



F. pallidiflora



F. pelinaea



F. persica



F. pinardii



F. pinetorum



F. pluriflora



F. pontica



F. pudica



F. purdyi



F. pyrenaica



F. raddeana



F. recurva

5 mm



F. reuteri



F. rhodia



F. rhodokanakis
subsp. *argolica*



F. rixii



F. roylei



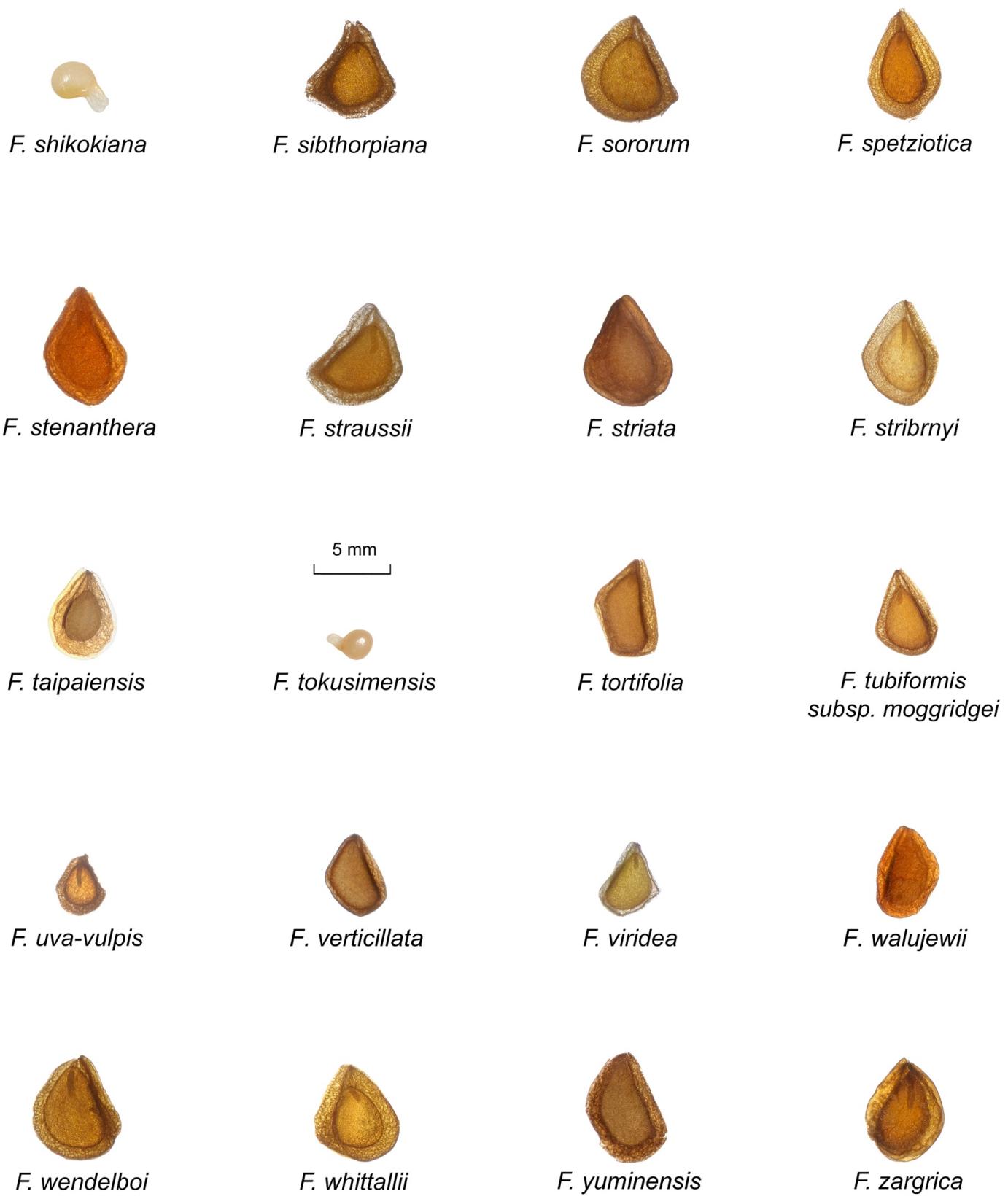
F. ruthenica



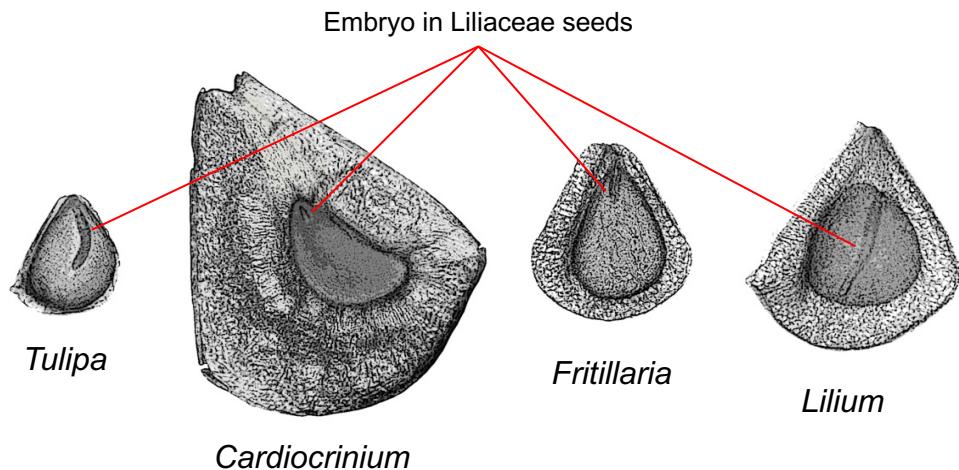
F. serpenticola



F. sewerzowii

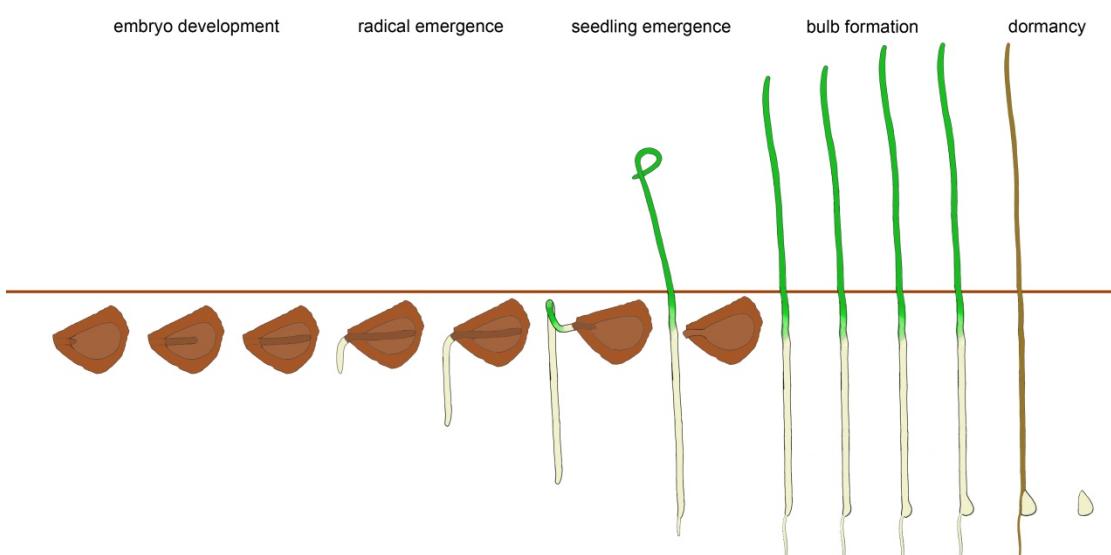


Seed Types: Most *Fritillaria* have flat deltoid shaped seed with a marginal wing to aid wind dispersal. This type of seed is dry at the point of dispersal, tolerant to desiccation and associated with open habitats. In the *Fritillaria* Japonica Group the seed are ovoid with an elaiosome to encourage dispersal by ants, myrmecochory, and are not tolerant to desiccation. Myrmecochory is found in several Japanese spring ephemerals and is associated with woodland habitats.



Seedling Recruitment: Within *Fritillaria* the number of ovules per ovary and flowers per plant varies greatly and consequently the potential seed output ranges from 10-15 seeds in higher altitude Japanese woodland species to 1800 seeds in *F. persica*. Actual seedling recruitment has been reported between zero and five percent in wild populations. A combination of factors limit seedling recruitment, for example pollination failure, grazing of flowers, capsules or seed, insect seed predators, soil pathogens or loss of viability with age as the testa (seed coat) is very thin. Competition from other seedlings or surrounding vegetation will cause further seedling mortality.

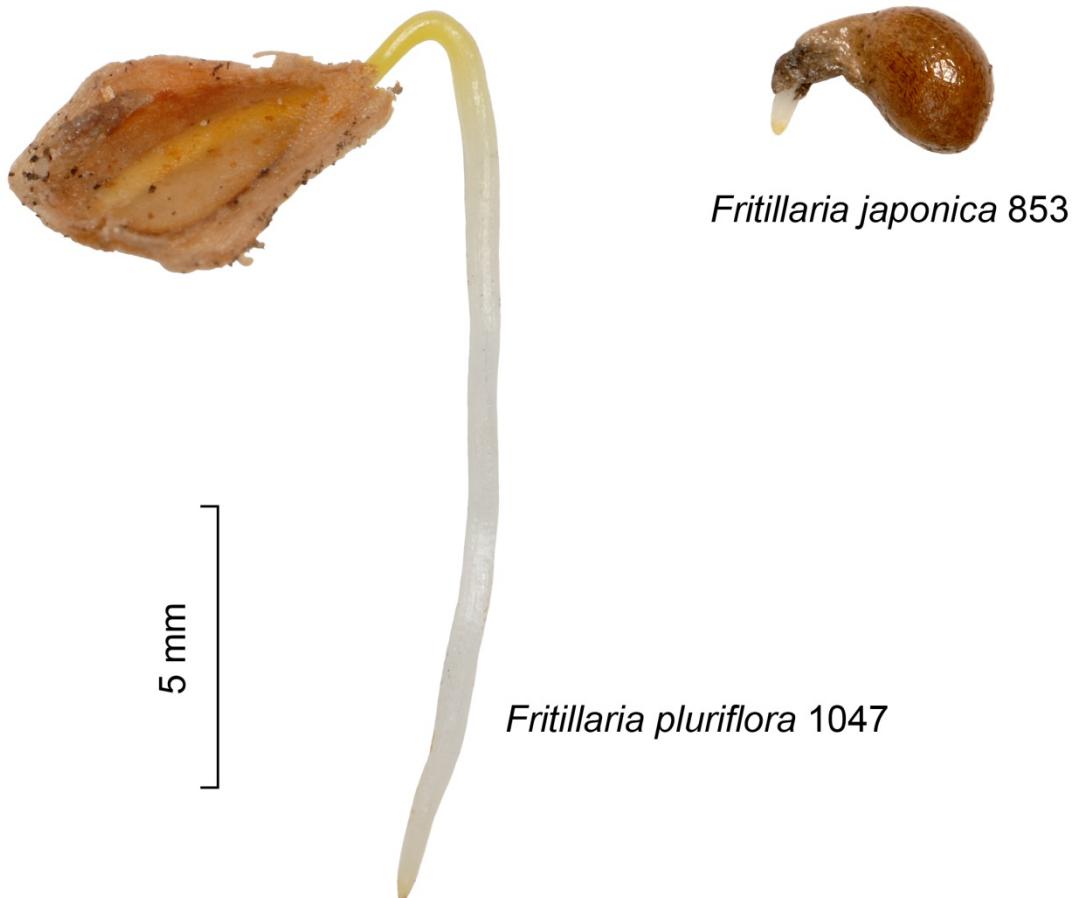
Fritillaria meleagris seed germination and initial bulb formation



