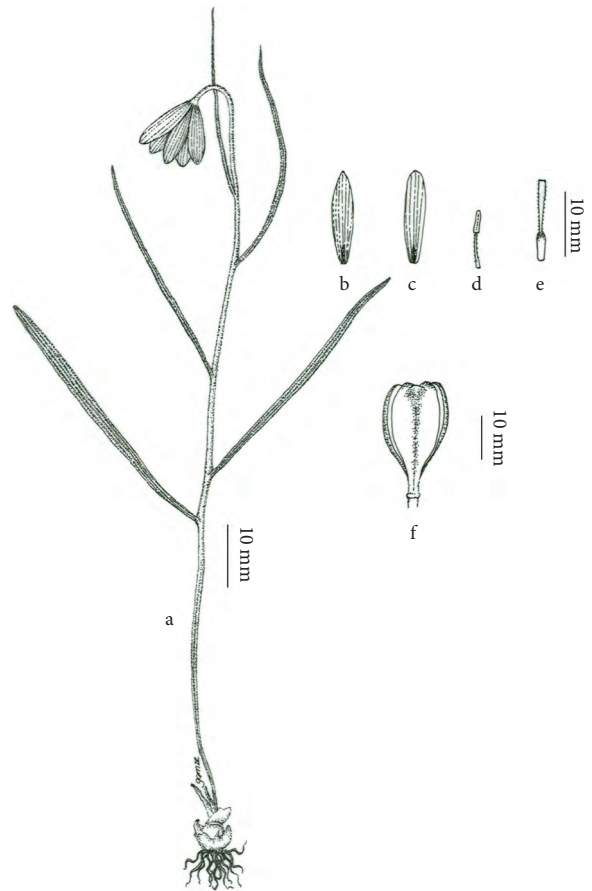


Figure 16. *Fritillaria forbesii*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

Bulb globose, $0.6-1.2 \times 0.6-1.5$ cm; tunica thin and papery. Stem erect, $8-31$ cm, papillose below around base and lowest leaves or smooth. Leaves $5-10$, sessile and alternate, green. Lowest leaves $4.6-15.8 \times 0.1-0.7$ cm, linear, acuminate. Median leaves $3.4-16.5 \times 0.1-0.5$ cm, linear, acuminate. Bract 1, $2.1-13.3 \times 0.1-0.3$ cm, linear, acuminate. Flowers 1-2. Perigon narrowly campanulate, yellow. Outer segments $14-25 \times 3.5-6.5$ mm, oblanceolate or lanceolate, obtuse, ciliate-tufted at apex; inner segments $14-25 \times 3-6$ mm, lanceolate, obtuse, ciliate-tufted at apex. Nectaries $2-5 \times 1$ mm, lanceolate, greenish-yellow, at base of tepals. Filaments $4-9$ mm, enlarged to base, papillose, papillae decreasing to base, yellow; anthers $4-8$ mm, oblong-elliptic, yellow, basifixed. Style $6-10.5$ mm, undivided, papillose; stigma clavate. Capsule $21-22 \times 12-14$ mm, narrowly obovoid, not winged. Seeds $3.5-7 \times 3.5-5$ mm, flat, ovate, testa pale brown, reticulate-faveolate.

Fl: 2-3.

Habitat: *Pinus brutia* forest, scrub and serpentine, 0-1000 m.

Specimens examined: C2 Muğla: Fethiye, Mendos Mt., 1-2 km from Ovacık village, 36°32'743"N, 29°11'586"E, 500-700 m, 02.03.2001, *M. Tekşen* 1997 (fl.) (GAZI); ibid., 13.07.2001, *M. Tekşen* 2111 (fr.) (GAZI).

Conservation status: EN B2ab (iii).

Distribution: Endemic. East Mediterranean element.

F. forbesii can be distinguished from the *F. sibthorpiana* species by its linear leaves and clavate style. It is stated in a footnote in the *Flora of Turkey* that *F. forbesii* is close to *F. carica*. However, it differs distinctly from *F. carica* by its linear and small leaves and leaf measurements, greenish-yellow nectary and clavate style. According to the pollen shape and morphological characteristics, it is between *F. bithynica* and *F. sibthorpiana*. *F. forbesii*, which is the only species with linear leaves among the yellow flowered *Fritillaria* species, is rearranged in the *Flora of Turkey*, because it was considered that the species should be placed between *F. bithynica* and *F. sibthorpiana* as phylogenetic. After this rearrangement, it seems that it is morphologically between *F. bithynica* and *F. carica*, since the number of leaves is decreased, broadness of style is increased, style is divided, and the smooth style is changed to the papillose style.

12. *Fritillaria mughlae* M. Tekşen & Aytaç in Ann. Bot. Fennici 45: 141 (2008).

Type: Turkey, C1 Muğla: Marmaris-Datça, Hisarönü-Emecik, 45 km from Datça, 70-80 m, 01.03.2001, rocky slopes, *M. Tekşen* 1996 (holo. GAZI, iso. ANK, ISTF, HUB) (Figures 13 & 17).

Bulb globose, 0.8-1.2 × 0.8-1.7 cm; tunica thin and papery. Stem erect, 7-25 cm, entire. Leaves 5-12, sessile and alternate, glaucous. Lowest leaves 4.5-12.3 × 0.5-0.8 cm, linear-lanceolate, acuminate. Median leaves 3.2-12.5 × 0.2-0.7 cm, linear, acuminate. Bract 1, 2.8-9.2 × 0.1-0.4 cm, linear, acuminate. Flowers 1-2. Perigon narrowly campanulate, greenish-yellow, fading to purple veins. Outer segments 14-20 × 5-6 mm, lanceolate, obtuse, ciliate-tufted at apex; inner

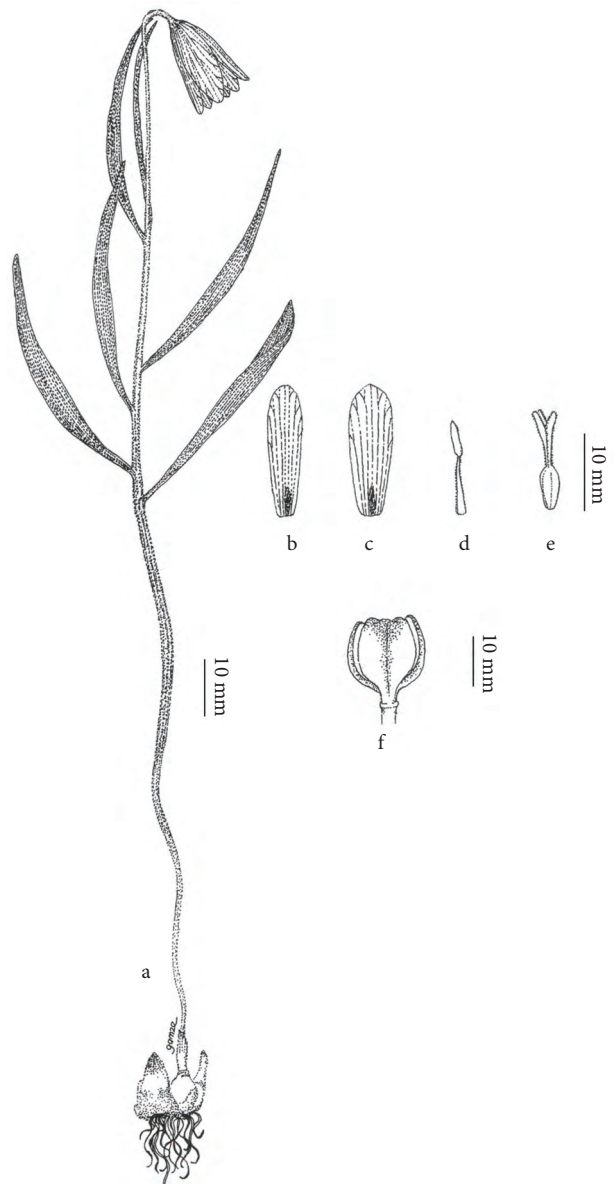


Figure 17. *Fritillaria mughlae*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

segments 14-20 × 4-5 mm, lanceolate, obtuse, ciliate-tufted at apex. Nectaries 3-4 × 1 mm, lanceolate, greenish-yellow, at base of tepals. Filaments 6.5-8 mm, broaden to base, papillose, yellow; anthers 3.5-5 mm, oblong-elliptic, yellow, basifixed. Style 6-8 mm, 3-fid, branches 1-3 mm, papillose; stigma entire. Capsule 18-21 × 10-13 mm, narrowly obovoid, not winged. Seeds 3.5-6 × 3.5-5 mm, flat, ovate, testa pale brown, reticulate-faveolate.

Fl: 2-3.

Habitat: *Quercus* scrub, rocky slopes, serpentine, c. 80 m.

Specimens examined: C1 Muğla: Marmaris-Datça, Hisarönü-Emecik, 45 km from Datça, 70-80 m, 14.07.2001, rocky slopes, *M. Tekşen* 2115 (fr.) (GAZI). C2 Muğla: Marmaris to Emecik, 350 m, 25.03.1956, *D. 25375* (ANK).

Conservation status: CR B1b (iii, iv).

Distribution: Endemic. East Mediterranean element.

F. mughlae differs from *F. forbesii* by its linear-lanceolate and glaucous leaves, greenish-yellow fading to purple vein flowers and 3-fid style. It is stated in a footnote in the *Flora of Turkey* that specimens which were collected by Davis from "C2 Muğla: Emecik, Marmaris" were *F. forbesii*. However, after collecting some specimens during our field work in the same location, they were investigated for morphological, palynological, cytological, and molecular data. As a result of these studies, these samples were described as a new species (Tekşen & Aytaç, 2008). In the *Flora of Turkey*, the mentioned specimen of Davis (*D. 25375*) was investigated at the ANK and it was observed that these specimens belong to *F. mughlae*.

13. *Fritillaria sibthorpiana* (Sm.) Baker in J. Linn. Soc. (Bot.) 14: 275 (1874).

Bulb globose, 0.5-0.7 × 0.7-2 cm; tunica thin and papery. Stem erect, 8-30 cm, entire. Leaves 2-4

(-7), sessile or small petiolate, glaucous or shining. Lowest leaves 2.5-23 × 1-5 (-10) cm, alternate or subopposite, elliptic, ovate-lanceolate, broadly lanceolate, amplexicaule or not, acute or obtuse. Median leaves 5.3-10.4 × 0.5-1 cm, alternate, lanceolate, narrowly lanceolate, linear-lanceolate, acuminate. Bract 1; 2.7-12 × 0.15-2.0 cm, linear or broadly lanceolate, acuminate. Flowers 1-2. Perigon narrowly campanulate, shining canary yellow or matt yellow to yellowish-green. Outer segments 13-23 × 4-8 mm, lanceolate, obtuse, ciliate-tufted at apex; inner segments 13-23 × 4-9 mm, lanceolate, obtuse or acute, ciliate-tufted at apex. Nectaries 3-4 × 1 mm, linear-lanceolate, green, at base of tepals. Filaments 5-8 mm, papillose, yellow; anthers 3.5-6 mm, oblong, apiculate, yellow, basifixed. Style 5-8 mm, undivided, papillose; stigma entire. Capsule 11-19 × 13-26 mm, orbicular, ovoid, ovoid-oblong, cuneate, not winged. Seeds 4.5-8 × 4-6 mm, flat, obovate, testa brown or pale brown, reticulate-faveolate.

1. Leaves 2-3, ovate-lanceolate, glaucous; perigon canary yellow.....subsp. **sibthorpiana**

1. Leaves 3-5, linear-lanceolate, shining; perigon greenish-yellow.....subsp. **enginiana**
subsp. **sibthorpiana**.

Type: Turkey, C2 Muğla: prope Cressam (nr Büğüş), hodie Porto Cavalieri (nr Akyar burnu), *Sibthorp* (lecto. OXF!) (Figures 18-19).

≡ *Tulipa sibthorpiana* Sm. in *Sibth. & Sm.*, Prodr. Fl. Graec.1: 229 (1809).

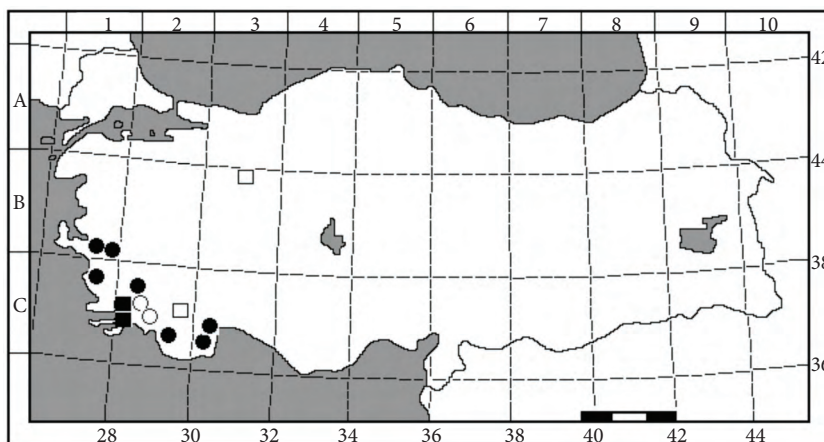


Figure 18. Distribution in Turkey of *Fritillaria sibthorpiana* subsp. *sibthorpiana* (■), *F. sibthorpiana* subsp. *enginiana* (○), *F. carica* (●), and *F. serpenticola* (□).

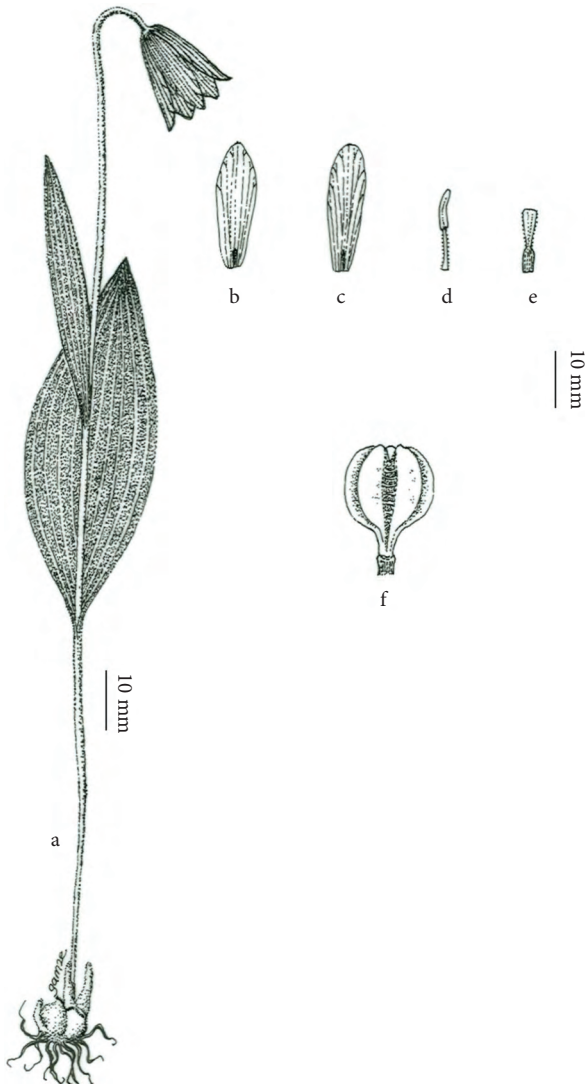


Figure 19. *Fritillaria sibthorpiana* subsp. *sibthorpiana*. a-habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

Type: Turkey, Muğla: 'prope Cressam, hodie Porto Cavalieri', *Sibthorp* (lecto. OXF!).

Fl: 3-4.

Habitat: *Pinus brutia* forest, limestone rocky slopes, open scrub, 30-500 m.

Specimens examined: C2 Muğla: Marmaris, Hisarönü, road distinction of Bozburun-Hisarönü, N 36°49' E 28°09', 30-50 m, 23.03.2000, *M. Tekşen* 1960 (fl.) (GAZI); *ibid.*, 14.07.2001, *M. Tekşen* 2113 (fr.) (GAZI); Marmaris, Değirmenyanı, to Kargıcak castle, 36°49'743"N, 28°09'539"E, 30-50 m, 24.02.2000, *M. Tekşen* 1964 (fl.) (GAZI); *ibid.*, 24.03.2000,

M. Tekşen 1985 (fl.) (GAZI); -Bozburun-Söğütköy, c. 1 km from yacht harbour, 36°40'529"N, 28°04'762"E, 20-50 m, 24.03.2000, *M. Tekşen* 1965 (fl.) (GAZI); Bozburun, Söğütköy-Taşlıca village, around grinder, 36°38'005"N, 28°05'887"E, 100-150 m, 25.03.2000, *M. Tekşen* 1966 (fl.) (GAZI); Bozburun, Söğütköy-Taşlıca village, 36°38'268"N, 28°05'953"E, 100-150 m, 25.03.2000, *M. Tekşen* 1967 (fl.) (GAZI); Bozburun, Taşlıca-Serçe villages, 36°36'134"N 28°03'777"E, 50-100 m, 25.03.2000, *M. Tekşen* 1968 (fl.) (GAZI); Marmaris-Turunç road, 400 m, 27.04.1993, *Koyuncu* (AEF); Marmaris, Bozburun road, above Bayır village, 500 m, 30.04.1982, *M. Koyuncu* 5057 (AEF).

Distribution: Turkey and Aegean Islands. East Mediterranean element.

subsp. **enginiana** Byfield & N. Özhatay, *The Karaca Arb. Mag.* 3, 1: 7-16 (1995).

Type: SW Turkey, C2 Muğla: Köyceğiz, Sandras Mt., Pankuduz hill, under woodland, rocky and moist slopes, 1000 m, 6.iv.1977, *E. Özhatay* 1077 (holo. ISTE, iso. ISTO, MARA) (Figures 18 & 20).

Fl: 2-4.

Habitat: *Platanus orientalis* and *Pinus brutia* forest, limestone and serpentine rockies, open scrub, 30-1450 m.

Specimens examined: C2 Muğla: Köyceğiz, Ekincik village, around Kargıcak, 36°49'670"N, 28°33'876"E, 50-100 m, 26.03.2000, *M. Tekşen* 1971 (fl.) (GAZI); *ibid.*, 26.03.2000, *M. Tekşen* 1972 (fl.) (GAZI); *ibid.*, 14.07.2001, *M. Tekşen* 2113a (fr.) (GAZI); Dalyan, Yıldırımli hill, 26.02.1999, 200 m, *H. Duman* 6882 (GAZI); Köyceğiz, Ekincik village, around Kargıcak, 19.03.1991, 30-200 m, *A. Güner* 8324 (GAZI, HUB); Köyceğiz, Çandır village-Boğazarası, 14.03.1992, *A. Güner* 10358 (HUB); Köyceğiz, Ülemez Tepe, 36°51'225"N, 28°35'016"E, 1884 m, 26.04.2008, *A. Güner* 14604 (GAZI).

Conservation status: EN B2b (iii).

Distribution: Endemic. East Mediterranean element.

F. sibthorpiana is distinguished by *F. carica* by its brown nectaries, amplexicaul or petiolate lowest leaves. The 2 subspecies can distinguished from each other with the given characteristic key.

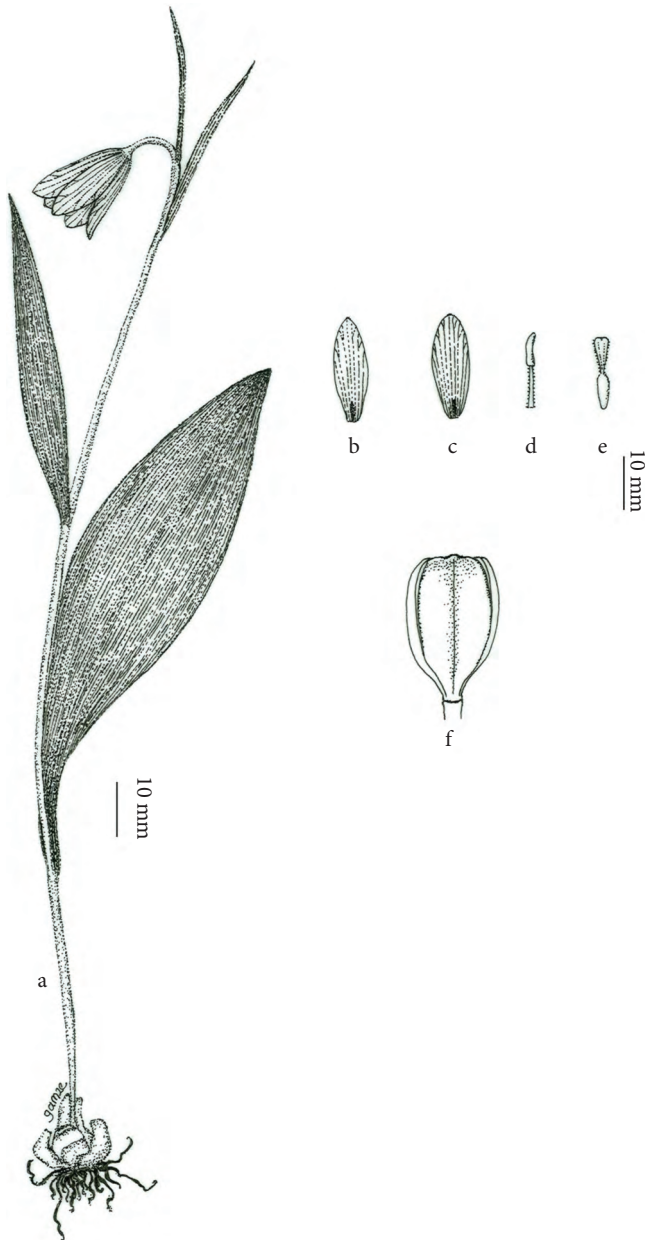


Figure 20. *Fritillaria sibthorpiana* subsp. *enginiana*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

14. *Fritillaria carica* Rix in Kew Bull. 30: 156 (1975).

Type: Turkey, C1 İzmir: Samsun Dag above Güzelcamli, 800 m, summit ridge in *Pinus brutia* forest, 24.iv.1965, *Davis* 41737 (holo. E!) (Figures 18 & 21).

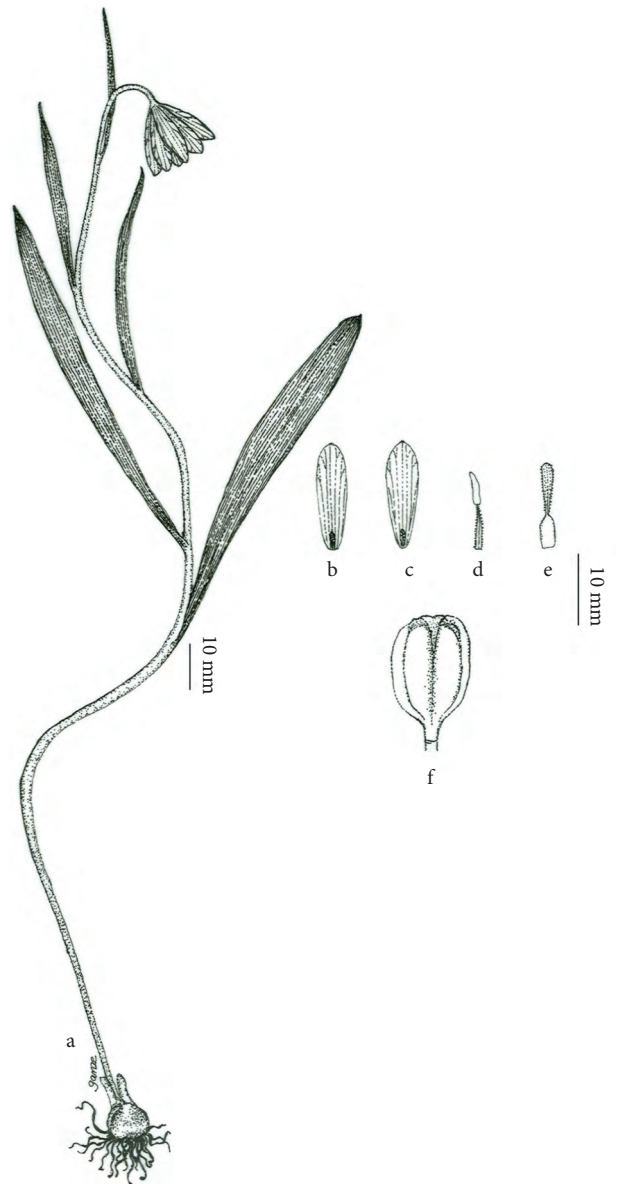


Figure 21. *Fritillaria carica*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

= *F. tulipifolia* Bieb. var. *dasyphlla* Baker in J. Linn. Soc. (Bot.), 14: 266 (1874) non *F. dasyphylla* Baker (1875).

= *F. chia* Boiss. ex Nyman, Consp.: 722 (1882), pro. syn.

= *F. sibthorpiana* sensu. Boiss., Fl. Or. 5: 187 (1884), pro parte (specimena ex Nymph

Dagh) non (Sibth. & Sm.) Baker.

Bulb obovoid, 0.7-2 × 0.8-1.5 cm, tunica thin and papery. Stem erect, 3-22 cm, entire, smooth or around lowest leaves papillose. Leaves 4-8, sessile, alternate, glaucous. Lowest leaves 3.0-12.5 × 0.6-2.1 cm, narrowly lanceolate or narrowly oblanceolate, elliptic-lanceolate, acute, papillose on margins. Median leaves 3.6-8.7 × 0.2-0.5 cm, narrowly lanceolate, acuminate. Bract 1; 2.5-4.4 × 0.1-0.2 cm, linear, acuminate. Flowers 1(-3). Perigon narrowly campanulate, yellow, greenish-yellow, sometimes purple on margins of tepal. Outer segments 13-23 × 4-8.5 mm, lanceolate, obtuse, ciliate-tufted at apex; inner segments 13-23 × 5-6.5 mm, obovate-lanceolate, obtuse, ciliate-tufted at apex. Nectaries 2-5.5 × 1-1.5 mm, linear-lanceolate, brown, at base of tepal. Filaments 5-11.5 mm, papillose, yellow; anthers 3-5 mm, yellow, elliptic, basifixed. Style 6-10 mm, undivided or 3-lobed, lobes up to 1 mm, densely papillose; stigma entire. Capsule 10-25 × 13-19 mm, globose, obovoid, oblong, cuneate, not winged. Seeds 4.5-8 × 3-6.5 mm, flat, obovate, testa brown, faveolate.

Fl: 3-5.

Habitat: *Pinus brutia* and *P. nigra* forest, *Quercus coccifera* scrub, *Cedrus libani*, *Juniperus excelsa* forest, limestone rocky and stony places, alpine steppe, 200-2200 m.

Specimens examined: C1 Muğla: Bodrum, Gündoğan road, c. 150 m, 19.03.2001, *F.Ertuğ* 488 (GAZI). C2 Muğla: Yılanlıdağı, 750-1000 m, 11.04.1981, *A.Güner* 3437 & *B.Yıldız* (HUB); Fethiye, Mendos Mt., 36°32'743"N, 29°11'586"E, 1350 m, 23.03.2001, *M.Tekşen* 2009 (fl.) (GAZI); *ibid.*, 13.07.2001, *M.Tekşen* 2112 (fr.) (GAZI); C3 Antalya: Kemer, Tahtalı, 1000-2200 m, 06.06.1979, *Peşmen & Güner* 4292 (AEF, ANK, HUB); Çakırlar, Hisarçandır village, Sarıçınar hill-Karlık, 1380-1810 m, 24.03.1979, *Peşmen & A.Güner* 4263 (HUB).

Distribution: Turkey and Aegean Islands. East Mediterranean element.

F. carica can be easily distinguished from *F. serpenticola* by its narrowly lanceolate lowest leaves, not twisted leaves, narrowly campanulate flower, papillose filaments.

15. *Fritillaria serpenticola* (Rix) M.Tekşen & Aytaç in *Isr. J. Plant Sci.* 52: 351 (2004).

Type: Turkey, C2 Antalya: between Karaçulha and Altinyayla, in bare brown scree, 1700 m, 5.iv.1980, *O. Sonderhausen* 680 (holo. E!) (Figures 18, 22).

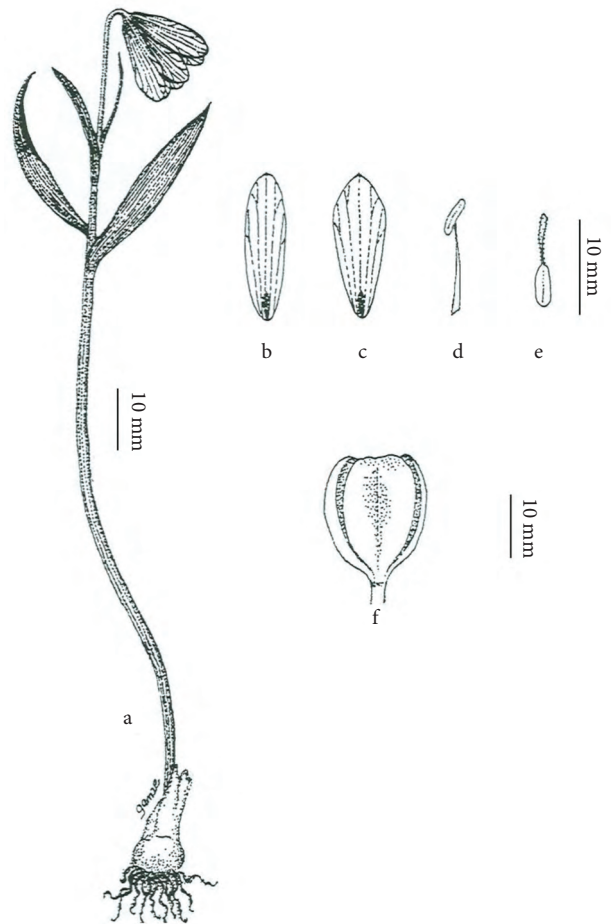


Figure 22. *Fritillaria serpenticola*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

≡ *F. carica* Rix subsp. *serpenticola* Rix in *Notes R.B.G. Edinb.* 31: 127, f. 1B (1971).

Type: Turkey, C2 Antalya: between Karaçulha and Altinyayla, in bare brown scree, 1700 m, 5.iv.1980, *O. Sonderhausen* 680 (holo. E!).

Bulb 0.8-1 × 0.8-1.5 cm, globose or obovoid, tunica thin and papery. Stem erect, 3-15 cm, smooth. Leaves 3-5, sessile, alternate and glaucous. Lowest leaves 2.7-7.5 × 0.5-1.8 cm, lanceolate, acute. Median leaves 1.7-6.7 × 0.1-0.7 cm, linear, acuminate, usually twisted at apex. Bract 1; 1.6-3.1 × 0.1 cm, linear,

acuminate, twisted at apex. Flowers 1(-3). Perigon conical, outside and inside yellow, fading to orange. Outer segments 11-20 × 3-7 mm, lanceolate, obtuse, ciliate-tufted at apex; inner segments 11-20 × 3.5-9 mm, oblanceolate, obtuse, ciliate-tufted at apex. Nectaries 2-4 × 1 mm, linear-lanceolate, brown, at base of tepal. Filaments 5-9 mm, smooth, yellow; anthers 2.5-3 mm, elliptic, yellow, basifixed. Style 6-10 mm, scarcely papillose; undivided or 3-lobed, lobes up to 1 mm, stigma entire. Capsule 11-24 × 13-19 mm, obovoid, cuneate, not winged. Seeds 4-7.5 × 3-6.5 mm, flat, obovate, testa shining, brown, faveolate.

Fl: 3-4.

Habitat: In serpentine with *Pinus* and *Juniperus* species, 1100-1700 m.

Specimens examined: B3 Eskişehir: Gökçekaya road, 59 km, 1100 m, *H.Malyer* 1454 (ANK, AEF). C2 Burdur: Altınyayla, Dirmil pass, 36°58'561"N, 29°34'419"E, 1500-1550 m, 18.04.2000, *M.Tekşen* 1975 (fl.) (GAZI); *ibid.*, 13.07.2001, *M.Tekşen* 2110 (fr.) (GAZI).

Conservation status: EN B2b (iii).

Distribution: Endemic. East Mediterranean element.

F. serpenticola can be distinguished by its conic flowers and blackish-brown nectaries. *F. serpenticola* differs from *F. carica* in having the lowest leaves broadly lanceolate (not narrowly lanceolate); upper

leaves twisted (not twisted); perigon conical (not narrowly campanulate); inner tepal 3.5-5 mm width (not 6-8 mm width); filaments smooth (not papillose); style 0.5 mm in diameter, sparsely papillose or only papillose at apex (not style 1 mm in diameter and densely papillose). Type specimens of these taxa were also investigated in the Kew Herbarium. As result of this taxonomic study, *F. carica* subsp. *serpenticola* was raised to species level (Tekşen & Aytaç, 2004).

16. *Fritillaria pinardii* Boiss., Diagn. ser. 1(7): 106 (1846).

Type: Turkey, C2: in Lycia, 1843, *Pinard* (holo. G!) (Figures 23-24).

= *F. armena* Boiss., Diagn. Ser. 1 (7): 106 (1846)

syn. nov. = *F. brevicaulis* Baker in Gard.

Chron. Ser. 3, 6: 38 (1889) (K!).

Type: Turkey, A8 Erzurum: in Armenia, prope Erzurum, *Aucher* 5377 (holo G!).

= *F. fleischeri* sensu Boiss., Fl. Or. 5: 186 (1884) non Steudel & Hochst. (1827)(G!).

= *F. zagrica* Stapf in Verh. Zool.-Bot. Ges. Wien 38: 551 (1888) **syn. nov.**

Type: Iran: vom Elwend, on Sultanabad und vom Kuh-i-barf bei Schiras, 1885, *Polak* (holo WU).

= *F. alpina* Freyn & Sint. in Öst. Bot. Zeitschr. 44: 327 (1894).

Type: A5 Kastamonu: d. Tosya, Giaur (Gavur) Da., *Sint.*, 1892: 3931 (GB!).

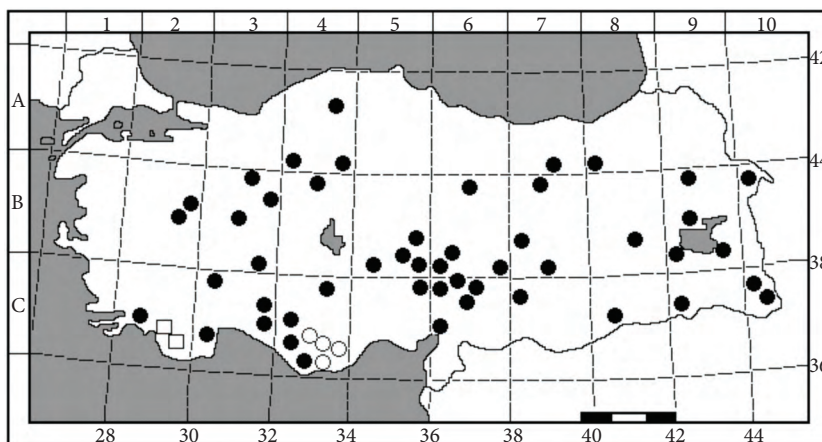


Figure 23. Distribution in Turkey of *Fritillaria pinardii* (●), *F. kittaniae* (□), and *F. assyriaca* subsp. *melananthera* (○).

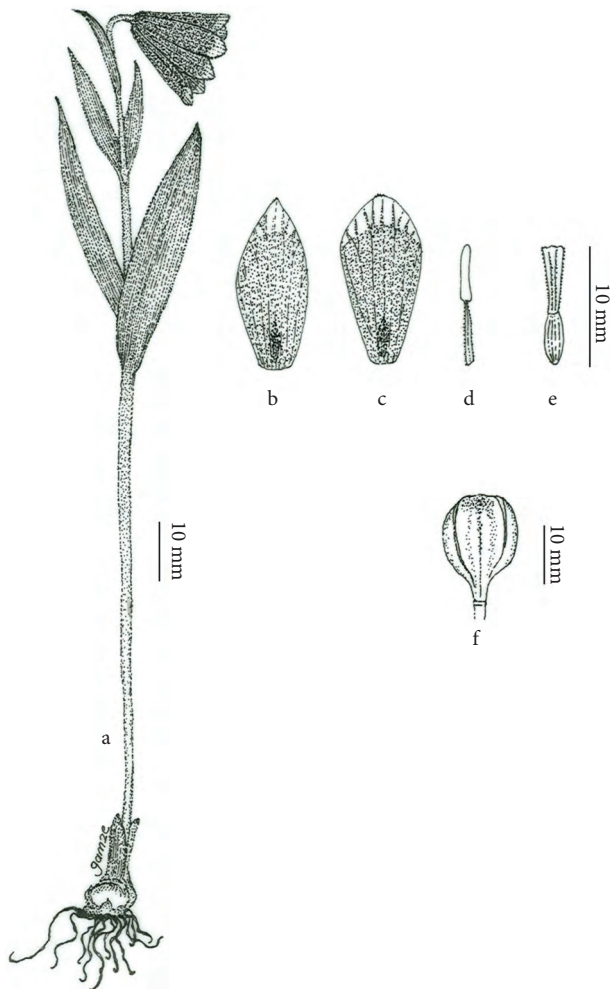


Figure 24. *Fritillaria pinardi*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

= *F. syriaca* Hayek & Siehe in Ann. Naturh. Mus. Wien. 28: 184 (1914).

= *Theresia pinardii* Klatt, Hamb. Gartenzeit. XVI. 439.

Bulb 0.5-1.2 × 0.7-3 cm, subglobose, globose, ovoid, bulblets 1 or many, tunica thin and papery, sometimes stolons. Stem erect, 4-20 cm, papillose below or smooth. Leaves 3-8 (-13), sessile, glaucous. Lowest leaves 2.2-9.7 × 0.4-2.4 cm, alternate or subopposite, narrowly or broadly lanceolate, elliptic, ovate, acute. Median leaves 1.4-6.5 × 0.15-0.9 cm, alternate, linear, elliptic, narrowly lanceolate, acuminate. Bract 1; 1.1-6 × 0.1-0.4 cm linear, linear-lanceolate, acuminate. Flowers 1-2(-4). Perigon narrowly campanulate, outside and inside purple or outside purple and

yellow at apex or exactly purple, glaucous, inside yellowish-orange or greenish-yellow or greenish, rarely outside and inside yellow. Outer segments 9-26 × 3-8.5 mm, lanceolate, ovate-lanceolate, oblong, acute or obtuse, ciliate-tufted at apex; inner segments 9-25 × 3-8 mm, narrowly oblanceolate, narrowly obovate, obtuse, ciliate-tufted at apex. Nectaries 1.5-6 × 0.5-1.5 mm, linear-lanceolate, green, 1 mm above tepal base. Filaments 6-16 mm, swollen or slender, broaden to base, densely or scarcely papillose, usually yellow, sometimes greenish-purple; anthers 2-7 mm, oblong, apiculate, yellow or purple, basifixed. Style 6.5-12 mm, undivided or 3-fid, branches 0.5-2 mm, densely or scarcely papillose; stigma entire. Capsule 11-30 × 11-15 mm, obovoid-oblong, cuneate, not winged. Seeds 3-7 × 3-5 mm, flat, obovate, obovate-orbicular, testa pale brown, reticulate-faveolate.

Fl: 4-6.

Habitat: Meadow, rocky slopes, alpinne steppe, *Pinus nigra* and *P. brutia* forest, open *Cedrus libani* forest, *Abies* forest, serpentine areas, edge of field, scrub, stony places, 900-2900 m.

Specimens examined: A4 Ankara: Ankara-Ayaş, Aysanti pass, 55 km from Ayaş, 1210 m, 01.06.2001, M. Tekşen 2097 (fr.) (GAZI); Ayaş, Ayaşbeli, 1200 m, 11.05.1993, A.A. Dönmez 3140 & Z. Aytaç, M. Ekici, F.A.K. (HUB, GAZI); Bağlum village, 1300 m, 25.04.1995, A.A. Dönmez 4454 (HUB); Keçiören, Hacıkadın river, c. 1010 m, 04.04.1955, K. Karamanoğlu 5376 (AEF); Ankara-Ayaş, 50 km, Ayaşbeli, 1200 m, 01.05.1993, Aytaç 5693 (GAZI); Kırıkkale: Sulakyurt, Yeşilyazı-Akkuyu village, 900 m, 08.04.1989, A.A. Dönmez 1074 (HUB); Çankırı: Ilgaz, Ilgaz Mt., 1900 m, 14.06.1992, A. Güner 10662 (GAZI, HUB); Kastamonu: Ilgaz Mt., TV tower, 2000 m, 17.06.1982, Y. Akman 12423 et al. (ANK). A8 Erzurum/Bayburt: Aşkale-Bayburt, Kop Mt., Kop pass, 2300 m, 17.05.2001, M. Tekşen 2082 (fl.) (GAZI); Aşkale-Bayburt, Kop Mt., Kop pass, Monument of martyr-military radar tower, 2400 m, 17.05.2001, M. Tekşen 2083 (fl.) (GAZI). B2 Kütahya: Gediz, Murat Mt., above Hamam, Gölyeri, 1750 m, 01.05.1977, M. Koyuncu (AEF); Gediz, Murat Mt., Sarıçiçek, 1800 m, 09.06.1977, A. Çırpıcı ISTF 30507 (ISTF); Gediz, Murat Mt., Kesiksöğüt, 1600 m, 18.05.1978, A. Çırpıcı ISTF 31515 (ISTF); Murat Mt. above Banaz, S. slope, 2000 m, 15.06.1965, Coode & Jones ISTF 20806

(ISTF); Uşak: Banaz, Murat Mt., Gürlek, Çukuroluk, 1650 m, 19.05.1978, *A.Çırpıcı* ISTF 31579 (ISTF). **B3** Konya: Akşehir, Sultan, Derecine plateau, 1800 m, 12.04.1986, *Y.Akman* 14297 (ANK); Eskişehir: Sündiken Mt., Bozalan, 1500 m, 02.05.1971, *T.Ekim* 669 (ANK); Afyon: Bayat, Yongalı hill, NE side, c. 1550 m, 26.04.1975, *M.Vural* 220 (GAZI); Isparta: Şarkikaraağaç, Kızıldağ Milli Parkı, around cemetery of Yörük, 900-1000 m, 25.03.1994, *B.Mutlu* 2248 (HUB). **B4** Ankara: Elmadağ, around radar, 1700 m, 27.04.1983, *M.Koyuncu* 5954 (AEF). **B5** Kayseri: Yılanlıdağ, 1250 m, 16.04.1996, *A.A.Dönmez* 5203 (HUB); *ibid.*, 20.04.1996, *Aytaç* 7336 (GAZI). **B6** Malatya: Doğanşehir, above Karşıyaka village, 1600-1700 m, 05.05.2002, *M.Tekşen* 2134 (fl.) (GAZI); Kahramanmaraş: Göksun, Acıelma village, Cennet river, 1800 m, 25.04.1981, *B.Yıldız* 2536 (HUB); Göksun, Çardak, Fındık village, Bostandere, 1800 m, 14.05.1978, *B.Yıldız* 1728 (HUB); Göksun, Korcağız village, Yuvaca Mt., 2000 m, 13.06.1978, *B.Yıldız* 2128 (HUB); Göksun, Berit Mt., Çavdar-Arpaçukuru, 1900-2550 m, 09.05.1991, *H.Duman & Z.Aytaç* 3777 (HUB). **B7** Malatya: Yaygın-Pütürge, Kubbe Mt., 1850 m, 04.05.2002, *M.Tekşen* 2133 (fl.) (GAZI); *ibid.* 17.04.2002, *M.Tekşen* 2115 (fl.) (GAZI); *ibid.* 19.04.2003, *M.Tekşen* 2168 (fl.) (GAZI); *ibid.* 16.05.2003, *M.Tekşen* 2176 (fl.) (GAZI); Erzincan: Erzincan-Refahiye, Alaçatlı village, Kurttepesi, 2100-2300 m, 25.05.2002, *M. Tekşen* 2140 (fl.) (GAZI). **B9** Bitlis: Adilceviz, Süphan Mt., Süte plateau, 2000 m, 04.06.1993, *Y.Altan* 4800 (GAZI); Tatvan, Nemrut Mt., E side, 2000-2900 m, 28.05.1972, *H.Peşmen* 2782 (HUB); Van: Erek Mt., above Değirmenköy, 38°30'148"N, 43°31'097"E, 2550 m, 26.05.2002, *M.Tekşen* 2152 (GAZI); Ağrı: Tahir, Tahir Mt., around radar, 2500 m, 25.05.2002, *M.Tekşen* 2149 (fl.) (GAZI); *ibid.*, 07.07.2002, *M.Tekşen* 2100 (fr.) (GAZI). **C3** Antalya: Akseki-Seydişehir, 500 m from Tınaztepe recreation service area, 1570 m, 21.04.2001, *M.Tekşen* 2041 (fl.) (GAZI); Akseki, Çukurköy plateau, Çağıldak, 12.06.1995, 2050 m, *Duran* 2750 (GAZI); Kemer, Tahtalı Mt., above Beycik village, 700-2000 m, 10.05.1978, *H.Peşmen* 3789 (HUB); Konya: Beyşehir, Kurucaova, Suludere, 1500-2000 m, 08.06.1975, *H.Peşmen & A.Güner* 1188 (HUB); Beyşehir, Kurucaova village, Kuzgun hill, 1350-1500 m, 24.04.1974, *H.Peşmen & A.Güner* 1032 (HUB, ANK); Isparta: 10-15 km from Isparta,

Aladağ, c. 1600-2000 m, 06.06.1981, *T.Ekim* 5629 & *B.Yıldız* (HUB); Eğirdir, Yukarı Gökdere village, Kasnak forest, 37°44'166"N, 30°49'507"E, 1507 m, 28.04.2008, *A.Güner* 14642 (GAZI). **C4** İçel: Anamur, Güneyli plateau, Kırkkuyu, 1800-1900 m, 11.04.1984, *H.Sümbül* 2779 (ANK, HUB); Konya: Sarıveliler-Taşkent, Barçın plateau, 1800 m, 02.05.1993, *M.Koyuncu* 9770 (AEF); Hadim, Aladağ-Mağara Mt., Saraybaşı, 1600 m, 16.04.1987, *M.Serin* 1267 (KNYA); Karapınar, Karacadağ, Sekikale hillside, 1400 m, 20.04.1983, *H.Dural* 1299 (KNYA); Karaman: Kazımkarabekir, 1400 m, 25.04.1983, *M.Serin* 768 (KNYA); Antalya: Gazipaşa, Çayırakası plateau, 1750 m, 20.05.1983, *H.Sümbül* 1873 (HUB); Gazipaşa, Sugözü village, Akçal hill, 1900-2000 m, 17.05.1983, *H.Sümbül* 1749 (HUB); Karaman: Ermenek-Karaman, north of Yelibel, 36°49'419"N, 32°55'412" E, 2030 m, 01.05.2008, *A.Güner* 14737 (GAZI); Ermenek-Karaman, south of Yelibel, 36°49'110"N, 32°55'425"E, 1920 m, 01.05.2008, *A.Güner* 14731 (GAZI); Ermenek-Karaman, around Akbel plateau, 36°41'366"N, 32°56'506"E, 1675 m, 01.05.2008, *A.Güner* 14722 (GAZI). **C5** Adana: Saimbeyli, Obruk plateau, 1300-1700 m, 02.06.1981, *S.Erik* 3130 (HUB). **C6** Kahramanmaraş: Ahır Mt., 7-8 km from Sulutarlabağları road distinction, 11.04.1999, 1450 m, *M.Tekşen* 1930 (GAZI); *ibid.*, 23.04.2000, *M.Tekşen* 1983 (fl.) (GAZI); *ibid.*, 11.04.1999, 1450 m, *M.Tekşen* 1934 (fl. yellow) (GAZI); Göksun, Tünel-Değirmendere, Püren pass, Angıtkayası, 37°56'603"N, 36°30'767"E, 1790 m, 21.05.2001, *M.Tekşen* 1993 (fl.) (GAZI)-Akher (Ahır) Mt., 1650 m, 01.05.1934, *Balls* 932 (ANK); Berit Mt., 1700 m, 01.05.1934, *Balls* 932a (ANK); Ahır Mt., around Hambur hill, 1800-2000 m, 02.05.1991, *Aytaç* 3510 & *Duman* (GAZI); Engizek Mt., Saçkayası, 2400-2500 m, 20.05.1987, *Duman* 2672 (GAZI); Erince Mt., 1400-1500 m, 22.04.1987, *Duman* 2513 (GAZI); Süleymanlı, Ilıca village, above Zorkunobası, 1800-2000 m, 24.04.1981, *B.Yıldız* 2519 (HUB); Adana: Osmaniye, Zorkun plateau, around fire tower, 2000 m, 07.05.1983, *Koyuncu* 5974 (AEF). **C8** Mardin: Hill on E of castle 900-1200 m, 14.04.1983, *Ş.Yıldırım* 4693 (HUB). **C10** Hakkari: Yüksekova, Esendere, Yıldız village, Şehsek and Destireşo, 1700-2150 m, 27.04.1978, *A.Güner* 1658 (HUB); Yüksekova, Esendere, 1700-1800 m, *A.Güner* 1882 (HUB), Esendere, above Sarıyıldız village, 1900

m, 21.04.2002, *M. Tekşen* 2123 (fl.) (GAZI); *ibid.*, 27.05.2002, *M. Tekşen* 2158 (fl.) (GAZI).

Distribution: Turkey, Iran, Armenia, Syria, Lebanon. Irano-Turanian element.

F. pinardii is distinguished from *F. kittaniae* by its outside and inside purple or outside purple and yellow at apex or exactly purple, glaucous, inside yellowish-orange or greenish-yellow or greenish, rarely outside and inside yellow.

There are very large variation limits in *F. pinardii*. Differences in morphological features are observed in the north-east, north-west, south, B5 and B6 squares of Turkey. Moreover, transitions exist among these populations.

Fritillaria specimens collected in the field were investigated in this study and within the project of the Scientific and Technological Research Council of Turkey (TÜBİTAK). *F. armena* and *F. zagrica* were noted to have similarities to *F. pinardii*. In the *Flora of Turkey*, it is stated that *F. armena* differs from *F. pinardii* by its outside and inside purple flowers and dark anthers. Many individuals in the *F. armena* specimens collected in the field have an inside greenish-yellow perigon together with outside and inside purple flowers. This perigon colour feature is exactly well-matched to *F. pinardii*. Purple anthers are the only difference between these 2 species. All the characteristics fall within the variation of *F. pinardii*. Also type specimens of these species have been examined in G. Consequently, *F. armena* is evaluated as synonymous with *F. pinardii*.

The similarity between *F. pinardii* and *F. zagrica* was noted during the field study. It is stated in a footnote in the *Flora of Turkey* that *F. zagrica* is close to *F. pinardii*, but differs from *F. pinardii* by having an outside and inside purple perigon with a yellow apex and a slender undivided style. Frequently the *F. pinardii* specimens collected in the field during our field work had a perigon with a yellow apex. Also *F. pinardii* has the slender undivided style characteristics in the *Flora of Turkey*. These characteristics do not differ from those of *F. pinardii* and *F. zagrica*. Although it is not stated in the *Flora of Turkey*, *F. zagrica* has dark anthers. This characteristic is not considered to be diagnostic in separating the 2 species. The anther colour is changeable in young and older individuals. *F. zagrica* is therefore considered to be a synonym of *F. pinardii*.

Some specimens were collected from Kahramanmaraş with yellow flowers during the field study. All the characteristics fit except for perigon colour with *F. pinardii*.

Varieties of these characteristics (inside and outside perigon colour and colour of anthers) in the *F. pinardii* group are not considered to be a different species of these taxa. All the characteristics fall within the variation of *F. pinardii*. *F. armena* and *F. zagrica* can be evaluated in the *F. pinardii* group (*sensu lato*).

17. *Fritillaria kittaniae* Sorger in *Herbertia* Vol. 43 (2): 33-41 (1987).

Type: Turkey, C2 Antalya: south of Sinekcibeli pass, on limestone rock in *Cedrus libani* forest, 1500 m, 23.04.1984, *F. Sorger & Kit Tan* 84-18-8 (holo. Hb. F. Sorger; iso E, RSA) (Figures 23 & 25).

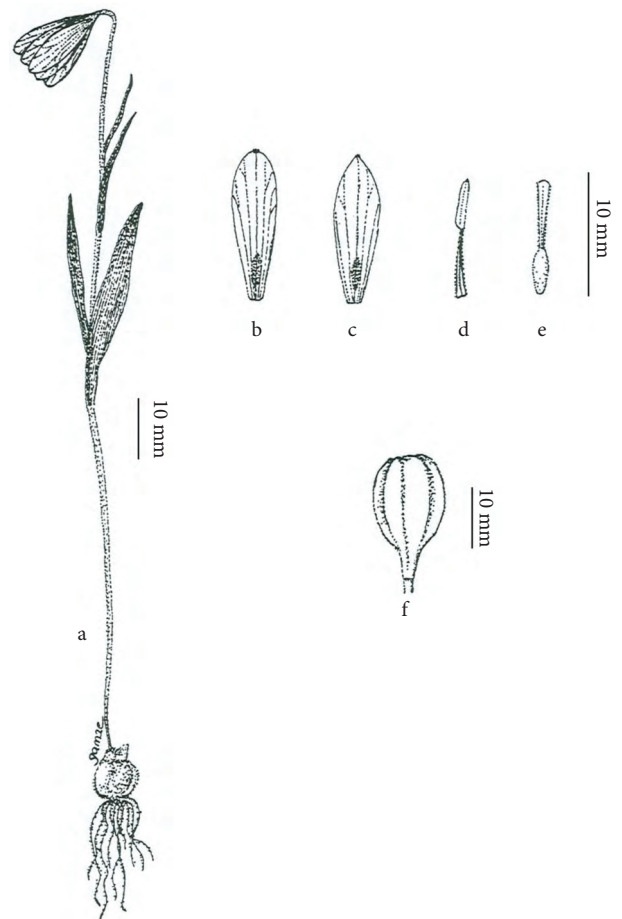


Figure 25. *Fritillaria kittaniae*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

Bulb 0.6-1 × 0.6-1 cm, globose, bulblet absent or 1-3, tunica thin and papery. Stem erect, 3-13 cm, entire. Leaves 2-5, sessile, alternate, glaucous. Lowest leaves 2-6.8 × 0.2-1.2 cm, lanceolate, narrowly lanceolate, elliptic, spatulate, acute, subacute. Median leaves 0.9-4.5 × 0.1-0.3 cm, linear, acuminate. Bract 1; 0.7-3.5 × 0.05-0.1 cm linear, acuminate. Flowers 1-2. Perigon narrowly campanulate. Outer segments 10-18 × 3-6 mm, lanceolate, elliptic-ovate, narrowly obovate, acute, outside and inside pale purple, yellowish-green striped or yellow, recurved at apex, ciliate-tufted at apex; inner segments 10-18 × 3-6 mm, elliptic, obovate, oblanceolate, spatulate, obtuse, yellow, purple at apex or yellowish-green striped, ciliate-tufted at apex. Nectaries 3 × 0.75-1 mm, linear-lanceolate, elliptic, green, yellowish-green, 1-2 mm above base of tepals. Filaments 6-11 mm, broaden to base, papillose; anthers 2.5-5.5 mm, elliptic, apiculate, yellow, basifixed. Style 4.5-9 mm, 3-fid, branches 0.1-5 mm, papillose; stigma entire. Capsule 15-20 × 12-15 mm, obovoid, oblong, not winged. Seeds 3.5-6.5 × 3.5-5 mm, flat, obovate, obovate-orbicular, testa brown, faveolate.

Fl: 4-5.

Habitat: Limestone area in *Cedrus libani* forest, *Juniperus* forest, stony, rocky places, 1300-1500 m.

Specimens examined: C2 Antalya: Elmalı-Kaş, Akçay-Gömüce, 1-2 km from Kuruova pass, 1520-1530 m, 18.05.2000, *M. Tekşen* 1986 (fr.) (GAZI); ibid, 20.04.2001, *M. Tekşen* 2038 (fl.) (GAZI); Elmalı, Akçay-Kuruova, S of Sinekcibeli pass, 1380 m, 23.03.2001, *M. Tekşen* 2017 (fl.) (GAZI); Elmalı-Kaş, Göme, Sinekcibeli, 36°27'19"N, 29°39'35"E, 1350-1400 m, 09.06.2001, *Z. Aytaç* 8060 (GAZI).

Conservation status: EN B2b (iii).

Distribution: Endemic. East Mediterranean element.

F. kittaniae can be easily distinguished from the other close species by its glaucous leaves, purple perigon with a green stripe. The perigon of *F. kittaniae*, which was described by the approach to *F. acmopetala* subsp. *wendelboi*, is not broadly campanulate. It is narrowly campanulate. It was not stated in the description whether or not the flowers are broadly or narrowly campanulate. Specimens collected in type location and, according to the classification of Rix in 2001, must be in the group with narrowly campanulate flowers, undivided or

3-lobed and stout and papillose style. It is close to *F. pinardii* with all of these characteristics. At the same time, it is close to *F. assyriaca* subsp. *melanathera* with outside and inside purple and with a perigon with a yellowish-green stripe. It differs from *F. assyriaca* subsp. *melanathera* by the characteristics of the shape and size of the leaves and apex of style. Consequently, *F. kittaniae* can be placed between *F. pinardii* and *F. assyriaca*.

18. *Fritillaria assyriaca* Baker in L. Linn. Soc. (Bot.) 14: 265 (1874).

subsp. *melanathera* Rix in Notes R.B.G. Edinb. 41: 52 (1983).

Type: Turkey, C4 İçel: 2 km N. of Mut, sandige Lehmhügel, 290 m, 5.vi.1966, *Sorger* 66-18-28 (holo. Hb. Sorger) (Figures 23 & 26).

Bulb 0.5-2 × 0.6-3 cm, globose or obovoid, united-2 kidney shaped, tunica thin and papery. Stem erect, 3.5-20 cm, elongating in fruit, usually papillose below. Leaves 4-12, sessile, glaucous, canaliculate. Lowest leaves 1.6-9 × 0.2-0.6 cm, alternate or subopposite, linear, acuminate. Median leaves 1.8-7.5 × 0.1-0.3 cm, alternate, linear, acuminate. Bracts 1-3, 1.2-6.2 × 0.5-2 cm, opposite, linear, acuminate. Flowers 1-2. Perigon narrowly campanulate, outside and inside purple, green striped. Outer segments 10-18 × 3-6 mm, narrowly lanceolate, acute or obtuse, ciliate-tufted at apex; inner segments 10-18 × 3-6 mm, oblanceolate, acute, ciliate-tufted at apex. Nectaries 2-4 × 1 mm, linear-lanceolate, green, 1 mm above base of tepals. Filaments 5-11 mm, papillose, papillae decreasing to base, yellow; anthers 3-5.5 mm, elliptic, purple, blackish, basifixed. Style 5-10 mm, undivided, papillose; stigma clavate. Capsule 11-18 × 11-16 mm, orbicular-ovoid, not winged. Seeds 4-6 × 3-5.5 mm, flat, obovate, testa pale brown, faveolate.

Fl: 3-5.

Habitat: Rocky slopes, stony places, steppe, sandy places, 0-700 m.

Specimens examined: C4 İçel: Mut-Ermenek, 70 km from Ermenek, 180 m, 25.03.2001, *M. Tekşen* 2032 (fl.) (GAZI); Mut-Ermenek, Suçatı-Evren, 36°24'847"N 33°17'931"E, 180 m, 28.04.2002, *M. Tekşen* 2129 (fr.) (GAZI); Konya: Ermenek-Karaman, Yelibel Mt., 2000 m, 16.06.1982, *M. Koyuncu* 11448 (AEF).

Conservation status: EN B2b (iii).

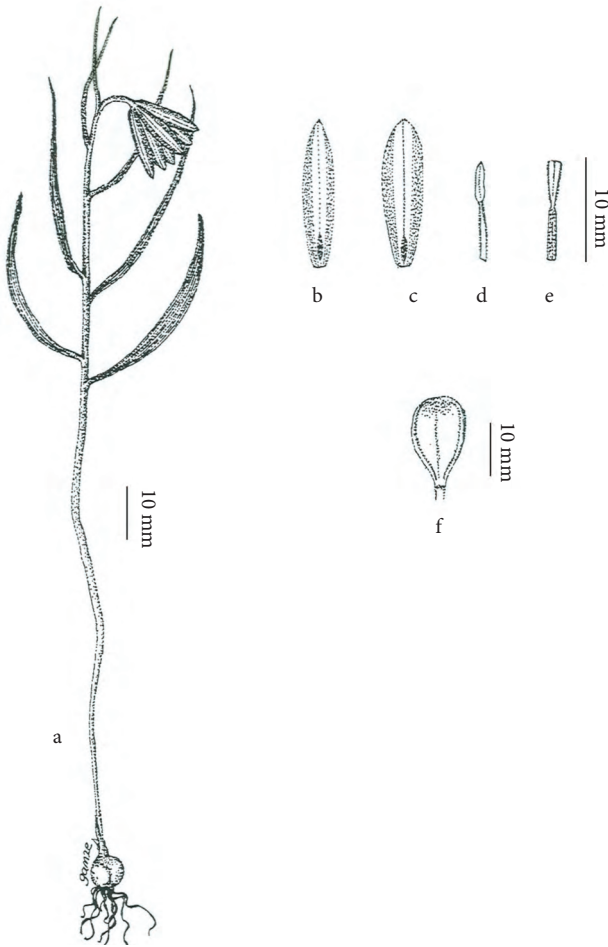


Figure 26. *Fritillaria assyriaca* subsp. *melananthera*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

Distribution: Endemic. East Mediterranean element.

F. assyriaca subsp. *melananthera* differs from *F. elwesii* by its shorter and papillose stem, undivided style, capitate stigma.

19. *Fritillaria elwesii* Boiss., Fl. Or. 5: 181 (1884).

Type: Turkey, C2 Muğla: in Lycia prope fluvium Dollomon (Dalaman Çay), *Elwes* (holo. G) (Figures 27-28).

= *F. acmopetala* sensu Baker in J. Linn. Soc.(Bot.) 14: 264 (1874) non Boiss. (1846).

= *F. siehana* Hausskn. ex Hayek in Ann. Naturh. Mus. Wien 25: 184 (1914).

Bulb 0.5-1 × 0.8-3 cm, globose or ovoid, bulblets 1-many, tunica thin and papery. Stem erect, 9-30

cm, smooth. Leaves 4-10, sessile, glaucous and canaliculate. Lowest leaves 2-11 × 0.2-1.1 cm, alternate, linear, acuminate. Median leaves 2.7-14 × 0.2-0.7 cm, alternate, linear, acuminate. Bracts 1-3, 2.8-11 × 0.1-0.5 cm, opposite, linear, acuminate. Flowers 1-4. Perigon narrowly campanulate, outside and inside brownish-purple and green striped. Outer segments 14-32 × 4-8 mm, lanceolate or oblanceolate, acute or obtuse, ciliate-tufted at apex; inner segments 14-32 × 4.5-11 mm, lanceolate or oblanceolate, acute or obtuse, ciliate-tufted at apex. Nectaries 2-7 × 1-1.5 mm, lanceolate, green, at base of tepal. Filaments 6-10 mm, papillose, yellow; anthers 3.5-7.5 mm, elliptic, apiculate, usually blackish-purple before dehiscence, after yellow, basifixed. Style 5-11 mm, 3-fid or 3-lobed, branches 1-3.5 mm, papillose; stigma entire. Capsule 15-24 × 9-16 mm, ovoid, oblong, cuneate or with stalk, glaucous, not winged. Seeds 3-5.5 × 3-4.5 mm, flat, obovate, obovate-orbicular, triangular, testa pale brown or yellowish-brown, faveolate.

Fl: 3-5.

Habitat: *Pinus brutia* forest and opens, *Quercus coccifera* scrubs, edge of field, rocky, stony places, 10-1600 m.

Specimens examined: C2 Antalya: Kaş-Antalya, 10 km, 400-500 m, 27.04.2002, *M. Tekşen* 2126 (fl.) (GAZI); *ibid.*, 08.04.2003, *M. Tekşen* 2166 (fl.) (GAZI). C3 Antalya: Akseki, Emiraşıklar village-İbradı, 19 km from İbradı, 600-700 m, 19.04.2000, *M. Tekşen* 1977 (fl.) (GAZI); Akseki, Güzelsu-Gündoğmuş, Sadıklar-Pınarbaşı village, 1050-1100 m, 20.04.2000, *M. Tekşen* 1978 (fl.) (GAZI); *ibid.*, 08.06.2002, *M. Tekşen* 2162 (fr.) (GAZI); Akseki, Güzelsu-Gündoğmuş, Pınarbaşı-Güneyyaka village, 1 km from Güneyyaka, around Karasu, 700-800 m, 20.04.2000, *M. Tekşen* 1979 (fl.) (GAZI); Akseki, Güzelsu-Gündoğmuş, Pınarbaşı-Güneyyaka village, around Kızıldere, 1170 m, 21.04.2001, *M. Tekşen* 2046 (fl.) (GAZI); Alanya, around Bademtaş village, 600 m, 08.04.1995, *Koyuncu* 11148 (AEF); Gündoğmuş, Gazi Kemal plateau, 1200 m, 17.04.1994, *Koyuncu* 10732 (AEF); Kemer, Tahtalı Mt., Yayla Kuzudere, Peynirlik-Kızıllalan, 800-1600 m, 04.05.1979, *Peşmen & Güner* 4628 (ANK, HUB); Manavgat to Akseki, 700 m, 08.04.1956, *D.* 25773 (ANK); Kırkgöz marshy, 290 m, 07.05.1972, *R. Çetik* 3946 (KNYA). C4 Antalya: Gazipaşa, Çörüş village, Sarıcığır district, Göcükaya-Tatlısu, 1200 m, 19.04.1983, *H. Sümbül* 1606 (HUB); Akseki-Çukurköy, Karataş, 08.04.1995,

800-900 m, *Duran* 2142 (GAZI); Akseki, Otluk Mt., Şimşirli Gözet hill, 1000-1200 m, 07.05.1995, *Duran* 2255 (GAZI); Alanya-Taşkent, Eriklidere (Kuşyuvası), 1330 m, 30.04.2008, *A.Güner* 14682 (GAZI); Alanya-Taşkent, Cebelireis mountains, Kaplanhanı, 36°34'580"N, 32°22'362"E, 1236 m, 30.04.2008, *A.Güner* 14682 (GAZI); İçel: Anamur-Aydıncık, Tekmen I-Yenikaş, 150-200 m, 25.03.2001, *M.Tekşen* 2023 (fl.) (GAZI); Mut-Ermenek, pass 40 km from Çamlı village, 650-700 m, 21.03.1981, *Koyuncu* (AEF). C5 İçel: Arslanköy road, 800 m, 08.04.1971, *Uslu* (ANK); Fındıkpınar above Mersin, 1200 m, 07.04.1957, *D.* 26500 (ANK).

Distribution: Turkey and Aegean Islands. East Mediterranean element.

It is similar to *F. assyriaca* subsp. *melananthera* and *F. latakienensis*. *F. elwesii* is distinguished from *F. latakienensis* by its stout filament, purple before dehiscing anthers, yellow after dehiscing, slender and papillose style. It differs from *F. assyriaca* subsp. *melananthera* by its longer and unpapillose stem; with 3-lobed style, entire stigma and lanceolate nectary.

20. *Fritillaria latakienensis* Rix in Kew Bull. 30: 161 (1975).

Type: Syria, Latakia, Ain Aramie, 20 iv 1938, *Fr. Louis* 454 (holo. P) (Figures 27 & 29).

= *F. elwesii* sensu Mouterde, *Nouv. Fl. Lib. Syr.* 1: 233 (1966) non Boiss. (1884).

Bulb 0.7-1 × 0.9-2 cm, globose or ovoid, bulblets absent or 1-2, tunica thin and papery. Stem erect, 8-45

cm, smooth. Leaves 5-10, sessile, glaucous. Lowest leaves 3-9.8 × 0.2-1.0 cm, alternate or subopposite, linear, obtuse, canaliculate. Median leaves 2.5-10.6 × 0.15-0.85 cm, alternate, linear, acuminate. Bract 1; 1.8-9.2 × 0.1-0.4 cm, linear, acuminate. Flowers 1-2. Perigon narrowly campanulate, outside purple, inside greenish-yellow or outside brownish-purple and green striped, inside greenish-yellow, purple and inner segments yellow at apex. Outer segments 18-30 × 4-8 mm, narrowly lanceolate, linear, obtuse, ciliate-tufted at apex; inner segments 18-30 × 6-15 mm, oblanceolate, spatulate, apiculate or obtuse, ciliate-tufted at apex. Nectaries 2-6 × 1-1.5 mm, narrowly or broadly lanceolate, green, 1 mm above base of tepals. Filaments 6-9.5 mm, papillose, whitish-yellow; anthers 2.5-7.2 mm, elliptic, apiculate, yellow, basifixed. Style 6.5-11 mm, 3-fid, branches 2-7 mm, smooth; stigma entire. Capsule 15-30 × 9-19 mm, ovoid, oblong, cuneate, glaucous, not winged. Seeds 4-6.5 × 3.5-5 mm, flat, obovate, narrowly obovate, testa pale brown or yellowish-brown, faveolate.

Fl: 3-4.

Habitat: Deciduous scrub and forest, scrub, stony areas, 500-950 m.

Specimens examined: C6 Hatay: Road junction of Yayladağ-Kışlak village, 13.04.1999, c. 750 m, *A.Güner* 12694 & *H.Duman* (GAZI); Yayladağ, Yayladağ-Kışlak road junction, 1-2 km from Kışlak road junction 920-930 m, 22.04.2000, *M.Tekşen* 1982 (fl.) (GAZI); *ibid.*, 29.03.2001, *M.Tekşen* 2034

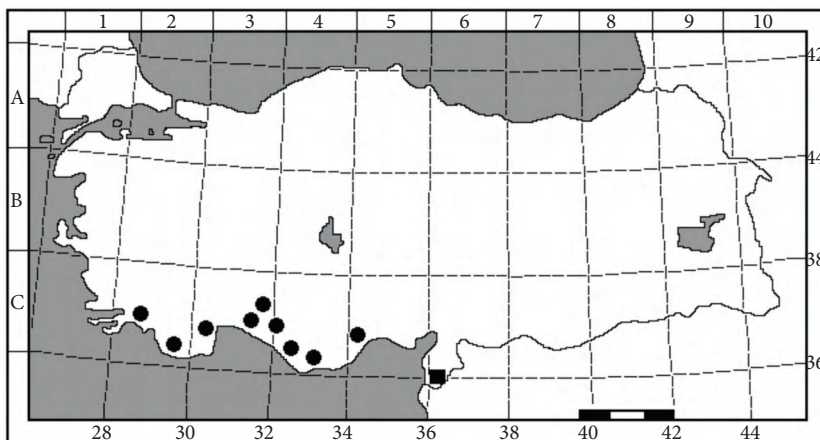


Figure 27. Distribution in Turkey of *Fritillaria elwesii* (●) and *F. latakienensis* (■).

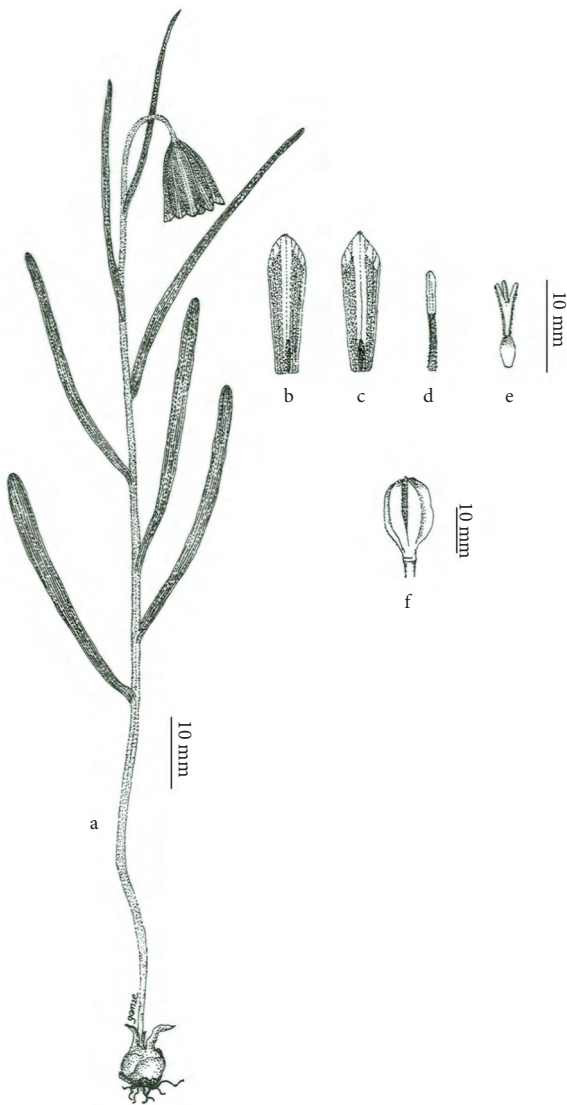


Figure 28. *Fritillaria elwesii*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

(fl.) (GAZI); *ibid.*, 09.06.2002, *M. Tekşen* 2165 (fr.) (GAZI).

Distribution: Turkey and Syria. East Mediterranean element.

F. latakiensis can be easily distinguished from *F. elwesii*, which is a close species, by its narrowly lanceolate, linear outer segments (not lanceolate or oblanceolate) and smooth style (not papillose). It is stated in a footnote in the *Flora of Turkey* that it was collected only by *Rückbrodt* from C2 Kaş (Antalya) in 1978. Moreover, it is stated that those which were described from the Latakia region in Syria could also

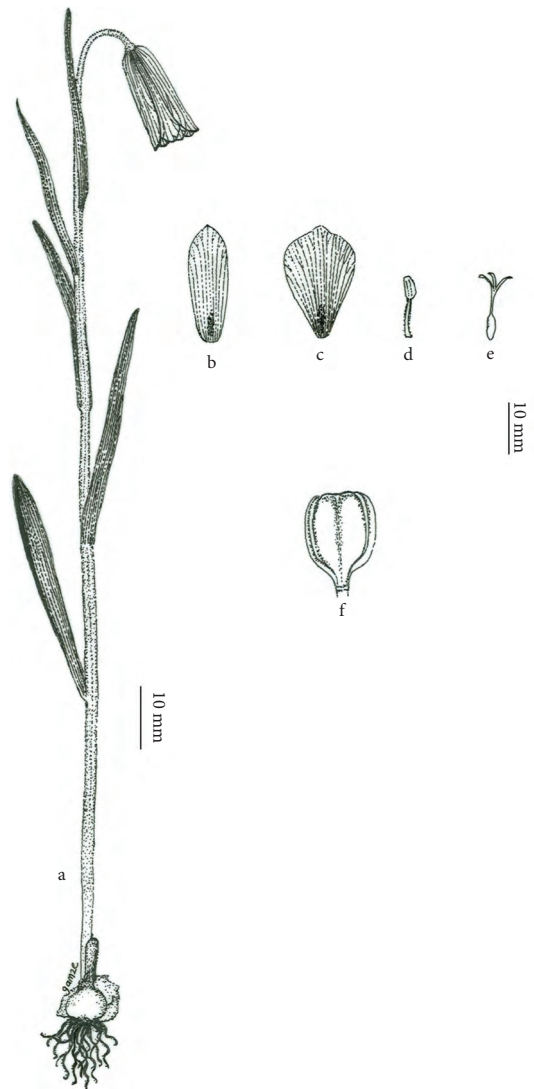


Figure 29. *Fritillaria latakiensis*. a- habit, b- outer tepals, c- inner tepals, d- stamen, e- pistil, f- capsule.

exist in Yayladağ, Hatay. We saw only the *F. elwesii* populations during our field work in Kaş. Probably, the record of *F. latakiensis* which is in the *Flora of Turkey* belongs to *F. elwesii*.

Conclusions

We have come to the following conclusions from our morphological studies on a wide range of herbarium material from a number of herbaria and from material collected in the wild.

After this study, *F. armena* and *F. zagrica* are reduced to synonyms of *F. pinardii*, and *F. sororum*

is reduced to a synonym of *F. acmopetala* subsp. *acmopetala*.

The phylogenetic orders of *F. forbesii* and *F. kittaniae* were changed based on morphological, palynological, cytological, and molecular studies (Çelebi et al., 2008).

There were 18 species and 4 subspecies recognised in the genus in the Mediterranean region before this study. The number has now increased to 20 species and 3 subspecies, 12 taxa of which are endemic. Eighteen taxa belong to the Mediterranean phytogeographical region, 10 taxa of which are endemic, and 5 taxa belong to the Irano-Turanian phytogeographical

region and 2 of them are endemic for the region. The genus *Fritillaria* is represented by 34 species and 7 subspecies in the *Flora of Turkey*. In this study, the number of taxa was determined as 35 species and 6 subspecies. Twenty-one of them are endemic.

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