

Fritillaria

A Family Portrait



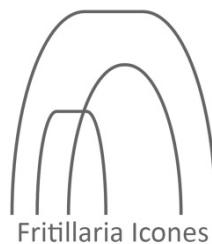
Laurence Hill

2014

Inspiring Kew

30 August 2014 – 1 February 2015

Shirley Sherwood Gallery of Botanical Art
Royal Botanic Gardens, Kew
Richmond
Surrey TW9 3AB
United Kingdom



Fritillaria Icons

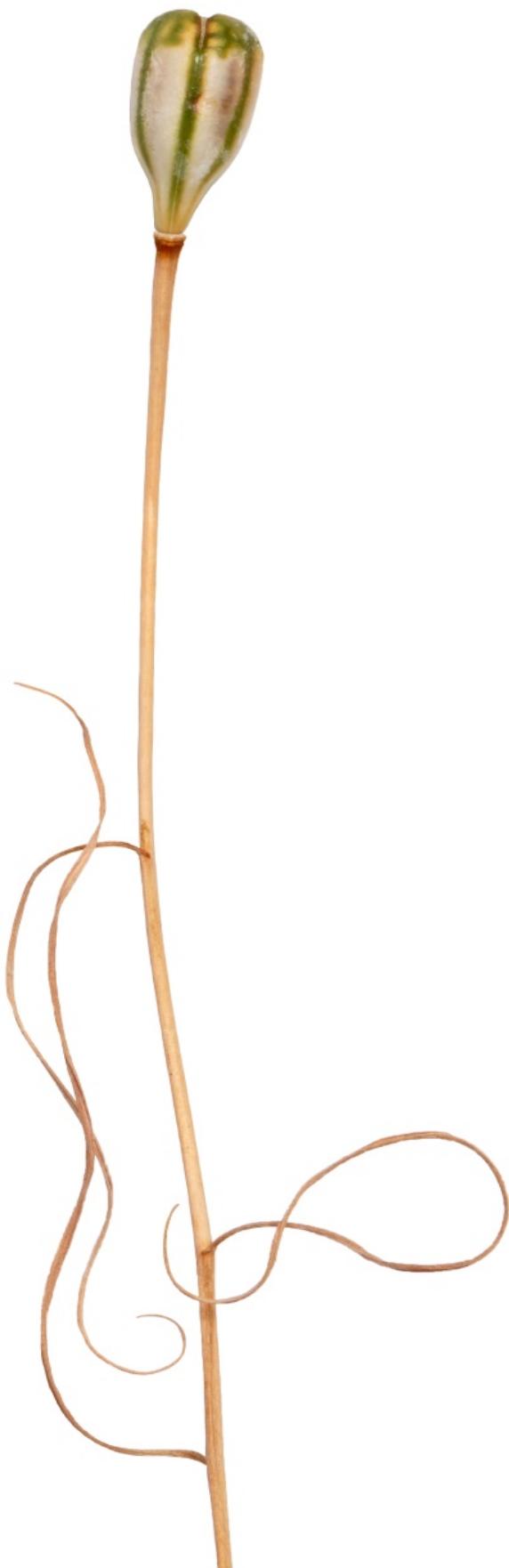
PART OF THE *Fritillaria Icons* PROJECT
www.fritillariaicons.com

Laurence Hill ©2014

For the last few years I've been collaborating with Dr Ilia Leitch and her team at the Jodrell Laboratory with their genetic research, Evolutionary Relationships in *Fritillaria* and Exploring the Evolutionary Dynamics of Genome Obesity in Plants. This partnership has in turn driven my own investigation further and I am particularly interested in how a systematic photographic approach can produce new insights.

The idea behind the *Fritillaria* image is to present a large number of species from a single genus in one continuous life-size image generating great insight into the biodiversity of life. The sequence in which the plants are represented is based on the most up-to-date research from Kew's Jodrell Laboratory. *Fritillaria* grow throughout most of the temperate region of the northern hemisphere. Their geographic distribution closely follows their genetic relationship, starting with the Iberian Peninsula on the left, through Central Asia and to the West of North America on the right. By over laying the image with the species full geographic distribution exposes three disjunctive groups which may have come about after three large scale extinctions.

Laurence Hill





In flowering plants, the amount of DNA in the nucleus of a cell (often called genome size) can vary by a staggering 2,400-fold. Compared with our own relatively slim genome which would stretch 2 m if all the DNA in a cell was unravelled, some bulbous monocots contain much larger genomes. The genus *Fritillaria* is particularly interesting as it includes species with some of the most obese genomes ever reported, indeed, some have genomes which would stretch over 60 m if unravelled. Our team is currently investigating how and why *Fritillaria* genomes have become so big. The image by Laurence has been particularly inspiring. Not only does it demonstrate the huge morphological diversity across the whole plant (including flowers, bulbs, root types), but also the complete lack of relationship between plant size and genome size. Who would have guessed that the biggest *Fritillaria* genomes, with up to 30x as much DNA in each nucleus compared with humans, are found in the tiny endemic Japanese *Fritillaria*?

Ilia Leitch – Plant Genetics Scientist

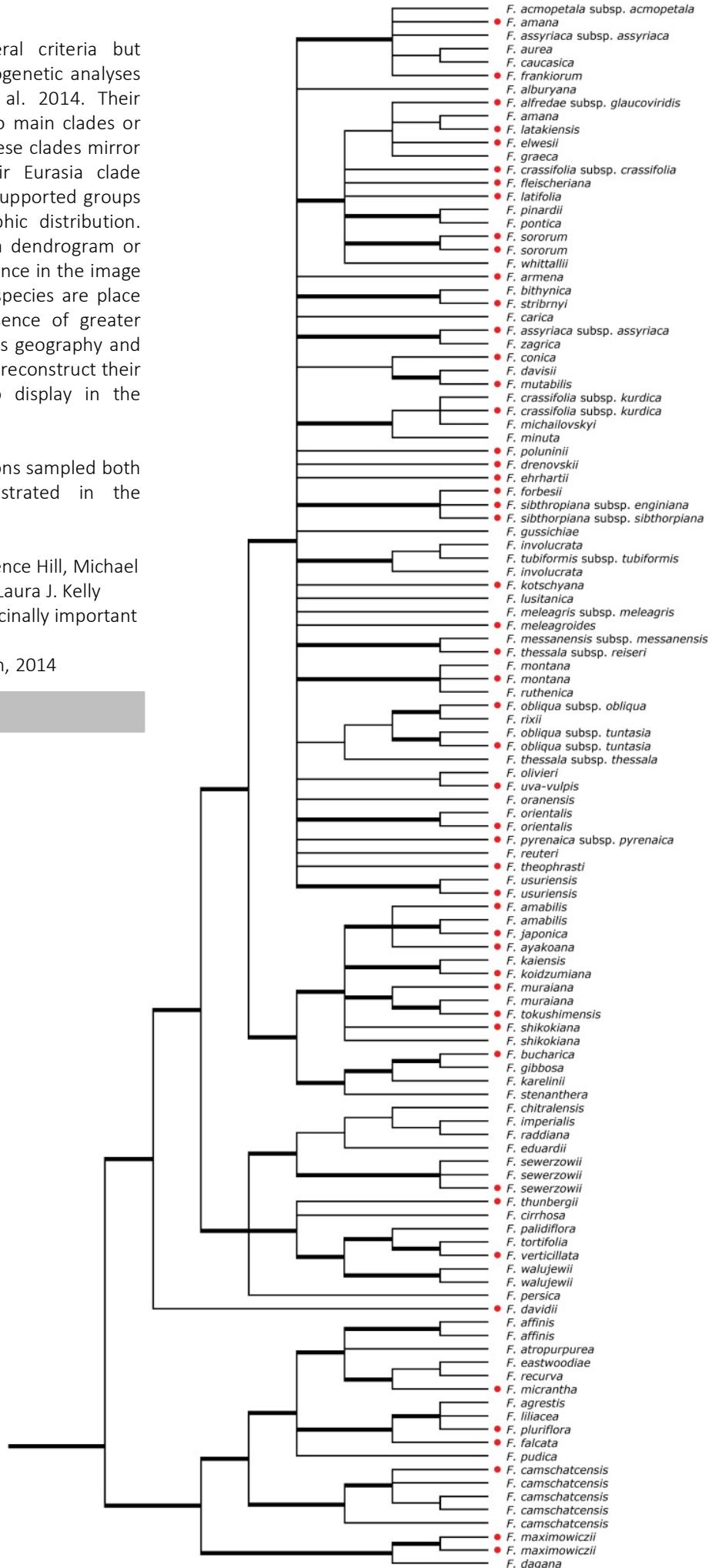
The *Fritillaria* sequence uses several criteria but primarily follows the molecular phylogenetic analyses of the plastid genome by Day et al. 2014. Their research resolves the genus into two main clades or genetically closely related groups. These clades mirror the two principle bulb types. Their Eurasia clade further divides into several strongly supported groups which closely reflects their geographic distribution. The genetic data is represented in a dendrogram or tree. This tree differs from the sequence in the image in that the unresolved groups and species are place alphabetically. Therefore in the absence of greater resolution in the genetic data, species geography and morphology are evaluated in order to reconstruct their most likely natural relationships to display in the photograph.

The red dots indicate specific accessions sampled both in the genetic analysis and illustrated in the photograph.

Peter D. Day, Madeleine Berger, Laurence Hill, Michael F. Fay, Andrew R. Leitch, Ilia J. Leitch, Laura J. Kelly
Evolutionary relationships in the medicinally important genus *Fritillaria* L. (Liliaceae).

Molecular Phylogenetics and Evolution, 2014

Fritillaria Systematics



P1

<i>F. pyrenaica</i> L.	2013	948	Spain: Provence of León, Cofiñal, 1600m. Laurence Hill, 27MAY2011
<i>F. meleagris</i> L.	2013	823	UK: Oxfordshire, Ducklington Meadows, 2009
<i>F. usuriensis</i> Maxim.	2011	202	China: Heilongjiang, Jilin, Liaoning, Korea, Russia
<i>F. meleagroides</i> Patrin ex Schult. & Schult. f.	2008	520	Ukraine: Poltavskaja Oblast, Krugloie Ozero, Nikolai Treba, 1996
<i>F. montana</i> Hoppe ex W. D. J. Koch	2011	612	France: Alps-Maritimes, Caussols, 1000 m. Paul Christian PJC282, 10APR1979
<i>F. ruthenica</i> Wikstrom	2014	596	Russia: Smolensk Vlastimil Pilous
<i>F. messanensis</i> Rafin ssp. <i>messanensis</i>	2012	732	Greece: Mt. Olympus, above Litochoro, 900m, R Wallis & R B Wallis, 18APR2001
<i>F. thessala</i> (Boiss.) Kamari ssp. <i>reiseri</i> Kamari	2011	142	Greece: Aetolia, Akarnanika. Rudolf Kaiser
<i>F. mutabilis</i> Kamari	2008	491	Greece: Oros Giona SW of Kaloskopi, Fokida, Norman Stevens, 1996
<i>F. davisii</i> Turrill	2013	537	Greece: Lakonia, NW of Pirgos Dirou
<i>F. conica</i> Boiss.	2007	490	Greece: South of Pilos, Messinia, 200m. Norman Stevens
<i>F. thessala</i> (Boiss.) Kamari ssp. <i>thessala</i>	2014	599	Greece: Northern Pindhos, Kathara Pass, 1700m, Vlastimil Pilous
<i>F. rixii</i> E. Zaharoff	2013	181	Greece: Evia
<i>F. obliqua</i> Ker Gawl. ssp. <i>obliqua</i>	2004	068	Greece: Attiki
<i>F. obliqua</i> Ker Gawl. ssp. <i>tuntasia</i> (Heldr.ex Halácsy) Kamari	2007	085	Greece: Cyclades Is.
<i>F. ehrharti</i> Boiss. & Orph.	2007	105	Greece: Aegean islands of Andros, Euboea, Siros and Skiros

P2

<i>F. drenovskyi</i> Degen & Stoj.	2010	727	Greece: Granitis nr. Drama. Marcus Harvey, 11JUL2002
<i>F. stribnnyi</i> Velen.	2008	398	Turkey: Thrace, 10 km south of Keşan, Horton & Stevens HS2067, 16APR1979
<i>F. bithynica</i> Baker	2010	719	Greece: Samos, near the village of Pirogs, Vlastimil Pilous
<i>F. carica</i> Rix	2014	505	Turkey: Muğla, Fethiye, Horton & Stevens HS2181
<i>F. forbesii</i> Baker	2010	714	Turkey: Muğla, Fethiye. Norman Stevens NS2173, 24APR1979
<i>F. sibthorpiana</i> (Sm.) Baker ssp. <i>enginiana</i> Byfield et N. Özhata	2006	094	Turkey: Muğla, Sandras Dağı, c.800 m. Wolfgang Kletzing, 1985
<i>F. sibthorpiana</i> (Sm.) Baker ssp. <i>sibthorpiana</i>	2005	109	Turkey: SW Anatolia
<i>F. theophrasti</i> Kamari & Phitos	2011	669	Greece: Lesbos, 350 m. H & I Barton
<i>F. pontica</i> Wahlenb.	2012	817	Turkey: Bursa, Uludağ. Thomas Hewer H385, 1964
<i>F. pinardii</i> Boiss.	2008	022	Armenia, Lebanon, Turkey, Syria
<i>F. fleischeriana</i> Steud. & Hochst. ex Schult.f.	2013	804	Turkey: Sariyer, 470m, J Rukšāns, A Seisums, G Tjerdsmaa, H Zetterlund, LST-091
<i>F. sororum</i> J. Persson & K. Persson	2010	814	Turkey: İçel, Taurus mountains, 950 m. Persson & Persson 87-97(GB) 30APR1987
<i>F. whitallii</i> Baker	2010	743	Turkey: N of Akseki, 1740m, R & R Wallis, R Wallis & RB Wallis 08101, 2008
<i>F. alfredae</i> Post ssp. <i>glaucoviridis</i> (Turrill) Rix	2010	744	Turkey: İçel, East of Hasanbeyli, R Wallis & RB Wallis, 08114, 2008
<i>F. elwesii</i> Boiss.	2012	605	Turkey: İçel, Mersin 1200m. Peter Davis & Ian C Hedge D26500, 07APR1957
<i>F. latakiensis</i> Rix	2011	090	Lebanon, S Turkey and Syria
<i>F. latifolia</i> Willd.	2011	888	Turkey: Gümüşhane, Köse Geçidi, 1960m.
<i>F. crassifolia</i> Boiss. & Huet ssp. <i>crassifolia</i>	2011	065	Turkey: Denizli, Honaz Dag. Norman Stevens

P3

<i>F. orientalis</i> Adam	2008	794	Russia: North Ossetia, Fiagdon Valley, Vlastimil Pilous, 26MAY1978
<i>F. armena</i> Boiss.	2009	726	Turkey, South of Erzurum, Eduard Hanslik HN-0212
<i>F. acmopetala</i> Boiss. ssp. <i>acmopetala</i>	2008	615	Turkey: nr. Fethie, Baba-Dag. Eduard Hanslik, 1998
<i>F. caucasica</i> Adam	2004	064	Turkey: Pass SW of Kars, Sarıkamış, Norman Stevens
<i>F. aurea</i> Schott	2012	965	Turkey: Sivas Provence, Ziyaret Tepe, Swedish-Latvian Turkey Exp. BATM371, 2004
<i>F. amana</i> (Rix) R.Wallis & R.B.Wallis	2008	430	Turkey: above Belen, Hatay 1500 m. Norman Stevens 1982
<i>F. frankiorum</i> R.Wallis & RB.Wallis	2007	091	Turkey: East of Kassab, 700m. R & R Wallis 96.11, 29MAR1996
<i>F. minuta</i> Boiss. & Noë	2008	610	Turkey: E & SE Anatolia
<i>F. michailovskyi</i> Fomin	2009	100	Turkey: NE Anatolia, Erzurum to Kars
<i>F. crassifolia</i> Boiss. & Huet ssp. <i>kurdica</i> (Boiss. & Noë) Rix	2014	060	Iran: East Azerbaijan, Ahar to Tabriz. R Wallis & RB Wallis 00123, 26MAY2000
<i>F. crassifolia</i> Boiss. & Huet ssp. <i>poluninii</i> Rix	2009	178	Iran: Kermanshahan. Per Wendelbo 78-01, 1978
<i>F. kotschyana</i> Herb.	2010	826	Iran: Elburz Mts., Mazandaran, 2100-2300m, Seisums, Liden & Popp, SLIZE98-068, 1998
<i>F. reuteri</i> Boiss.	2011	437	Iran: Esfahan, North of Daran, Jim Archibald
<i>F. olivieri</i> Baker	2013	906	Iran: Kordestan, Dasht-e-Zaghghah, 2000m, Gholamreza Bakhshi Khaniki, GBK94.59
<i>F. uva-vulpis</i> Rix	2011	821	Iran: Rezaiyeh, 20 km SE of Mahabad. 1700m. Paul Furse 2173, 1962
<i>F. assyriaca</i> Baker ssp. <i>assyriaca</i>	2011	668	Iran: Kordestan, Sanandaj to Marivan, 1350m, J Archibald, N Stevens, B Wallis, 2000
<i>F. bucharica</i> Regel	2011	488	Tadzhikistan: Dushanbe, Romit Gorge. Norman Stevens

P4

<i>F. gibbosa</i> Boiss.	2011	371	Armenia, Iran, Turkmenia, Afghanistan, Pakistan, Uzbekistan
<i>F. stenantha</i> (Regel) Regel	2009	688	Uzbekistan: Chirgum Mts., 1700m, Brickell & Mathew 10657, 22APR1984
<i>F. japonica</i> Miq.	2009	702	Japan: Honshu, Okayama Pref., Chofukui 96m. Laurence Hill 702, 05APR2008
<i>F. ayakoana</i> Maruy. & Naruh.	2009	712	Japan: Honshu, Shimane Pref., Sada-cho, 103m. Laurence Hill 712, 07APR2008
<i>F. amabilis</i> Koidz.	2010	785	Japan: Honshu, Okayama Pref., Niimi-shi, 170m. Laurence Hill 785, 27MAR2009
<i>F. shikokiana</i> Naruh.	2009	701	Japan: Shikoku, Ehime Pref., Mt Amagiriya, 722m. Laurence Hill 701, 04APR2008
<i>F. muraiana</i> Ohwi	2010	699	Japan: Shikoku, Ehime Pref., Kuma Kogen, 519m. Laurence Hill 699, 04APR2008
<i>F. tokushimensis</i> Akasawa, Katayama & T.Naito	2013	944	Japan: Shikoku, Tokushima Pref., Myodo-gun, 698m. Hill, Katayama, Naito, 944, 25MAR2011
<i>F. koidzumiana</i> Ohwi	2008	485	Japan: Honshu, Niigata Pref., Hoigawa, Atushi Kuyama, MAY1979
<i>F. persica</i> L.	2004	057	Iran, Iraq, Israel, Jordan, Lebanon, Syria, Turkey
<i>F. imperialis</i> L.	2009	157	Turkey, Iran, Iraq, Afghanistan, Pakistan, India
<i>F. raddeana</i> Regel	2014	1115	Iran: Norman Stevens
<i>F. sewerzowii</i> Regel	2009	029	Uzbekistan: Chirgan Valley, 2000m. Norman Stevens, 1980
<i>F. verticillata</i> Willd.	2010	498	Kazakhstan: Southern Altai, Kara-Sumbe Valley, Arnis Seisums, MAY1990
<i>F. pallidiflora</i> Schrenk	2009	012	Kazakhstan: Dzungarian Alatau, China: Xinjiang

P5

<i>F. walajewii</i> Regel	2010	223	Kazakhstan: Dzungarian Alatau, China: Xinjiang
<i>F. cirrhosa</i> D. Don	2008	541	China, India, Nepal, Bhutan
<i>F. thunbergii</i> Miq.	2010	015	China: Anhui, Jiangsu, Zhejiang
<i>F. davidii</i> Franch	2009	739	China: Sichuan, Baoxing. Mikinori Ogisu, 1987
<i>F. maximowiczii</i> Freyn	2010	806	Russia: Eastern Siberia, Habarovkiy District, Mart Veerus & Arnis Seisums VS 93-101, 1990
<i>F. camschatcensis</i> (L) Ker Gawl.	2008	617	Russia: Southern Sakhalin Island, Near Tomari
<i>F. affinis</i> (Schultes) Sealy	2014	1045	USA: California, Mendocino Co., Ukiah, 284m. Laurence Hill 1045, 29MAR2012
<i>F. recurva</i> Benth.	2014	1049	USA: Lake Co., Butts Canyon Road, 314m, Laurence Hill 1049, 29MAR2012
<i>F. micrantha</i> A Heller	2008	115	USA: California, Northern Sierra Nevada Range, 1600m. Ron Ratko NNS00-371, 2000
<i>F. pudica</i> (Pursh) Sprengel	2014	1131	USA: Oregon, John Day River, Nature Conservancy Preserve, Jane McGary
<i>F. pluriflora</i> Torr. ex Benth.	2006	084	USA: California, Upper Sacramento Valley
<i>F. liliacea</i> Lindl.	2014	1043	USA: California, Marin Co., Mt. Burdell, 69m. Laurence Hill 1043 28MAR2012
<i>F. biflora</i> Lindl.	2004	059	USA: California, Southern Coastal Range
<i>F. falcata</i> (Jep.) Beetle	2007	112	USA: California, San Benito Mts. 1360m, Ron Ratko

PANELS NUMBERED LEFT TO RIGHT

Species name and author citation
 Year of photograph
 Accession number in the *Fritillaria Icones* project
 Collection details (black) or species distribution (grey)

DETAILS FOR PHOTOGRAPHS USED IN THIS BOOKLET

Capsule – *F. forbessii* 714, Portrait – *F. shikokiana* 790,
 Tepal – *F. meleagris* 823, Bulb – *F. orientalis* 794

Specimen Details



The composite image of 80 *Fritillaria* comprises more than 150 photographs taken between 2004 and 2014. Each plant was grown by the photographer and captured at dehiscence of the anthers. Over the decade different cameras have been deployed as technology has improved and more complex techniques developed to record ever greater detail. The image can be viewed on various levels; as a phenotypic study, a taxonomic document, a voucher specimen for genetic research or the journey of a photographer. The five panels in the exhibition total 10 x 1.45 m.

Image Details











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