***Fritillaria* Seeds**

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Dormancy, Germination & Seedling Emergence: One common aspect of all *Fritillaria* seed is their underdeveloped embryo at the time of dispersal, so before the seeds can germinate the embryo has to complete its development. Post-dispersal embryo development will only start after imbibition and the rate of embryo growth increases at lower temperatures. The shoot-root axis in *Fritillaria* is always with the root apical meristem at the base of the seed and as the embryo develops it expands away from the base. Germination is the point at which the radical emerges and in Japanese woodland species this is timed to correspond with leaf fall and is synchronized with root growth in adult bulbs. In most other *Fritillaria* species radical emergence starts several months after root growth in adult bulbs. Optimum temperature for post-dispersal embryo development and germination is thought to be 4-5°C. Seedling emergence in all *Fritillaria* occurs at or just before the emergence of adult bulbs from February to July depending on species.



SEED PROVENANCE

- F. acmopetala* †: Acc. No. [615](#), Turkey, Baba-Dağ, Eduard Hanslik
F. affinis †: Acc. No. [898](#), Canada, Vancouver Island, 3-5 m, Laurence Hill, 2010
F. agrestis: Acc. No. 1033, USA, California, Mariposa Co., 724 m, Alan Bradshaw, 2011
F. albidiflora †: Acc. No. 1471, Hort. Cyril Lafong, 2020
F. alburyana: Acc. No. 1357, Turkey, Palandoken Mtns., Vlastimil Pilous
F. amabilis †: Acc. No. [786](#), Japan, Honshu, Hiroshima Prefecture, 150 m, Laurence Hill, 2008
F. amana: Acc. No. 1197 Turkey, Puren Gecidi, 1530 m, R Wallis & RB Wallis RRW13264, 2013
F. ariana: Acc. No. 378, Colin Everett
F. armena: Acc. No. 1350, Turkey, Kop Pass, Vojtěch Holubec
F. atropurpurea: Acc. No. 1034, USA, Nevada, White Pine Co., 2515 m, Alan Bradshaw, 2011
F. aurea †: Acc. No. 966, Turkey, 2000 m, Ole Sonderhausen OS1143
F. assyrica: Acc. No. 1279, Turkey, Mardin. Vlastimil Pilous
F. ayakoana †: Acc. No. [709](#), Japan, Honshu, Shimane Prefecture, 421 m, Laurence Hill, 2008
F. biflora †: Acc. No. 1296 USA, California, San Luis Obispo Co., 224 m, Laurence Hill, 2016
F. bithynica: Acc. No. 1210 Greece, Samos, Mt. Ambelos 700 m, M Harvey
F. bucharica †: Acc. No. 547, Hort. 'Nurek Giant'
F. burnattii: Acc. No. 1268, Italy, Croce Domini, 1900 m, Pavel Krivka, 2015
F. camschatcensis †: Acc. No. 899, Canada, BC, Squamish, 9 m, Laurence Hill 2010
F. carica: Acc. No. 1211 Greece, Samos, Mt. Ambelos 1000 m, M Harvey
F. caucasica: Acc. No. 1358, Armenia, Seven Lake, Vlastimil Pilous
F. chlororhabdota: Acc. No. 1188 Iran, Kurt Vickery
F. chitralensis †: Acc. No. 372, Afghanistan, Chitral, Carter 762, 1970
F. cirrhosa: Acc. No. 1269, China, Yunnan, Tian Xi, 3900 m, Pavel Krivka
F. collina: Acc. No. 1270, Russia, Caucasus Mtns. Lagonaki, 1800 m, Pavel Krivka
F. crassifolia †: Acc. No. 525, Hort.
F. delavayi: Acc. No. 1273, China, Yunnan, Xianggelila, Tianbaoshan 3900-4000 m, Bjøørn Olson, 2015
F. davisii †: Acc. No. [537](#) Greece, Lakonia, NW of Pirgos Dirou.
F. drenovskii Acc. No. 1380, Greece, Pengeo, S. Hertel.
F. eastwoodiae †: Acc. No. 1054, USA: California, Butte Co. Oroville, 743 m, Laurence Hill 2012
F. eduardii †: Acc. No. 910, Tadzhikistan, Pamir Alai, 3200 m, JJ & JH Halda 8194
F. ehrhartii: Acc. No. 1319, Greece, Evia, E of Karistos. 200m, Jim and Jenny Archibald, JJA 0.494.800
F. elwesii: Acc. No. 1283, Turkey, Cevizii, Vlastimil Pilous
F. enginiana †: Acc. No. [094](#) Turkey: Sandras Dağı, Ağıla, Muğla, c800 m, Wolfgang Klietzing
F. epirotica: Acc. No. 1213, Greece, Epirus, Metsovo 1500 m, M Harvey
F. euboeica: Acc. No. 1360, Greece, Euboea, Mt. Dirfis, Vlastimil Pilous
F. falcata †: Acc. No. 1293, USA, California, San Benito Co. 1341 m, Laurence Hill, 2016
F. ferganensis: Acc. No. 1264, Kyrgyzstan: Kyrgyz Ala tau, 1900 m, Vojtěch Holubec, 2015
F. fleischeriana: Acc. No. 1351, Turkey, Akyarma, Vojtěch Holubec
F. frankiorum †: Acc. No. [091](#) Syria, East of Kassab, 700 m, R & R Wallis RRW98.11, 1996
F. gibbosa: Acc. No. 1069, Iran, Kurt Vickery, KV187, 2012
F. glaucoviridis: Acc. No. 843, Turkey, Amanus-Dağ, 1000 m, Mojmir Pavelka, 2010
F. graeca: Acc. No. 1285, Greece, Kaiseniani, . Vlastimil Pilous
F. grandiflora: Acc. No. 1286, Azerbaijan, talysh Mtns. Vlastimil Pilous
F. grayana †: Acc. No. 1315, USA, California, Mendocino Co. Ukiah, 706 m, Laurence Hill, 2016
F. guussichiae †: Acc. No. 374 Macedonia, Katlanovo, 400 m, Petricevac 40975, 1985
F. hakkarensis: Acc. No. 1359, Turkey, Yüksekovala, Vlastimil Pilous
F. hermonis: Acc. No. 1201 Syria, Rankous, S95.07b
F. imperialis †: Acc. No. 1099, India, Kashmir, Chris Chadwell, 2012
F. involucrata: Acc. No. 1071, France, Basses, Kurt Vickery, 2012
F. ionica subsp. *ionica*: Acc. No. 1367, Greece, Katara Pass, Vlastimil Pilous
F. ionica subsp. *reiseri*: Acc. No. 772, Greece, Etoliko, Vlastimil Pilous
F. ionica subsp. *thessala*: Acc. No. 1070, Greece, Kurt Vickery, 2012
F. japonica †: Acc. No. 702, Japan, Honshu, Okayama Pref. Chofukui 96 m, Laurence Hill, 2008
F. karelinii: Acc. No. 1073, Kazakhstan, Kurt Vickery, 2012
F. kittianae †: Acc. No. [445](#), Turkey: Central Taurus, nr. Kas, 1600 m , Vlastimil Pilous, 1995
F. kiusiana †: Acc. No. [790](#), Japan, Kyushu, Kumamoto Prefecture, Aso-gun, Laurence Hill, 2009
F. koidzumiana †: Acc. No. 1108, Japan, Honshu, Niigata, Yahikoyama, 136m, Laurence Hill, 2013
F. kurdica †: Acc. No. [1011](#), Iran, Shibli Pass, 2050 m, R Wallis & RB Wallis RRW04040, 2004
F. latakensis †: Acc. No. 446, Turkey: Ziyaret Mts., Vlastimil Pilous
F. latifolia: Acc. No. 1363, Georgia, Krestovy Pereval, Vlastimil pilous
F. liliacea †: Acc. No. [1043](#), USA, California, Marin Co. 69 m, Laurence Hill 2012

Seed marked (†) are fully verified



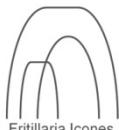
Fritillaria Seeds

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SEED PROVENANCE

- F. lusitanica*: Acc. No. 1214, Spain, Jaen, Sierra de Cazorla, A Edwards
F. melantha: Acc. No. 442, Turkey, Central Taurus, Vlastimil Pilous
F. meleagris †: Acc. No. 1183, UK: Wiltshire, Cricklade, 85 m, Anita Barrett, 2014
F. meleagroides: Acc. No. 1374, Ukraine, Poltav District, Treba 1996
F. messanensis subsp. *gracilis* †: Acc. No. 1288, Montenegro, Nikšić, Vlastimil Pilous
F. messanensis subsp. *messanensis* †: Acc. No. 375, Greece, Oros Olimbos, 1500 m, J & J Archibald 5459, 1993
F. messanensis subsp. *neglecta* †: Acc. No. 1289, Croatia, Biokovo Mtns, Vlastimil Pilous
F. messanensis subsp. *sphaciotica*: Acc. No. 1216 Greece, Crete, Rethymno, Kedros 1000 m, M Harvey
F. michailovskyi †: Acc. No. 737, Turkey, R Wallis & RB Wallis, RRW93139
F. minuta: Acc. No. 1365, Turkey, Kop Pass, Vlastimil Pilous
F. montana †: Acc. No. [612](#), France, Alps-Maritimes, 1000 m, Paul J. Christian, PJC.282, 1979
F. mutabilis †: Acc. No. [491](#), Greece, Fokida, 1800 m, Norman Stevens, 1996
F. muraiana †: Acc. No. [945](#), Japan: Shikoku, Tokushima, Myodo-gun, 631 m, Laurence Hill 2011
F. obliqua subsp. *obliqua*: Acc. Mo. 1217, Greece, Attiki-Pireas, Marathon 100 m, M Harvey
F. obliqua subsp. *tuntasia* †: Acc. No. 419, Hort.
F. olgae: Acc. No. 1391, Tajikistan: Peter I. Mtn Range, 2400 m, Vojtěch Holubec, 2017
F. ojaiensis †: Acc. No. 1297, USA, California, Santa Barbara Co. 866 m, Laurence Hill, 2016
F. oranensis †: Acc. No. 1111, Algeria, Mt. Tessala, 808 m, Khadidja Bouzid, 2012
F. orientalis †: Acc. No. [794](#), Russia, North Ossetia, 1700-1800 m, Vlastimil Pilous, 1978
F. pallidiflora †: Acc. No. 452, Kazakhstan, Alan Bradshaw
F. pelinaea †: Acc. No. 1095, Greece, Chios, Mt. Pelinoe, 700 m, Marcus Harvey
F. persica: Acc. No. 1178, Mt. Hermon 800m, Oron Peri, OP214072
F. pinardii: Acc. No. 1202 Turkey, Alseki-Seydisher, Eduard Hanslik
F. pinetorum: Acc. No. 1134, USA, California, Los Angeles Co., 2800 m, Walt Bando, 2013
F. pluriflora †: Acc. No. 1047, USA, California, Lake Co. 665 m, Laurence Hill, 2012
F. pontica †: Acc. No. [817](#), Turkey, Bursa, Ula Dağ, Thomas F. Hewer, H385
F. pudica: Acc. No. 1020, USA, Montana, Linda Verbeek, 2011
F. purdyi: Acc. No. 1138, USA, California, Mendocino Co., 1900 m, Jim Reid, 2013
F. pyrenaica †: Acc. No. [948](#) Spain, Provence of León, Cofiñal, 1600 m, Laurence Hill 2011
F. raddeana: Acc. No. 316, Turkmenistan, Kopet-Dağ, Jan Jilek
F. recurva †: Acc. No. 1049, USA, California, Lake Co. 314 m, Laurence Hill, 2012
F. reuteri †: Acc. No. [437](#), Iran, Esfahan, 2500 m, Jim Archibald
F. rhodia: Acc. No. 1179, Greece: Rhodes, 20 m, Oron Peri, OP28144
F. rhodokanakis subsp. *argolica* †: Acc. No. 1097, Greece, Argolida, Poros, 300 m, Marcus Harvey
F. rixii: Acc. No. 769, Greece, Euboia, Kandilla Mts., Vlastimil Pilous
F. roylei †: Acc. No. 1101 India, Kashmir, 2900 m, Chris Chadwell, CC7333, 2012
F. ruthenica †: Acc. No. [596](#) Russia, Smolensk
F. serpentifolia †: Acc. No. [770](#), Turkey, West Taurus, Burdura, Vlastimil Pilous
F. sewerzowii †: Acc. No. [029](#), Uzbekistan: Chimgan Valley, 2000 m, Norman Stevens, 1980
F. shikokiana †: Acc. No. [946](#), Japan: Shikoku, Tokushima, Miyoshi-gun, 501 m, Laurence Hill 2011
F. sibthorpiana †: Acc. No. 1219 Greece, Mugla, Bozborun 200 m, M Harvey
F. sororum: Acc. No. 1187 Turkey, R Wallis & RB Wallis, RRW9204, 2004
F. spetziotica: Acc. No. 450, Greece, Spetsos, Vlastimil Pilous
F. stenanthera: Acc. No. 912, Kazakhstan, Berkara Valley, Vladimir Kolbintsev, 2010
F. straussii †: Acc. No. [608](#), Iran: Kordestan, south of Marivan, 2500 m, Norman Stevens & Jim Archibald, 2005
F. striata †: Acc. No. 1300, USA, California, Kern Co. 655 m, Laurence Hill, 2016
F. stribnyi †: Acc. No. [398](#), Turkey, Thrace, 10 km south of Keşan, Horton & Stevens HS2067, 1979
F. taipaiensis: Acc. No. 1277, China, Sichuan, Chongqing, Chengkou, 2450m, Bjørnar Olson, 2015
F. tokusimensis †: Acc. No. [944](#), Japan: Shikoku, Tokushima, Myodo-gun, 698 m, Hill, Katayama & Naito 2011
F. tortifolia: Acc. No. 1368, China, Xinjiang, Vlastimil Pilous
F. tubiformis subsp. *moggridgei*: Acc. No. 774, France, Valle de Roya, Vlastimil Pilous
F. uva-vulpis †: Acc. 516, Hort.
F. verticillata: Acc. No. 1081, Kazakhstan, Altai Mt., Vladimir Kolbintsev, 2012
F. viridea †: Acc. No. 1292, USA, California, San Benito Co. 1275 m, Laurence Hill, 2016
F. walujewii †: Acc. No. [223](#), Hort.
F. wendelboi: Acc. No. 1184 R Wallis & RB Wallis RRW13222, 2013
F. whittallii: Acc. No. 1204 Turkey, Kurmova Pass, M Harvey
F. yuminensis: Acc. No. 533, China, Xinjiang, Yumin County, Duan Xian-zhen, 2006
F. zagrica: Acc. No. 1192, Iran, Kurt Vicker.

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