Fl. China 11: 90–96. 2008.

21. CITRUS Linnaeus, Sp. Pl. 2: 782. 1753.

柑橘属 gan ju shu

Zhang Dianxiang (张奠湘); David J. Mabberley

Aurantium Tournefort ex Miller; *Citreum* Tournefort ex Miller; ×*Citrofortunella* J. Ingram & H. E. Moore; ×*Citroncirus* J. Ingram & H. E. Moore; +*Citroponcirus* H. Wu et al.; *Fortunella* Swingle; *Limon* Tournefort ex Miller; *Papeda* Hasskarl; *Poncirus* Rafinesque; *Pseudaegle* Miquel; *Sarcodactilis* C. F. Gaertner.

Shrubs or small trees, evergreen, rarely deciduous. Young branches often flat and angled, usually with solitary (rarely paired) spines at axils. Leaves 1-foliolate, rarely 3-foliolate or simple; petiole usually articulated with base of leaf blade, usually conspicuously winged; leaf blade subleathery to leathery, with dense pellucid fragrant oil dots, margin crenulate or rarely entire. Flowers axillary, hermaphrodite or male, solitary or in small fascicles, fragrant. Calyx cup-shaped; lobes 3–5, subglabrous. Petals (3 or)4 or 5(–8), white or outside pinkish red, imbricate, thick. Stamens usually 4(–10) × as many as petals, free or basally coherent. Disk annular or short, with nectary glands. Ovary (3–)5–14(–18)-loculed, each locule with 2–8 or more ovules; stigma large. Fruit a berry (hesperidium) with sarcocarp segments of pulp vesicles and adaxially attached seeds. Seed coat smooth or ridged; embryo(s) 1 to many, like cotyledons milky white, green, or rarely yellowish, germination hypogeous.

Between 20 and 25 species: E, S, and SE Asia, Australia, SW Pacific islands, with many cultivated taxa widely naturalized in warm countries; 11 species and hybrid species (three endemic) native, naturalized, or extensively cultivated in China, plus five hybrid species cultivated to a limited extent.

In China, many early hybridizations appear to have taken place, and many cultivated taxa have become naturalized (these are listed at the end of the generic account). For a discussion of the status of several taxa formerly considered species see Nicolosi et al. (Theor. Appl. Genetics 100: 1155–1166. 2000) and Mabberley (Blumea 49: 481–498. 2004). Hybrids readily form between species, and as apomixis is common, such hybrids can be fixed as cultivars, with occasional outcrossings leading to yet more. Because these hybrids can thereby span, through backcrossing, the spectrum of variation between the original, probably geographically isolated, species, it is impossible to provide a key to cover all plants that may be found. The key here therefore covers the apparently wild species and some of the most common cultivar groups now referred to as hybrid taxa. Doubtful taxa are not included in the key, but descriptions of two are included at the end of the treatment.

Because of the enormous worldwide economic importance of the genus, *Citrus* is treated more fully, particularly with regard to synonymy, than is the norm in this flora. The following treatment is the first floristic one to take account of current advances in the understanding of the genus.

1a. Plants deciduous; leaves of mature plants 3(–5)-foliolate ..... 1. *C. trifoliata*
1b. Plants evergreen; leaves 1-foliolate or rarely simple.
2a. Ovary with 3 or 4(–6) locules, each with 3 or 4 ovules ..... 4. *C. japonica*
2b. Ovary with (6 or)7–15 locules, each with many ovules.
3a. Leaves with a winged petiole much more than half as long as leaf blade.
4a. Leaf blade margin entire to finely crenulate, apex acuminate ..... 2. *C. cavaleriei*
4b. Leaf blade margin conspicuously crenulate, apex obtuse to subrounded and sometimes mucronate ..... 3. *C. hystrix*
3b. Leaves with a winged petiole less than half as long as leaf blade or absent.
5a. Petiole not winged; fruit pericarp thicker than sarcocarp ..... 5. *C. medica*
5b. Petiole winged although sometimes only narrowly; fruit pericarp thinner than sarcocarp.
6a. Cotyledons green.
7a. Fruit oblong or at least with a marked apical mammilla; petals outside pinkish or reddish ..... 9. *C.* ×*limon*
7b. Fruit globose, oblate, pyriform, or broadly obconic and without a marked apical mammilla; petals outside white or purplish.
8a. Young branches, calyx lobes, and ovaries with trichomes; fruit 10 cm or more in diam. ..... 6. *C. maxima*
8b. Young branches, calyx lobes, and ovaries glabrous; fruit to 10 cm in diam. but often much smaller ..... 10. *C.* ×*aurantium*
6b. Cotyledons milky white.
9a. Flowers solitary or in small fascicles; pericarp easily removed.
10a. Fruit pale yellow, orange, red, or carmine; sarcocarp usually sweet ..... 7. *C. reticulata*
10b. Fruit pale yellow; sarcocarp acid and bitter ..... 11. *C.* ×*junos*
9b. Flowers usually in fascicles; pericarp not easily removed.
11a. Fruit greenish yellow, with an apical papilla; sarcocarp very acid ..... 8. *C.* ×*aurantiifolia*
11b. Fruit orange, reddish, or sometimes yellow, without an apical papilla; sarcocarp sour or sweet ..... 10. *C.* ×*aurantium*

1. Citrus trifoliata Linnaeus, Sp. Pl., ed. 2, 2: 1101. 1763.

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Aegle sepiaria Candolle; *Citrus trifolia* Thunberg; *C. trifoliata* subf. *monstrosa* (T. Itô) Hiroe; *C. trifoliata* var. *mon-*

strosa T. Itô; *C. triptera* Desfontaines; *Poncirus trifoliata* (Linnaeus) Rafinesque; *P. trifoliata* var. *monstrosa* (T. Itô) Swingle; *Pseudaegle sepiaria* (Candolle) Miquel.

Trees or treelets, 1–5 m tall. Branches green, flat, ridged when young; spines ca. 4 cm, base flat, apex rufous. Foliage spurs unarmed, developed from dormant buds on twigs of previous year, with very short internodes bearing 1–5 leaves. Leaves palmately 3(–5)-foliolate, in juveniles usually simple or 1-foliolate; petiole narrowly winged; leaflet blades 2–5 × 1–3 cm, central one as long or longer than laterals, midvein with short trichomes when young, margin finely crenulate or entire. Flowers solitary or paired, 3.5–8 cm in diam. Calyx lobes 5–7, basally connate. Petals (4 or)5(or 6), white, obovate, 1.5–3 cm, imbricate. Stamens usually 20; filaments of different lengths. Ovary 6–8-loculed, hairy; ovules 4–8, in 2 rows per locule; style short, thick; stigma clavate. Fruit dark yellow, subglobose to pyriform, usually 3–4.5 × 3.5–6 cm, with coarse ring-shaped furrows or sometimes smooth. Seeds 20–50, broadly ovoid, 0.9–1.2 cm; embryo(s) solitary or several; seed coat smooth or with inconspicuous fine ridges. Fl. May–Jun, fr. Oct–Nov.

● Anhui, Chongqing, S Gansu, N Guangdong, N Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, NW Jiangxi, S Shaanxi, Shandong, S Shanxi, Zhejiang.

2. Citrus cavaleriei H. Léveillé ex Cavalerie, Bull. Géogr. Bot. 21: 211. 1911.

宜昌橙 yi chang cheng

Citrus ×*aurantium* Linnaeus subsp. *ichangensis* (Swingle) Guillaumin; *C. hongheensis* Y. M. Ye et al.; *C. ichangensis* Swingle; *C. macrosperma* T. C. Guo & Y. M. Ye.

Trees or shrubs, 2–10 m tall. Branchlets subglabrous; spines straight, stout, smaller on flowering branches. Leafy petiole 1–3 × as long as blade, narrowly elliptic, 6–16 × 2.5–4 cm, base cuneate, margin finely crenulate, apex rounded; leaf blades ovate-lanceolate, ca. 2(–8) × 0.7–1.5(–4.5) cm, margin entire to finely crenate, apex acuminate. Flowers solitary or to 9 in fascicles, 3–3.5 cm in diam.; buds pale purplish red, broadly ellipsoid. Calyx lobes 5. Petals 4 or 5, white or pink, 1–1.8 × 0.5–0.8 cm. Stamens 16–30; filaments distinct or cohering in bundles, ciliate. Ovary pale green, subellipsoid; style ca. 6.5 mm; stigma pale yellow, with fine shallow grooves. Fruit pale yellow, oblate, globose, or pyriform, usually 3–5 × 4–6 cm but when pyriform to 9–10 × 7–8(–12) cm, with narrow longitudinal grooves, oil dots large and conspicuously prominent, base rounded, apex rounded, dimpled, and with or without a papilla; pericarp to 2 cm thick but usually much less; sarcocarp in 7–13 segments, yellowish white, very sour. Seeds 30 or more, subglobose to irregularly pyramidal, ca. 1.5 × 1.5 × 1.2 cm; seed coat yellowish white, chalaza dark brown, large, and covering almost half of coat; embryo(s) solitary to numerous; cotyledons milky white. Fl. Mar–Jun, fr. Oct–Dec.

● Mountains, hills, valleys; below 2500 m. S Gansu, N Guangxi, Guizhou, W Hubei, NW and W Hunan, S Shaanxi, Sichuan, Yunnan.

This species is a parent with *Citrus* ×*aurantium* of *C.* ×*webberi* Wester, and possibly a parent with *C. reticulata* of *C.* ×*junos*.

3. Citrus hystrix Candolle, Cat. Pl. Horti Monsp. 19, 97. 1813.

箭叶橙 jian ye cheng

Citrus auraria Michel; *C. echinata* Saint-Lager; *C. hyalopulpa* Tanaka; *C. kerrii* (Swingle) Tanaka; *C. macroptera* Montrouzier var. *kerrii* Swingle; *C. papeda* Miquel; *Fortunella sagittifolia* F. M. Feng & P. I Mao; *Papeda rumphii* Hasskarl.

Trees 3–6 m tall. Branchlets with spines. Leaves dark red when young; petiole winged, apex rounded to truncate; leaf blade ovate, 5–8 × 2.5–4.5 cm, 1–2.5 cm longer (rarely same length) and 0.5–1 cm wider than winged petiole, tertiary veins conspicuous, margin apically conspicuously and sparsely crenate, apex narrowly obtuse. Inflorescences with (1 or)3–5 flowers; peduncle 1–5 mm. Flower buds globose. Calyx lobes 4 or 5, broadly triangular, ca. 4 × 6 mm. Petals white but pinkish red outside, 7–10 mm. Stamens ca. 30; filaments distinct. Style short, thick. Fruit lemon yellow, ellipsoid to subglobose, 5–7 × 3–5 cm, slightly coarse or smooth, oil dots numerous and prominent, apex rounded; pericarp thick; sarcocarp in 11–13 segments, very acidic and slightly bitter. Seeds numerous 1.5–1.8 × 1–1.2 cm, ridged; embryo solitary; cotyledons milky white. Fl. Mar–May, fr. Nov–Dec.

N Guangxi, Yunnan [Indonesia, Myanmar, New Guinea, Philippines, Thailand].

Although apparently native to S China into SE Asia and Malesia, the natural distribution of this species is obscured by cultivation. Selected forms are cultivated throughout the warm parts of the world for their culinary (leaves) and medicinal (fruit) uses. All named taxa (save perhaps some from central Malesia) seem to have been based on cultivated plants as discussed by Mabberley (Gard. Bull. Singapore 54: 173–184. 2002). Commonly seen in China are cultivated plants (the "lime leaves" of commerce) with the following characteristics: leaf blade broadly elliptic, apex obtuse to rounded; fruit subglobose, ca. 4 × 3.5 cm, smooth, apex with a papilla; pericarp ca. 2 mm thick; sarcocarp in 6 or 7 segments, 6–8-seeded but 1 or 2 seeds undeveloped; seeds pyramidal, 1.5–1.8 × 1–1.4 cm, 0.8–1.2 mm thick, with alveolate ridges.

4. Citrus japonica Thunberg, Nova Acta Regiae Soc. Sci. Upsal. 3: 208. 1780.

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Atalantia hindsii (Champion ex Bentham) Oliver ex Bentham; *Citrus* ×*aurantium* Linnaeus var. *globifera* Engler; *C.* ×*aurantium* subsp. *japonica* (Thunberg) Engler; *C.* ×*aurantium* var. *japonica* (Thunberg) Hooker; *C.* ×*aurantium* subvar. *madurensis* (Loureiro) Engler; *C.* ×*aurantium* subvar. *margarita* (Loureiro) Engler; *C.* ×*aurantium* var. *oliviformis* Risso ex Loiseleur; *C.* ×*aurantium* subvar. *spinosa* Siebold & Zuccarini ex Engler; *C. hindsii* (Champion ex Bentham) Govaerts; *C. inermis* Roxburgh; *C. japonica* subf. *crassifolia* (Swingle) Hiroe; *C. japonica* subf. *hindsii* (Champion ex Bentham) Hiroe; *C. japonica* var. *madurensis* (Loureiro) Guillaumin; *C. japonica* subf. *margarita* (Loureiro) Hiroe; *C. japonica* var. *margarita* (Loureiro) Guillaumin; *C. kinokuni* Tanaka; *C. madurensis* Loureiro; *C. margarita* Loureiro; *C.* ×*nobilis* Loureiro var. *inermis* (Roxburgh) Sagot; *Fortunella chintou* (Swingle) C. C. Huang; *F. crassifolia* Swingle; *F. hindsii*

(Champion ex Bentham) Swingle; *F. hindsii* var. *chintou* Swingle; *F. japonica* (Thunberg) Swingle; *F. margarita* (Loureiro) Swingle; *F. obovata* Tanaka; *F. venosa* (Champion ex Bentham) C. C. Huang; *Sclerostylis hindsii* Champion ex Bentham; *S. venosa* Champion ex Bentham.

Trees to 5 m tall, d.b.h. to 20 cm. Branchlets numerous; spines variable, to 5 cm on young growth but some only a few mm on flowering shoots. Leaves 1-foliolate or sometimes mixed with simple leaves; petiole 6–9 mm, narrowly winged; leaf blade elliptic to obovate-elliptic, 4–6 × 1.5–3 cm, base rounded to broadly cuneate, margin dentate near apex or rarely entire, apex rounded and rarely mucronate. Flowers solitary or fascicled, subsessile. Calyx 4- or 5-lobed. Petals 5, ca. 5 mm or less. Stamens ca. 20; filaments cohering into 4 or 5 bundles. Ovary as long as style, 3- or 4-loculed, with 3 or 4 ovules per locule. Fruit bright orange to red, globose to slightly oblate, 9–10 mm in diam., smooth, 3- or 4-seeded; pericarp sweet and edible; sarcocarp acidic. Seeds broadly ovoid, apex mucronate; seed coat smooth; embryos at least sometimes numerous; cotyledons green. Fl. Apr–May, fr. Oct–Dec. 2*n* = 18*, 20*, 36*.

● Evergreen broad-leaved forests; 600–1000 m. S Anhui, Fujian, Guangdong, SE Guangxi, Hainan, Hunan, Jiangxi, Zhejiang.

This appears to be the truly wild kumquat from which cultivars with greatly increased fruit-sizes of different shapes have been selected. However, recent field studies in China show a considerable amount of variation within some wild populations of what is treated here as *Citrus japonica*. Future comprehensive field and cytological studies throughout the complex may show that geographical subspecies or cytological races of the wild form could be formally recognized.

None of the cultivars, formerly recognized as species, has been found in truly “natural” habitats. They are cultivated on a large scale in S China and have sometimes become naturalized. *Citrus japonica* and *C. reticulata* are parents of *C.* ×*microcarpa*. Many of the above synonyms can perhaps best be referred to cultivar groups, corresponding to the subformae of Hiroe. Commonly seen cultivar groups in China have the following characteristics, but some cultivars are intermediate.

Round Kumquat Group

Trees 2–5 m tall. Petiole 6–10 mm or rarely longer, wings narrow; leaf blade ovate-elliptic to elliptic-lanceolate, 4–8 × 1.5–3.5 cm, base broadly cuneate, apex obtuse and sometimes mucronate. Flowers 1–3 per fascicle; peduncle 6 mm or less. Petals 6–8 mm. