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A classification for edible citrus: an update, with a note on *Murraya* (Rutaceae)

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Abstract

In the light of the continuing threat of huanglongbing, an update of the author's 1997 classification for edible citrus is presented and a new combination in *Murraya* J.Koenig is proposed.

Introduction

The continuing international disaster wrought by the bacterial disease huanglongbing (formerly known as citrus greening, the most severe form of which is associated with *Candidatus* 'Liberibacter asiaticus' (CLas, originally from South Asia; it is now widespread in Asia reaching New Guinea, the Americas and now Africa) in the citrus industries of much of the world has led to the need for a workable classification of the genus *Citrus* L. and its allies, notably *Murraya* J.Koenig, which genus is known to include species, notably *M. paniculata* (L.) Jack, the orange jasmine (Mabberley 2016), harbouring the bacterium (Beattie & Barkley 2009; Hall et al., 2013; Ajene et al. 2019, 2020). Some *Citrus* species, notably Australian ones, and hybrids have shown some resistance to the disease, though the evolutionary explanation for this is elusive (Folimonova et al. 2009, Ramadugu et al. 2016). Breeding programs inspired by this finding would inevitably have a long lead time in terms of introduction of resistant citrus to the trade and orchard.

Encouragingly, very recent research has focused on comparative expression analysis of small RNAs and messenger RNAs between HLB-sensitive cultivars and HLB-tolerant taxa, such that candidate natural defence genes potentially responsible for HLB tolerance have been identified (Huang et al., 2021). One of these candidate regulators from the Australian finger lime (*Citrus australasica* F.Muell.) is an antimicrobial peptide (AMP), named stable antimicrobial peptide (SAMP), which has been shown to kill *Liberibacter crescens* (Lcr), a Liberibacter strain in culture, and to prevent infections of CLas and 'solanacearum' strains in greenhouse trials. These peptides not only reduce disease symptoms but also induce immunity to fresh infections; these promising results need confirmation in field trials. Meanwhile it has also been mooted that CRISPR technology can also be brought to bear on the problem (Wheatley & Yang 2021).

Citrus

Published some 25 years ago in this journal, the first of two precursors (Mabberley 1997, 1998) for the account of Rutaceae-Aurantioideae in *Flora of Australia* (Mabberley 2013), was an attempt to bring order to the chaotic nomenclature then obtaining within the literature on the commercially significant species of the genus *Citrus*, most taxa in the trade being hybrid, homoploid, apomictic (occasionally out-crossing) clones: previous systems had recognised 1–167 'good' species. Building on the pioneering chemotaxonomic work of the Polish-American botanist Rainer Scora (1928–2016), the 'basic' species (Scora 1975) then held to be the parents of commercially significant citrus were set out and their names typified; the cultivated hybrids formed between them were named and those names typified; for the first time the oranges, sweet and sour, with the grapefruit and their backcrosses were accommodated in cultivar groups within *Citrus* ×*aurantium* L. (*C. reticulata* Blanco × *C. maxima* (Burm.) Merr.), a single binomial, as mandated by the *International Code of Nomenclature for algae, fungi, and plants* (ICN; Turland et al. [eds] 2018) for all hybrids and backcrosses between two species. With continuously improving elucidation, updates, additions and refinements, reflecting such advances, have been published since (e.g. Mabberley 1998, 2002, 2004, 2013, 2017, 2018; Zhang & Mabberley 2008; Wearn & Mabberley 2016; Mabberley & Xu 2022), such that these contributions can be considered a series of evolving materials leading towards a projected monograph of the genus *Citrus*.

Other workers have published a draft genome, and pinned down the origin, of true wild mandarin, one of Scora's basic species (Wu et al. 2014, 2021; Wang et al. 2018; Mabberley & Xu 2022) and the draft genome of a sweet orange ('Valencia') has also been published (Xu et al. 2013). Over the last ten years, in particular, there has been a welcome series of publications of molecular work on *Citrus* systematics, effectively expanding on the 1997 framework (see especially the important synthesis of molecular work by Ollitrault et al. 2020 and commentary by Mabberley 2021, though there have been further developments since) through bringing clarity and solutions to long-standing questions. In the light of all this, it now seems appropriate, not only to provide an update of the 1997–2018 classifications published by the author, but also to take the opportunity to add further significant species and hybrids encountered in commerce, particularly in Australia. Not least, this account of the current state-of-play, effectively a 'skeletal' monograph of the genus *Citrus*, provides pointers to conservation imperatives in the truly autochthonous, non-apomictic taxa likely critical in plant-breeding for disease-resistance and other useful traits. Particularly concerning in this regard, though, is the fact that no unquestionably autochthonous populations of either citron (*C. medica* L.) or pomelo (*C. maxima*), two of the six 'basic' species of commercial citrus, have so far been definitively identified.

Conspectus

In the accounts of accepted species and hybrid names in the conspectus below only synonyms commonly encountered today are noted; others are covered in the publications cited above. Many of yet other published names of cultivated citrus have no type specimens and exiguous or scarcely diagnostic descriptions, making their identity dubious (see Tanaka 1930 for an earlier lament) and their continued use valueless (though some may in fact represent known hybrid combinations enumerated below - or yet others). Moreover, the literature is littered with conclusions based on misidentified taxa, besides names applied in ways completely at odds with their type specimens (where they exist), while even modern molecular work is sometimes unaccompanied by citation of herbarium vouchers, making identification of sampled taxa equivocal and thereby interpretation of consequent phylogenetic trees problematic.

Citrus L., *Sp. Pl.* 2: 782 (1753); Kubitzki, *Fam. Gen. Vasc. Pl.* 10: 349 (2011); Mabberley, *Fl. Australia* 26: 504 (2013).

Type: *Citrus medica* L.

Citreum Tournef. ex Mill., *Gard. Dict.*, abr. ed. 4: [338] (1754), nom. superfl. pro *Citrus* L.

Type: *Citrus medica* L.

Aurantium Tournef. ex Mill., *Gard. Dict.*, abr. ed. 4: [160] (1754); *Citrus* sect. *Aurantium* (Mill.) Tanaka, *Stud. Citrol.* 3: 170, 171 (1929).

Type: not indicated, but all included taxa now referred to *Citrus* ×*aurantium* L.

Limon Tournef. ex Mill., *Gard. Dict.*, abr. ed. 4: [788] (1754).

Type: not indicated, but all included taxa now referred to *Citrus* ×*limon* (L.) Osbeck.

Sarcodactilis C.F.Gaertn., *Suppl. Carp.*: 39, t. 185 (1805).

Type: *S. helicteroides* C.F.Gaertn. = *Citrus medica* L. 'Fingered'.

Poncirus Raf., *Sylva Tellur*.: 143 (1838).

Type: *P. trifoliata* (L.) Raf. = *Citrus trifoliata* L.

Papeda Hassk., *Flora* 25, 2 Beibl. 1: 42 (1842); *Citrus* sect. *Papeda* (Hassk.) Miq., *Fl. Ned. Ind.* 1, 2: 529 (1859) & Tanaka, *Stud. Citrol*. 3: 169, 170 (1929) isonym; *Citrus* subg. *Papeda* (Hassk.) Burkill, *Gard. Bull. Straits Sett*. 5: 220 (1931).

Type: *P. rumphii* Hassk. = *C. hystrix* DC.

Oxanthera Montrouz., *Mém. Acad. Roy. Sci. Lyon, Sect. Sci*. ser. 2, 10: 186 (1860).

Type: *O. fragrans* Montrouz. = *Citrus oxanthera* Beauv.

Pseudaegle Miq., *Ann. Mus. Bot. Lugd.-Bat*. 2: 83 (1865), nom. superfl. pro *Poncirus* Raf.

Type: *P. sepiaria* (DC.) Miq., nom. illeg. = *Citrus trifoliata* L.

Eremocitrus Swingle, *J. Agric. Res*. 2: 86 (1914); *Citrus* subg. *Eremocitrus* (Swingle) Burkill, *Gard. Bull. Straits Sett*. 5: 218 (1931).

Type: *E. glauca* (Lindl.) Swingle = *C. glauca* (Lindl.) Burkill.

Fortunella Swingle, *J. Washington Acad. Sci*. 5: 167 (1915); *Citrus* subg. *Fortunella* (Swingle) Burkill, *Gard. Bull. Straits Sett*. 5: 218 (1931).

Type: *F. margarita* (Lour.) Swingle = *C. japonica* Thunb.

Microcitrus Swingle, *J. Washington Acad. Sci*. 5: 570 (1915); *Citrus* subg. *Microcitrus* (Swingle) Burkill, *Gard. Bull. Straits Sett*. 5: 219 (1931).

Type: *M. australasica* (F.Muell.) Swingle = *C. australasica* F. Muell.

Pleurocitrus Tanaka, *Stud. Citrol*. 3: 169, 181 (1929).

Type: *P. inodora* (F.M.Bailey) Tanaka = *Citrus inodora* F.M.Bailey

Citrus subg. *Archicitrus* Tanaka, *Stud. Citrol*. 3: 169, 170 (1929).

Type: not indicated.

Citrus sect. *Limonellus* Tanaka, *Stud. Citrol*. 3: 170, 171 (1929).

Type: not indicated.

Citrus sect. *Citrophorum* Tanaka, *Stud. Citrol*. 3: 170, 171 (1929).

Type: not indicated.

Citrus subg. *Metacitrus* Tanaka, *Stud. Citrol*. 3: 170, 171 (1929).

Type: not indicated.

Citrus sect. *Osmocitrus* Tanaka, *Stud. Citrol*. 3: 170, 171 (1929).

Type: not indicated.

Citrus subg. *Acrumen* Tanaka, *Stud. Citrol*. 3: 170, 171 (1929).

Type: not indicated.

Citrus sect. *Microacumen* Tanaka, *Stud. Citrol*. 3: 170, 171 (1929).

Type: not indicated.

Citrus sect. *Pseudofortunella* Tanaka, *Stud. Citrol*. 3: 170, 171 (1929).

Type: not indicated.

Clymenia Swingle, *J. Arnold Arbor*. 20: 251 (1939).

Type: *C. polyandra* (Tanaka) Swingle = *Citrus polyandra* Tanaka.

×*Citroncirus* J.W.Ingram & H.E.Moore, *Baileya* 19: 171 (1975).

Type: ×*C. webberi* J.W.Ingram & H.E.Moore (non *Citrus* ×*webberi* Wester [1915] =?) = *Citrus* ×*insitorum* Mabb.

×*Citrofortunella* J.W.Ingram & H.E.Moore, *Baileya* 19: 169 (1975).

Type: not indicated.

+*Citroponcirus* H.Wu et al., *J. Trop. Subtrop. Bot*. 12: 179 (2004).

Type: +*C.* 'Hormish' (*C. trifoliata* L. + *C.* ×*aurantium* 'Ponkan').

Description: see Kubitzki (2011), Mabberley (2013).

Notes: Recent molecular evidence counters some earlier molecular findings (see Appelhans et al. 2021 for discussion), so *Feroniella* Swingle is here removed from earlier synonymies. With hybridisation right across *Citrus*, the maintenance of infrageneric taxa in such a relatively small genus is rather pointless (Mabberley 2002, 2021).

Australia has six native species (besides the three listed below, there are *Citrus garrawayi* F.M.Bailey, *C. gracilis* Mabb. and *C. inodora* F.M.Bailey, which shows some resistance to huanglongbing (Folimonova et al. 2009, Ramadugu et al. 2016); see Mabberley 1998, 2013), China five (besides the four listed below, there is *C. mangshanensis* S.W.He & G.F.Liu from southern China; see Wu et al. 2014, Gmitter et al. 2020, Ollitrault et al. 2020). Other apparently truly autochthonous species not listed below are: *C. halimii* B.C.Stone (West Malesia, allied to *C. japonica* Thunb.; Mabberley & Kiew 2005, Luro et al. 2022); *C. indica* Tanaka (NE India, a close ally of *C. medica*) and *C. latipes* (Swingle) Tanaka (NE India, very similar to *C. cavaleriei* H.Lév. ex Cavalerie and included in it by Luro et al. 2002; it shows some resistance to *C*Las; Folimonova et al. 2009, Ramadugu et al. 2016)); the rest (in need of modern revision) being from the south-west Pacific islands: *C. neocaledonica* Guillaumin, *C. oxanthera* Beauvis. and *C. undulata* Guillaumin (besides *Oxanthera brevipes* B.C.Stone) from New Caledonia; *C. polyandra* Tanaka (*Clymenia polyandra* (Tanaka) Swingle), with round pulp-vesicles as in *C. australasica* (and *C. mangshanensis*), *C. wakonai* P.I.Forst. & M.W.Sm., *C. warburgiana* F.M.Bailey and *C. wintersii* Mabb. (Mabberley 1998, 2013) all from Papua New Guinea, making a grand total of about 25 species, at most, for the whole genus.

Autochthonous, outcrossing species in commerce or parental species of commercially significant hybrids

Rather than give 'varietal' names to sets of cultivars using the *International Code of Nomenclature for Algae, Fungi and Plants* (Turland et al. 2018, it seems more appropriate to follow customary practice with cultivated plants and use cultivar groups according to the *International Code of Nomenclature for Cultivated Plants* (Brickell et al. 2016), as in Mabberley 1997, 2021; Zhang & Mabberley 2008; cf. Webber 1943, e.g. *Citrus japonica* (Oval Kumquat Group) 'Nagami'. Names are presented below in alphabetical order.

1. ***Citrus australasica*** F.Muell., *Fragm.* 1: 26 (1858).

Type: Australia, Queensland, Moreton Bay, *W. Hill s.n*. (**MEL** (MEL 1059262) holo).

Common name: finger lime.

Description: Mabberley (2013: 507).

Distribution: Australia (south-east Queensland and north-east New South Wales).

Notes: Mueller (1858) also cited "Mueller" under specimens seen, but no such material is to be found at MEL. Formerly used synonym: *Microcitrus australasica* (F.Muell.) Swingle (see Mabberley 1998, 2013). Shows some resistance to huanglongbing (Folimonova et al. 2009, Ramadugu et al. 2016). Commonly seen cultivars in Australia (where very many more have been raised): 'Alstonville', 'Blunobia Pink Crystal', 'Durham's Emerald', 'Judy's Everbearing', 'Pink Ice', 'Rainforest Pearl'. A parent of *C.* ×*oliveri* Mabb. and *C.* ×*virgata* Mabb.; crossed with *C.* ×*otaitensis* (Risso & Poit.) Risso to give 'blood lime' (Mabberley 2004).

2. ***Citrus australis*** (Mudie) Planchon, *Hort. Donat*.: 18 (1858).

Basionym: *Limonia ? australis* A.Cunn. ex Mudie, *Pict. Australia*: 151 (1829).

Type: Australia, Queensland, Moreton Bay, 1829, *A. Cunningham* '26' (**BM** (BM013719093) lectotype designated by D.J. Mabberley, *Telopea* 7: 339. 1998); **G** (G00096611), **K** isolecto).

Common names: dooja, (Australian) round lime.

Description: Mabberley (2013: 509).

Distribution: Australia, south-east Queensland.

Notes: Formerly used synonym: *Microcitrus australis* (Mudie) Swingle (see Mabberley 1992, 1998, 2013). Shows some resistance to huanglongbing (Folimonova et al. 2009, Ramadugu et al. 2016). A parent of *C.* ×*virgata*.

3. ***Citrus cavaleriei*** H.Lév. ex Cavalerie, *Bull. Géogr. Bot*. 21: 211 (1911).

Type: "J'ai trouvé dans les bois, loin de toute habitation, dans les environs de Ma-Jo et de Kai-Tchéou [K'ai Chow], vers 1700 metres d'altitude". China: K'ai Chow 60 km NNE of Kweiyang (P5240963), *P.J. Cavalerie s.n.* (**P** [**NSW** photo] lectotype designated by D.J. Mabberley & P.G. Kodela, *Telopea* 18: 116 [2015]).

Common name: Ichang papeda.

Description: Zhang & Mabberley (2008: 91).

Distribution: south-west and south-central China.

Notes: Formerly used synonym: *C. ichangensis* Swingle (see Zhang & Mabberley 2008; Mabberley & Kodela 2015); *C. latipes* has also been referred here as *C. ichangensis* subsp. *latipes* Swingle. A parent of *C.* ×*junos*.

4. ***Citrus glauca*** (Lindl.) Burkill, *Gard. Bull. Straits Sett.* 5, Index: 3 (1932).

Basionym: *Triphasia glauca* Lindl. in Mitchell, *J. Exped. Trop. Austral*.: 353 (1848).

Type: Australia [Queensland, Dublin County, near junction of Maranoa & Merivale rivers], 17 Oct 1846, 'Tastes like Rue', *T.L. Mitchell 398* (**CGE** holo [transparency seen]; **? BM** (BM013719095), **GH** (GH002451400), **K, L** (L0017830, 'subtropical New Holland 1846'), **NSW** (NSW 421084) iso).

Common names: limebush, wild lime, desert lime.

Description: Mabberley (2013: 509).

Distribution: eastern Australia.

Notes: Formerly used synonym: *Eremocitrus glauca* (Lindl.) Swingle (see Mabberley 1998, 2013). Of all *Citrus* species and hybrids so far examined (Folimonova et al. 2009, Ramadugu et al. 2016), *C. glauca* shows most resistance to huanglongbing. Successfully crossed in cultivation with *C. japonica*, *C. medica*, *C.* ×*limon* - to give 'eremolemons', with *C.* ×*aurantium* Sweet Orange Group - to give 'eremoranges', with *C.* ×*insitorum* - to give 'citrangeremos' and with *C. wintersii* (Swingle 1943: 365–366; Mabberley 1998, 2013).

5. ***Citrus hystrix*** DC., *Cat. Pl. Horti Monsp*.: 19, 97 (1813 '*histrix*') & *Prodr*. 1: 539 (1824 '*hystrix*').

Type: France [cult.], "Frutex spectabilis olim ex insula Mauritiana [Mauritius] (ubi forsan cultus) merit. Mercatori Nemauensi Roland a navarcha quodam allatus, et anno 1808 a D°. Roland horto Monspeliensi humanissime missus", Hérault, Montpellier, Jardin des plantes (G00209703), *Anon. s.n.* (**G-DC** holo?, fide D.J. Mabberley, *Gard. Bull. Singapore* 54: 187 [2002]).

Common names: makrut, Thai lime, leech-lime (N.B. the regrettably all-too-frequently used name 'kaffir lime' is to be strongly discouraged, as such a name is offensive to many people).

Description: Zhang & Mabberley (2008: 92).

Distribution: Myanmar and Thailand to Sumatra, east to New Guinea, though natural distribution probably obscured by cultivation, its having been carried far into the Pacific (A.C. Smith, *Fl. Vitiensis Nova* 3: 186, 1985), for example.

Notes: Formerly used synonyms: *C. combara* Raf., *C. macroptera* Montr.; commonly used synonym: *C. micrantha* Wester (see Mabberley 1998, 2022). A parent of *C.* ×*amblycarpa* and *C.*×*aurantiifolia* (see Ollitrault et al. [2020]; as accurately concluded by Bonavia [1886, 1888]); see also *C.* ×*latifolia*. N.B. Candolle later amended his '*histrix*' to '*hystrix*' and, according to Vincent Demoulin (pers. comm. 17 April 2022), this is indeed a correctible orthographic error in any case.

6. ***Citrus japonica*** Thunb., *Nova Acta Regiae Soc. Sci. Upsal*. 3: 199 (1780).

Type: Japan [cult.], *C.P. Thunberg s.n.* in Herb. Thunb. 17862 (**UPS-THUNB** holo; **S** S-G-1442 iso).

Description: Zhang & Mabberley (2008: 92).

Distribution: southern China.

Common name: kumquat (cumquat in Australia).

Notes: Formerly used synonyms: *C. margarita* Lour., *Fortunella japonica* (Thunb.) Swingle, *F. margarita* (Lour.) Swingle. Cultivar group status is appropriate to accommodate the cultivars with different fruit-shapes (see Zhang & Mabberley 2008): Round Kumquat Group e.g. 'Marumi' and Oval Kumquat Group e.g. 'Nagami'. A parent of: *C.* ×*floridana*, *C.* ×*georgiana*, *C.* ×*microcarpa*, *C.* ×*oliveri*; other crosses, e.g. with *C.* ×*junos* (q.v.), not in commercial cultivation in Australia.

7. ***Citrus maxima*** (Burm.) Merr., *Interpr. Herb. Amboin*. 46: 296 (1917).

Basionym: *Aurantium maximum* Burm., *Herb. Amboin. Auctuar*. 6–7: Index [16] (1755).

Type [icon]: 'Limo decumanus' Rumpf, *Herbarium Amboin.* 2: t. 24 f. 2 & B. 1741; fide A.C. Smith, *Fl. Vitiensis Nova* 3: 522 (1985).

Common name: pomelo (pummelo)

Description: Zhang & Mabberley (2008: 93).

Distribution: ?SE Asia (Thailand posited by Scora & Nicolson [1986]), but no unequivocally 'wild' populations have been identified, though some specimens from northern Thailand and southern Lao could perhaps be autochthonous.

Notes: Formerly used synonyms: *C. decumana* L., *C. grandis* (L.) Osbeck (see Mabberley 1997). Cultivar group status is appropriate for the cultivars with different fruit-shapes.

Commonly seen cultivar in Australia: 'Chandler'. A parent of *C.* ×*aurantium*; see also *C.* ×*insitorum*, *C.* ×*latifolia*, *C.* ×*limon*.

8. ***Citrus medica*** L., *Sp. Pl.* 2: 782 (1753).

Type: "Habitat in Asia, Media, Assyria, Persia"; [icon] 'Citreum' in Tournefort, *Inst. Rei Herb*. 620. t. 396, 1700, lectotype designated by D.M. Porter in C.E. Jarvis et al. (ed.), *Regnum Veg*. 127: 34. 1993 (see Mabberley 1997, 2018, 2022).

Common names: citron, etrog.

Description: Zhang & Mabberley (2008: 93)

Distribution: ?NE India, but no unequivocally 'wild' populations have been identified.

Notes: Cultivar group status is appropriate to accommodate the cultivars with different fruit-shapes and flavours. 'Etrog' is one of the citrons used in the Feast of the Tabernacles. Commonly seen cultivars: 'Corsican', 'Fingered' (Buddha's hand; 佛手 fo shou). The male parent of *C.* ×*limon,* and *C.* ×*otaitensis*. Florentine citrons (*C. medica* var. *florentina* Risso) are backcrosses with lemons, so referable to *C.* ×*limon* (q.v.).

9. ***Citrus reticulata*** Blanco, *Fl. Filip*.: 610 (1837), nom. cons. prop.

Type: China [cultivated], Hubei Province, Wuhan, Huazhong Agricultural University (material grown from seed from Hunan Province, Mangshan region [24° 98' N, 112° 88' E]), 25 July 2022, *Q. Xu s.n.* (KUN 1543827) KUN, typ. cons. prop. ; HIB, PE.

Common name: wild mandarin; it is perhaps the same as *C. reticulata* var. *austera* Swingle, *J. Wash. Acad. Sci*. 32: 25 (1942). "Mandarins" in international commerce are referable to a cultivar group of *C.* ×*aurantium* – see Mabberley (1997), Curk et al. (2015), Ollitrault et al. (2020), Mabberley & Xu (2022), while *C. mangshanensis* is now excluded, as confirmed to be a distinct species – see above.

Description: [var. *austera*] Swingle (1943: 415).

Distribution: southern China.

Notes: The name, like *C. nobilis* Lour. before it, was applied to pure mandarin, though the types of both are in fact *C.* ×*aurantium* cultivars. Mabberley & Xu (2022) have proposed a solution to stabilise the nomenclature through typification based on pure wild mandarin. Apparently in cultivation only as a rootstock (Swingle 1943: 415; Ollitrault et al. 2020); possibly conspecific with *C. daoxianensis* S.W.He & G.F.Liu (Curk et al. 2015; Ollitrault et. al. 2020). A parent of *C.* ×*amblycarpa, C.* ×*aurantium*, *C.* ×*junos*, *C.* ×*otaitensis, C.* ×*tachibana*; see also *C.* ×*georgiana*, *C.* ×*insitorum*, *C.* ×*latifolia, C.* ×*limon*, *C.* ×*oliveri*.

10. '***Citrus ryukyuensis***'; G.Wu et al., *Nature Comm*. 12: 4377 (2021) [nom. inval.].

Distribution: Japan (Ryukyu Islands).

Notes: Shortly to be formally named and described (G. Wu in litt. 12 April 2022), though it is possibly the same as *C. nobilis* var. *spontanea* T.Itô, *J. Coll. Sci., Tokyo Imp. Univ*. 12: 361 (1900). https://www.biodiversitylibrary.org/item/31156#page/461/mode/1up

Apparently not in cultivation. A parent of *C.* ×*tachibana* (Wu et al. 2021).

11. ***Citrus trifoliata*** L., *Sp. Pl*., ed. 2, 1: 1101 (1763).

Type: "Habitat in Japonia"; [icon] 'Karatats banna' Kaempfer, *Amoen. Exot*. Fasc. 801, 802 (1712), lectotype designated by W.T. Swingle in Webber & Batchelor, *Citrus Industry* 1: 368 (1943).

Common name: trifoliate orange.

Description: Zhang & Mabberley (2008: 91).

Distribution: Central & north China.

Notes: Commonly used synonym: *Poncirus trifoliata* (L.) Raf. (see Mabberley 2002).

Shows some resistance to huanglongbing (Folimonova et al. 2009, Ramadugu et al. 2016). A parent of *C.* ×*insitorum*. Commonly seen cultivars in Australia are largely rootstocks but 'Monstrosa' ('Flying Dragon') is also grown as an ornamental.

Hybrid taxa

In the literature, many of the following apomictic, (usually) homoploid, hybrid taxa found naturalised in tropical Asia have been mistaken for autochthonous sexual species.

Growers need names for the principal hybrid groups in cultivation, even though many of those groups have complex parentage, so making 'hybrid formulae' unwieldy. Moreover, rather than give 'varietal' names to sets of cultivars using the *International Code of Nomenclature for Algae, Fungi and Plants* (Turland et al. 2018), it seems more appropriate to follow customary practice with cultivated plants and use cultivar groups according to the *International Code of Nomenclature for Cultivated Plants* (Brickell et al. 2016), as in Mabberley 1997, 2021; Zhang & Mabberley 2008, e.g. *Citrus* ×*aurantium* L. (Sweet Orange Group) 'Valencia'.

Those citrus crops cultivated in Australia are listed below. Other names recognised by Ollitrault et al. (2020) for hybrid taxa, perhaps not grown in Australia, are: *Citrus* ×*lumia* Risso (*C. medica* × *C. maxima*), though this name has apparently not been properly typified, and some "lumias" seem to be pure *C. medica* with others perhaps involving *C.* ×*limon* (cf. '*C.* ×*pseudolumia*' an invalidly published name [Ollitrault et al. 2020; but for which combination there may be published names already – see above] for *C. hystrix* × *C. maxima* × *C. medica*, the Borneo or baboon lemon), while yet another "lumia", the Pomme d'Adam, is now referred to *C.* ×*aurantiifolia* (Curk et al. 2016).

1. ***Citrus*** ×***amblycarpa*** (Hassk.) Ochse, *Ind. Vruchten*: 217 + t. 104 (1927), pro sp.

Basionym: *C.* ×*limonellus* Hassk. var. *amblycarpa* Hassk., *Flora* 25, Beibl. 2: 43 (1842).

Type: Indonesia [cult.], Java, Bogor (not preserved – see Tanaka [1930: 233]).

Common name: jeruk limo (or limau), nasnaran mandarin.

Description: Backer & Bakhuizen van den Brink (1965: 109).

Parentage: (male) *C. hystrix* × (female) *C. reticulata* (Curk et al. 2015; Ollitrault et al. 2020).

Notes: A common market fruit (for sambal) in Java, its leaves besides fruits (jeruk) sold for use in fish dishes in Sarawak (Peter Boyce & Sin Yen Wong pers. comm. 21 April 2022), but also grown, particularly by Indonesian people, in Australia.

2. ***Citrus*** ×***aurantiifolia*** (Christm.) Swingle, *J. Wash. Acad. Sci*. 3: 465 (1913), pro sp.

Basionym: *Limonia* ×*aurantiifolia* Christm., *Vollst. Pflanzensyst*. 1: 618 (1777), pro sp.

Type [icon]: 'Limonellus sive Limon Nipis' Rumpf, *Herb. Amboin*. 2: t. 29 (1741) lecto designated by B.C. Stone in M.D. Dassanayake & F.R. Fosberg, *Revis. Handb. Fl. Ceylon* 5: 424 (1985).

Common names: (Key or Mexican) lime, alemow.

Description: Zhang & Mabberley (2008: 94)

Parentage: (male) *C. medica* × (female) *C. hystrix* (Bonavia [1886, 1888: 82] was the first to realise *C. hystrix* was in the parentage; Curk et al. 2016, Ollitrault et al. 2020; Mabberley 2022).

Notes: Commonly used synonym: *C.* ×*macrophylla* Wester. A parent of *C.* ×*floridana* and *C.* ×*latifolia*.

3. ***Citrus*** ×***aurantium*** L., *Sp. Pl*. 2: 782. 1753, pro sp.

Type: "Habitat in India." Probably cultivated in Europe, Herb. Linn. No. 937.2, upper row of leaves (**LINN** lecto designated by D.J. Mabberley, *Telopea* 7: 170, 1997).

Common names: orange, grapefruit, chinotto, clementine, ortanique, satsuma, tangelo, tangerine, tangor (and the 'mandarins' in modern commerce).

Description: Zhang & Mabberley (2008: 95).

Parentage: (male) *C. reticulata* × (female) *C. maxima* including many back-crosses (Scora 1975; Mabberley 1997, 2004; Ollitrault et al. 2020).

Notes: Commonly used synonyms: '*C.* ×*clementina*' auctt., *C.* ×*deliciosa* Ten., *C.* ×*nobilis* Lour., *C.* ×*paradisi* Macfad., *C* ×*poonensis* Tanaka, *C.* ×*sinensis* (L.) Osbeck, *C.* ×*tangelo* J.W.Ingram & H.E.Moore, *C.* ×*tangerina* Yu. Tanaka, *C.* ×*unshiu* (Swingle) Marcow. (see Mabberley 1997; Zhang & Mabberley 2008; Wu et al. 2014). Commonly seen cultivars in Australia: 'Barnfield', 'Delta Seedless', 'Hamlin', 'Lane Late', 'Leng', 'Ruby', 'Tarocco Ippolito', 'Valencia', 'Washington Navel' ('Baia', an older name; see also 'Bahia Navel' being grown in what is now the Royal Botanic Garden, Sydney in 1828 – Bowman [1955]), 'Winter Sunrise' - all Sweet Orange Group; 'Duncan', 'Flame', 'Marsh', 'Ray Ruby', 'Rio Red', 'Star Ruby', 'Texas Pink', 'Thompson', 'Wheeny' - all Grapefruit Group; 'Minneola', 'Seminole' - Tangelo Group; 'Wilking' - (Tangor Group'), 'Clementine', 'Dancy', 'Ellendale', 'Honey Murcott', 'Murcott', 'Ortanique', 'Temple', 'Wilking' - Tangerine or Tangor Group; 'Afourer', 'Cleopatra', 'Emperor', 'Imperial', 'Miho Wase', 'Owari', 'Ponkan' - Satsuma or Mandarin Group, 'mandarins'; Seville oranges (Sour Orange Group; see Saunt 2000: 140), e.g. 'Bouquet', are used for marmalade, while 'Myrtifolia' (*C.* ×*myrtifolia* Reider), chinotto is apparently a bud mutation of a sour orange (Swingle 1943: 489–490). A parent of *C.* ×*floridana*, *C.* ×*insitorum*, *C.* ×*limon*.

4. ***Citrus*** ×***floridana*** (J.W.Ingram & H.E.Moore) Mabb., *Telopea* 7: 337 (1998).

Basionym: ×*Citrofortunella floridana* J.W.Ingram & H.E.Moore, *Baileya* 19: 170 (1975).

Type [icon]: "Evstis [sic = 'Eustis'] limequat (No 48798), grown in the greenhouse at Washington, D.C.", *J. Agric. Res*. 23: [237] t. 4 (1923).

Common name: limequat.

Description: Swingle & Robinson (1923).

Parentage: (male) *C. japonica* × (female) *C.* ×*aurantiifolia* (Swingle & Robinson 1923; Mabberley 1998).

Note: Formerly used synonym: ×*Citrofortunella floridana* (see Mabberley 1998). Cultivars include 'Eustis' and 'Lakeland' (Saunt 2000: 137).

5. ***Citrus*** ×***georgiana*** Mabb., *Blumea* 49: 490 (2004).

Type: Germany [cult. from material received from Citrus Arboretum, Winterhaven, Florida, 1996; see http://members.aol.com/agrumivoss/thomasv.jpg], Lower Saxony, Stade, Jork, Moorende 149, Voss's Töpferei und Citruspflanzen-Spezialgärtnerei, Sept. 2004 (L4151394), *B. Voss 2* (**L** holo; **NSW** iso).

Common name: citrangequat.

Description: Swingle & Robinson (1923).

Parentage: (male) *C.* ×*insitorum* × (female) *C. japonica* (Swingle & Robinson 1923; Mabberley 2004).

Note: Cultivar in commerce: 'Thomasville'.

6. ***Citrus* ×*insitorum*** Mabb., *Gard. Bull. Sing*. 54: 193 (2002).

Basionym: ×*Citroncirus webberi*, J.W.Ingram & H.E.Moore, *Baileya* 19: 171 (1975), non *Citrus* ×*webberi* Wester (= ?).

Type [icon]: USDA Yearbook 1904: 228 tt. XI n. 716, XII f. 1–3 ('Rusk').

Common name: citrange, citrumelo.

Description: Webber (1943: 654).

Parentage: (male) *C.* ×*aurantium* × (female) *Citrus trifoliata* (Webber 1943: 656; Mabberley 2002).

Notes: Formerly used synonyms: ×*Citroncirus webberi* (see Mabberley 2002). Besides conferring tristeza-resistance, it shows some resistance to huanglongbing (Albrecht & Bowman 2011). Commonly seen cultivars in Australia (largely as rootstocks): 'Carrizo', 'Rusk', 'Troyer' (which is the parent, with *C.* ×*otaitensis*, of another synthesized rootstock), 'Willits'.

7. ***Citrus* ×*junos*** (Makino) Tanaka, *Sieb. Sens. Tor. Hyakun. Kin. Ronbunshu*: 65 (1924), pro sp.

Basionym: *C.* ×*aurantium* subsp. *junos* Makino, *Bot. Mag. (Tokyo)* 15: 165 (1901).

Type: Japan [cult.], "Prov. Musashi: Tokyo, Bot. Gard. Koishikawa (Herb.! Sc. Coll. Imp. Univ. Tokyo, May 31, 1881)" (**TI** lectotype designated by S. Akiyama et al., *J. Jap. Bot.* 90: 261, 2015).

Common name: yuzu.

Description: Zhang & Mabberley (2008: 95).

Parentage: *C. cavaleriei* × *C. reticulata* (Swingle 1943: 427, though also including some contributions from *C. japonica* and *C. maxima*, according to García-Lor et al. 2015).

Notes: Several other Japanese citrus cultivars analysed by Shimizu et al. (2016) are also Ichang papeda/mandarin crosses (ichandarins), some with contributions from other taxa: such include *Citrus* ×*tamurana* Tanaka ex Takahashi (hyuganatsu, konatsu) and *C.* ×*sudachi* Shirai (sudachi), amongst the whole array of hybrid "mandarins" selected and highly favoured in Japan.

8. ***Citrus* ×*latifolia*** (Yu.Tanaka) Tanaka, *Syst. Pomol*.: 140 (1951), pro sp.

Basionym: *Citrus* ×*aurantiifolia* var. *latifolia* Yu.Tanaka, *Agr. & Hort.* 9: 2346 (1934).

Type: Not preserved?

Common names: Persian lime, Tahiti[an] lime.

Description: Webber (1943: 624 as 'Tahiti Group')

Parentage: (male) *C.* ×*aurantiifolia* × (female) *C.* ×*limon* (Mabberley 2004; Zhang & Mabberley 2008; Curk et al. 2016, Olitrault et al. 2020).

Notes: A sterile triploid, it is one of the most commonly grown of all limes and is the lime least susceptible to huanglongbing (Folimonova et al. 2009). Cultivars grown in Australia: 'Bearss' (very similar to the original 'Tahiti'), 'Idemor'. It is rather surprising that there is not an older Latin name for this ubiquitous hybrid which is said to have reached Australia by 1824 and, in 1828, was being grown as 'Persian' in what is now the Royal Botanic Garden, Sydney (Bowman 1955); it reached California from Tahiti (presumably hence the common name, readily confusable with *C. otaitensis* 'Otaheite' – see below) in the mid-1800s.

9. ***Citrus* ×*limon*** (L.) Osbeck, *Reise Ostindien*: 250 (1765 as '*limonia*'), pro sp.

Basionym: *Citrus medica* var. *limon* L., *Sp. Pl.* 2: 782 (1753).

Type [icon]: 'Limon vulgaris' in Ferrari, *Hesperides* 191, 193, 1646 lectotype designated by D.J. Mabberley, *Telopea* 7: 169 (1997, q.v. for discussion of Osbeck's publication).

Common names: lemon, bergamot, limetta, sweet lemon, Florentine citron.

Description: Mabberley (2013: 505).

Parentage: (male) *C. medica* × (female) *C.* ×*aurantium* (Scora 1975, Mabberley 1997, Curk et al. 2016, Ollitrault et al. 2020).

Notes: Formerly used synonyms: *C.* ×*aurantium* subsp. *bergamia* (Risso) Engl., *C.* ×*bergamia* (Risso) Risso & Poit., *C.* ×*limetta* Risso (see Mabberley 1997, 2022). Parent of *C.* ×*latifolia*. Cultivar group status is appropriate to accommodate cultivars with different fruit-shapes and flavours e.g. Sweet Lemon Group, Bergamot Group. Commonly seen cultivars in Australia: 'Eureka', 'Fino' ('Primofiori'), 'Lisbon', 'Meyer', 'Verna', 'Villafranca', 'Yen Ben'. Florentine citrons (formerly *C. medica* var. *florentina* Risso), are backcrosses (formerly *C.* ×*limonimedica* Lush.) with citron. The Florentine citron is one of the components (the other being a sour orange) of a celebrated graft-chimaera, the bizzaria, (*Citrus* 'Bizzaria') which arose in Firenze, Italy, in the seventeenth century (Ragionieri 1927).

10. ***Citrus*** ×***microcarpa*** Bunge, *Enum. Pl. Chin. Bor.*: 10 (1833), pro sp.

Type: China [cult.], "Chine boreal" (P02441071), *Anon.* in Herb. Bunge *s.n.* (**P** ?holo, fide D.J. Mabberley, *Telopea* 7: 337, 1998).

Common names: calamondin, calamansi.

Description: Swingle (1943: 357).

Parentage: *C. reticulata* × *C. japonica* (Swingle 1943: 415; Mabberley 1998; Curk et al. 2016).

Notes: Formerly used synonyms: ×*Citrofortunella microcarpa* (Bunge) Wijnands, ×*C. mitis* (Blanco) J.W.Ingram & H.E.Moore, *Citrus* ×*mitis* Blanco (see Mabberley 1998, 2002). A parent of *C.* ×*oliveri.* Calamansi is important in the soft drink industry, especially in the Philippines.

11. ***Citrus*** ×***oliveri*** Mabb., *Blumea* 49: 490 (2004).

Type: Germany [cult. from material received in 1996 from Citrus Arboretum, Winterhaven, Florida, USA; see http://members.aol.com/agrumivoss/faust.jpg), Lower Saxony, Stade, Jork, Moorende 149, Voss's Töpferei und Citruspflanzen-Spezialgärtnerei (L4196570), *B. Voss 3* (**L** holo).

Common names: faustrimedrin, sunrise lime.

Description: Swingle (1943: 360)

Parentage: *C. australasica* × *C.* ×*microcarpa* (Mabberley 2004).

Note: Shows some resistance to huanglongbing (Folimonova et al. 2009, Ramadugu et al. 2016).

12. ***Citrus*** ×***otaitensis*** (Risso & Poit.) Risso, *Fl. Nice*: 86 + t. [7] (1844 '*taitensis*'), pro sp.

Basionym: *C.* ×*aurantium* var. *otaitensis* Risso & Poit., *Hist. Nat. Orang.*: 66 + t. 27 (1819).

Type [icon]: Risso & Poit., *Hist. Nat. Orang.*: t. 27 [1819] lectotype designated by Mabberley (2022, accepted).

Common names: rough (or bush - Australia) lemon, Rangpur lime, Canton lemon, Volkamer lemon.

Description: Webber (1943: 626, as Rangpur).

Parentage: *C. medica* × *C. reticulata* (Curk et al. 2016).

Notes: See Mabberley (2022 in press) for discussion of this name, which has to be corrected from 'taitensis'. Commonly used synonyms: '*C.* ×*limonia*' auctt., non *C.* ×*limon* (L.) Osbeck ('*limonia*'; see Mabberley 1997), *C.* ×*jambhiri* Lush., *C.* ×*volcameriana* (Risso & Poit.) V.Ten. & Pasq. Used as a rootstock tolerant of tristeza (Saunt 2000: 149); a fashionable flavouring ingredient in gin. Crossed with *C. australasica* to give 'blood lime', while one rootstock in cultivation is a synthesized hybrid with *C.* ×*insitorum* 'Troyer'. According to Saunt (2000: 151) 'Otaheite' (Tahitian orange) is a sweet (as opposed to sour) cultivar, apparently the original dwarf introduction to Europe (the type); it is often seen in USA as a pot-plant, when only 30 cm tall producing fruits in winter (Webber 1943: 630).

13. ***Citrus*** ×***tachibana*** (Makino) Tanaka, *Bult. Sci. Fak. Terk. Kjusu Imp. Univ*. 1: 31 (1924), pro sp.

Basionym: *C.* ×*aurantium* var. *tachibana* Makino, *J. Soc. Hort. Jap*. 75: 2 [+ t., n.v.] (1896).

Type: Lost, cf. Swingle (1943: 421), or not preserved.

Common name: Tachibana (Japan)

Description: Swingle (1943: 421); Ohwi (1984: 585).

Parentage: *C. reticulata* × '*C. ryukyuensis*' (Wu et al. 2021).

Note: Tachibana is of great cultural significance to Japanese people, figuring in early poetry besides on modern coinage and the medal of the Order of Cultural Merit.

14. ***Citrus* ×*virgata*** Mabb., *Telopea* 7: 339 (1998).

Type: USA [cult.], Washington DC, USDA greenhouses, 'C.P. & B. no. 7775-E', 23 Oct. 1939, *W.T. Swingle s.n.* (NSW 418672) (**NSW** holo).

Description: Swingle (1943: 382).

Parentage: *C. australasica* × *C. australis* (Swingle 1943: 382; Mabberley 1998, 2013).

Notes: Cultivar commercial in Australia: 'Sydney Hybrid'. It shows some resistance to huanglongbing (Folimonova et al. 2009, Ramadugu et al. 2016) and has been successfully crossed with *C.* ×*aurantium* 'Clementine' (Mabberley 1998).

Murraya

It has been recognised that *Murraya paniculata* (L.) Jack s.s. is favoured by the psyllid vector of *C*Las (and is a transient host of the bacterium), whilst other currently recognised species formerly included within *M. paniculata* s.l., have not been recorded as such (George Beattie pers. comm., 12 April 2022). These include the Australian *M. lucida* (G.Forst.) Mabb., but also a mainland Asian taxon (Om 2017), for which the name *M. elongata* A.DC. ex Hook.f. has very recently been revived (see Nguyen et al. 2019, Mou et al. 2021). However, in their monographic treatment, Mou et al. (2021), unfortunately did not consider the first available name, *Chalcas intermedia* M.Roem.: the correct binomial in *Murraya*, when *M. paniculata* is used in the narrow sense, is therefore:

Murraya intermedia (M.Roem.) Mabb., **comb. nov.**

Basionym: *Chalcas intermedia* M.Roem., *Syn. Monogr.* 1: 48 (1846).

Type: India, Assam, Goalpara ('Gualpara'), 19 Aug. 1803 (E00940361), *F. Buchanan-Hamilton 1054* (**E** lectotype designated here).

Note: Max Roemer, copying material from Wight & Walker-Arnott (1834: 94), has a somewhat ambiguous description (in a key), but cites only one specimen, here chosen as lectotype. His confused description perhaps comes from consideration of a cited Roxburgh drawing now at **K** and probably referable to *M. paniculata s.s.*, orange jasmine.

[*Chalcas paniculata sensu* Lour., *Fl. Cochinch.*: 270 (1790), non L.]

Note: There is Loureiro material (BM000832568) at **BM**.

[*M. paniculata* sensu mult. auctt., p.p., non Jack (1820 quoad basionym)]

M. elongata A.DC. ex Hook.f., *Fl. Brit. India* 1: 503 (1875), **syn. nov**.; *Camunium elongatum* (Hook.f.) Kuntze, *Rev. Gen.* 1: 99 (1891).

Type: Myanmar, Kayin, "817 Taong-dang [i.e. Thandaung] Village near the houses 26 Novbr [1826]" (K001132323), *N. Wallich s.n.* [found after n. *6369* in *Herb. EIC*] (**K** holo).

Description: Mou et al. (2021: 392), as *M. elongata*.

Distribution: Mainland Asia (India to peninsular Malaysia). It is the geographical vicariant of *Murraya sumatrana* Roxb. (Sumatra and eastwards in Malesia) and the closely related *M. lucida* (east Malesia and western Pacific south to Australia); see Nguyen et al. (2019).

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References

Ajene IJ, Khamis F, Mohammed S, Rasowo B, Ombura FL, Pietersen G, van Asch B, Ekesi S (2019) First report of field population of *Trioza erytreae* carrying the huanglongbing-associated pathogen, '*Candidatus* Liberibacter asiaticus', in Ethiopia. *Plant Disease Notes* 103: 1766. https://doi.org/10.1094/PDIS-01-19-0238-PDN

Ajene IJ, Khamis FM, van Asch B, Pietersen P, Seid N, Rwomushana I, Ombura FLO, Momany G, Finyange P, Rasowo BA, Tanga CM, Mohammed S, Ekesi S (2020) Distribution of *Candidatus* Liberibacter species in Eastern Africa, and the first report of *Candidatus* Liberibacter asiaticus in Kenya. *Scientific Reports* 10: 3919. https://doi.org/10.1038/s41598-020-60712-0

Albrecht U, Bowman KD (2011) Tolerance of the trifoliate citrus hybrid US-897 (*Citrus reticulata* Blanco × *Poncirus trifoliata* L.[sic] Raf.) to huanglongbing. *HortScience* 46: 16–22. https://doi.org/10.21273/HORTSCI.46.1.16

Appelhans MS, Bayly MJ, Heslewood MM, Groppo M, Verboom GA, Forster PI, Kallunki JA, Duretto MF (2021) A new subfamily classification of the *Citrus* family (Rutaceae) based on six nuclear and plastid markers. *Taxon* 70: 1035–1061. https://doi.org/10.1002/tax.12543

Backer CA, Bakhuizen van den Brink RC (1965) *Flora of Java (spermatophytes only)*. Vol. 2, *Angiospermae, families 111–160*. (Noordhoff, Groningen)

Beattie GAC, Barkley P (2009) *Huanglongbing and its vectors: a pest-specific contingency plan for the citrus and nursery and garden industries* (Version 2), February 2009. (Horticulture Australia, Sydney)

Bonavia E (1886) On the probable wild source of the whole group of cultivated limes (*Citrus acida* Roxb., *C. medica* var. *acida* of Brandis, Hooker, and Alph. de Candolle). *Journal of the Linnean Society, Botany* 22: 213–218. https://doi.org/10.1111/j.1095-8339.1886.tb00463.x

Bonavia E (1888) *The cultivated oranges and lemons, etc. of India and Ceylon, with researches into their origin and the derivation of their names, and other useful information. With an atlas* [1890] *of illustrations*. (Allen, London) https://www.biodiversitylibrary.org/item/70168#page/7/mode/1up

Bowman FT (1955 [?1956]) A history of citrus growing in Australia 1788–1900. *Citrus News* 31(8): 102–113 [reprinted with own pagination (pp. 12); copy in Solander Library, Royal Botanic Garden, Sydney]

Brickell CD, Alexander C, Cubey JJ, David JC, Hoffman MHA, Leslie AC, Malécot V, Jin X (2016) *International Code of Nomenclature for Cultvated Plants*. Ninth ed. [*Scripta horticulturae* 18]. (International Society for Horticultural Science, Leuven, Belgium)

Curk F, Ancillo G, Ollitrault F, Perrier X, Jacquemoud-Collet JP, García-Lor A, Navarro L, Ollitrault P (2015) Nuclear species-diagnostic SNP markers mined from 454 amplicon sequencing reveal admixture genomic structure of modern citrus varieties. *PLoS One* 10(5): e0125628. https://doi.org/10.1371/journal.pone.0125628

Curk F, Ollitrault F, García-Lor A, Luro F, Navarro L, Ollitrault P (2016) Phylogenetic origin of limes and lemons revealed by cytoplasmic and nuclear markers. *Annals of Botany* 117: 563–583. https://doi.org/10.1093/aob/mcw005

Folimonova AS, Robertson CJ, Garnsey SM, Gowda S, Dawson WO (2009) Examination of the responses of different genotypes of citrus to Huanglongbing (citrus greening) under different conditions. *Phytopathology* 99: 1346–1354. https://doi.org/10.1094/PHYTO-99-12-1346

García-Lor A, Luro F, Ollitrault P, Navarro L (2015) Genetic diversity and population structure analysis of mandarin germplasm by nuclear, chloroplastic and mitochondrial markers. *Tree Genetics and Genomes* 11: 123. https://doi.org/10.1007/s11295-015-0951-1

Gmitter G, Wu GA, Rokshar DS, Talon M (2020) The citrus genome. In Talon M, Caruso M, Gmitter Jr FG (eds), *The genus* Citrus. pp. 1–8 (Woodhead Publishing, Duxford, United Kingdom) https://doi.org/10.1016/B978-0-12-812163-4.00001-2

Hall DG, Richardson ML, Ammar E-D, Halbert SE (2013) Asian citrus psyllid, *Diaphorina citri*, vector of huanglongbing disease. *Entomologia Experimentalis et Applicata* 146: 207–223. https://doi.org/10.1111/eea.12025

Huang C-Y, Araujo K, Niño Sánchez J, Kund G, Trumble J, Roper C, Elvin K, Godfrey KE, Jin H (2021) A stable antimicrobial peptide with dual functions of treating and preventing citrus Huanglongbing. *Proceedings of the National Academy of Sciences* 118 No. 6 e2019628118, https://doi.org/10.1073/pnas.2019628118

Luro F, Baccati C, Paoli M, Marchi E, Costantino G, Gibernau M, Ollitrault P, Tomi F (2022) Phylogenetic and taxonomic status of *Citrus halimii* B.C. Stone determined by genotyping complemented by chemical analysis of leaf and fruit rind essential oils. *Scientia Horticulturae* 299: 111018. https://doi.org/10.1016/j.scienta.2022.111018

Mabberley DJ (1992) Robert Mudie (1777–1842) and Australian botany, or, the saga of the black bean. *Australian Systematic Botany Society Newsletter* 70: 13–15. https://asbs.org.au/newsletter/pdf/92-mar-070.pdf

Mabberley DJ (1997) A classification for edible *Citrus* (Rutaceae). *Telopea* 7: 167–172. http://rbgsyd.nsw.gov.au/__data/assets/pdf_file/0019/73216/Tel7Mab167.pdf

Mabberley DJ (1998) Australian Citreae with notes on other Aurantioideae (Rutaceae). *Telopea* 7:333–344. https://plantnet.rbgsyd.nsw.gov.au/emuwebnswlive/objects/common/webmedia.php?irn=357&reftable=ebibliography

Mabberley DJ (2002) Limau hantu and limau purut: the story of lime-leaves (*Citrus hystrix* DC., Rutaceae)? *Gardens' Bulletin, Singapore* 54: 185–197. http://biostor.org/cache/pdf/b3/4b/89/b34b898ffbe3dc3a879c0e931df4ffbc.pdf

Mabberley DJ (2004) *Citrus* (Rutaceae): a review of recent advances in etymology, systematics and medical applications. *Blumea* 49: 481–498. https://doi.org/10.3767/000651904X484432

Mabberley DJ (2013) Rutaceae, Group 4 [including *Citrus*], pp. 496–510, in Wilson AJG (ed.), *Flora of Australia* Vol. 26 (Meliaceae, Rutaceae, Zygophyllaceae). (ABRS/CSIRO Australia, Melbourne) https://www.awe.gov.au/sites/default/files/env/pages/fb3709f5-d0b4-4a15-94bc-17686ac6a9ae/files/flora-australia-26-meliaceae-rutaceae-zygophyllaceae.pdf

Mabberley DJ (2016) The typification of *Murraya*, *M. exotica* and *M. paniculata* (Rutaceae): its significance for the world citrus industry. *Taxon* 65: 366–371. https://doi.org/10.12705/652.15

Mabberley DJ (2017) *Mabberley's Plant-book. A portable dictionary of plants, their classification and uses.* Fourth edition. (Cambridge University Press, Cambridge)

Mabberley DJ (2018) Botany of citron (*Citrus medica* L.) and the citrus tribe. Pp. 83–107 [in Hebrew, trans. by the eds; English abstract: p. 13] in Goldschmidt EE, Bar-Joseph M (eds), *The etrog citron* (Citrus medica *L.): tradition and research.* (Mosad Harav Kook, Jerusalem [reprinted with corrections, 2019])

Mabberley DJ (2021) The Compleat Citrus? [review of M Talon et al. (eds), *The genus Citrus*]. *Australasian Systematic Botany Society Newsletter* 186: 26–29. https://asbs.org.au/newsletter/pdf/21-mar-186.pdf

Mabberley DJ (2022 accepted) The biology of the etrog citron (*Citrus medica* L., Rutaceae-Aurantioideae-Aurantieae), its hybrids and allies. In Goldschmidt EE, Bar-Joseph M (eds), *The Etrog Citron Compendium*. (Springer)

Mabberley DJ, Kiew R (2005) A particularly important de Alwis watercolour: *Citrus halimii*. *Gardenwise* 25: 30. https://www.nparks.gov.sg/sbg/research/publications/-/media/sbg/gardenwise/2005-jul-gardenwise-vol-25.ashx

Mabberley DJ, Kodela PG (2015) Lectotypification of *Citrus cavaleriei* H.Lév. ex Cavalerie (Rutaceae: Aurantioideae). *Telopea* 18: 115–119. https://doi.org/10.7751/telopea8510

Mabberley DJ, Kodela PG (submitted) *Citrus*. In Raven PH, Abbott JR (eds), *List of Species of the Plants of India* (Missouri Botanical Garden, St Louis)

Mabberley DJ, Xu L (2022 accepted) Proposal to conserve the name *Citrus reticulata* (Rutaceae) with a conserved type. *Taxon 71*

Mou F-J, Peng Y, Li, Y-G, Hu X (2021) Taxonomic revision of *Murraya* J. Koenig (Rutaceae) based on the molecular phylogeny and morphological characters. *Taiwania* 66: 387–397. https://doi.org/10.6165/tai.2021.66.387

Nguyen CH, Beattie GAC, Haigh AM, Astiti IP, Mabberley DJ, Weston PH, Holford P (2019) Molecular differentiation of the *Murraya paniculata* complex (Rutaceae: Aurantioideae: Aurantieae). *BMC Biology* 19: 236. https://doi.org/10.1186/s12862-019-1555-4

Ohwi J (1984) *Flora of Japan*. (Smithsonian Institution, Washington DC.)

Ollitrault P, Curk F, Krueger R (2020) Citrus taxonomy. In Talon M, Caruso M, Gmitter Jr FG (eds), *The genus* Citrus. pp. 57–81. (Woodhead Pulishing, Duxford, United Kingdom)

Om N (2017) *The roles of psyllids, host plants and environment in the aetiology of huanglongbing in Bhutan*. (Ph. D. thesis, Western Sydney University, Richmond, NSW)

Ragionieri A (1927) Origin of the Florentine bizzarria. *Journal of Heredity* 18: 527–528. https://doi.org/10.1093/oxfordjournals.jhered.a102788

Ramadugu C, Keremane, ML, Halbert SE, Duan YP, Roose ML, Stover E, Lee RF (2016) Long-term field evaluation reveals huanglongbing resistance in *Citrus* relatives. *Plant Disease* 100: 1858–1869. https://doi.org/10.1094/PDIS-03-16-0271-RE

Saunt J (2000) *Citrus varieties of the world*. Second ed. (Sinclair, Norwich)

Scora RW (1975) On the history and origin of citrus. *Bulletin of the Torrey Botanical Club* 102: 369–375. https://doi.org/10.2307/2484763

Scora RW, Nicolson DH (1986) The correct name for the shaddock, *Citrus maxima*, not *C. grandis* (Rutaceae). *Taxon* 35: 592–595. https://doi.org/10.2307/1221927

Shimizu T, Kitajima A, Nonak K, Yoshioka T (2016) Hybrid origins of citrus varieties inferred from DNA marker analysis of nuclear and organelle genomes. *PLoS One*, 11 (11): e0166969. https://doi.org/10.1371/journal.pone.0166969

Swingle WT (1943) The botany of Citrus and its wild relatives of the orange subfamily (family Rutaceae, subfamily Aurantioideae). Pp. 129–474 in Webber HJ, Batchelor LD *The citrus industry* vol. 1. *History, botany, and breeding*. (University of California Press, Berkeley & Los Angeles) https://catalog.hathitrust.org/Record/002003866

Swingle WT, Robinson TR (1923) Two important new types of citrous [sic] hybrids for the home garden, citrangequats and limequats. *Journal of Agricultural Research* 23: 229–238. https://digitalcollections.library.miami.edu/digital/collection/asm0188/id/775/

Tanaka T (1930) Enumeration of Indian species of Rutaceae-Aurantioideae (Revisio Aurantiacearum – VI). *Journal of Botany British and Foreign* 68: 225–236.

Turland NJ, Wiersema JH, Barrie FR, Greuter W, Hawksworth DL, Herendeen PS, Knapp S, Kusber W-H, Li D-Z, Marhold K, May TW, McNeill J, Monro AM, Prado J, Price MJ, Smith GF (eds) (2018) *International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017* [*Regnum Vegetabile* 159]. (Koeltz Botanical Books, Glashütten) https://doi.org/10.12705/Code.2018

Wang L, He F, Huang Y, He J, Yang S, Zeng S, Zeng J, Deng C, Jiang X, Fang Y, Wen S, Xu R, Yang X, Zhong G, Chen C, Yan X, Zhou C, Zhang H, Xie Z, Larkin RM, Deng X, Xu Q (2018) Genome of wild mandarin and domestication history of mandarin. *Molecular Plant* 11: 1924–1037. https://doi.org/10.1016/j.molp.2018.06.001

Wearn J, Mabberley DJ (2016) Citrus and orangeries in northern Europe. *Curtis's Botanical Magazine* n.s. 33: 94–107. https://doi.org/10.1111/curt.12128

Webber HJ (1943) Cultivated varieties of citrus. Pp. 475–668 in Webber HJ, Batchelor LD *The citrus industry* vol. 1. *History, botany, and breeding*. (University of California Press, Berkeley & Los Angeles)

Wheatley M, Yang,Y (2020) Versatile applications of the CRISPR/Cas toolkit in plant pathology and disease management. *Phytopathology* 111: 1080–1090. https://doi.org/10.1094/PHYTO-08-20-0322-IA

Wight R, Walker-Arnott GA (1834) *Prodromus Florae Peninsulae Indiae Orientalis: containing abridged descriptions of the plants found in the peninsula of British India, arranged according to the natural system.* Vol. 1. (Parbury, Allen, London)

Wu GA, Prochnik S, Jenkins J, Salse J, Hellsten U, Murat F, Perrier X, Ruiz M, Scalabrin S, Terol J, Takita MA, Labadie K, Poulain J, Couloux A, Jabbari K, Cattonaro F, Del Fabbro C, Pinosio S, Zuccolo A, Chapman J, Grimwood J, Tadeo FR, Estornell LH, Muñoz-Sanz JV, Ibanez V, Herrero-Ortega A, Aleza P, Pérez-Pérez J, Ramón D, Brunel D, Luro F, Chen C, Farmerie WG, Desany B, Kodira C, Mohiuddin M, Harkins T, Fredrikson K, Burns P, Lomsadze A, Borodovsky M, Reforgiato G, Freitas-Astúa J, Quetier F, Navarro L, Roose M, Wincker P, Schmutz J, Morgante M, Machado MA, Talon M, Jaillon O, Ollitrault P, Gmitter F, Rokhsar D (2014) Sequencing of diverse mandarin, pummelo and orange genomes reveals complex history of admixture during citrus domestication. *Nature Biotechnology* 32(7): 656–663. https://doi.org/10.1038/nbt.2906

Wu GA, Sigimoto C, Kinjo H, Azama C, Mitsuda F, Talon M, Gmitter FG, Roksar DS (2021) Diversification of mandarin citrus by hybrid speciation and apomixis. *Nature Communications* 12: 4377. https://doi.org/10.1038/s41467-021-24653-0

Xu Q, Cen L-L, Ruan X, Chen D, Zhu A, Chen C, Bertrand D, Jiao WB, Hao B-H, Lyon MP, Chen J, Gao S, Xing F, Lan H, Chang J-W, Ge X, Lei Y, Hu Q, Miau W, Wang L, Xiao S, Biswas MK, Zeng W, Guo F, Cao H, Yang X, Xu X-W, Cheng Y-J, Xu J, Liu J-H, Luo OJ, Tang Z, Guo W-W, Kuang H, Zhang H-Y, Roose ML, Nagarajan N, Deng X-X, Ruan Y (2013) The draft genome of sweet orange (*Citrus sinensis*). *Nature Genetics* 45: 59–66. https://doi.org/10.1038/ng.2472

Zhang D, Mabberley DJ (2008) *Citrus* Linnaeus, *Sp. Pl.* 2: 782. 1753, in Wu ZY, Raven PH, Hong DY (eds), *Flora of China* 11 (Oxalidaceae through Aceraceae): 90–96. (Science Press: Beijing/Missouri Botanical Garden Press: St Louis) http://flora.huh.harvard.edu/china/PDF/PDF11/Citrus.pdf

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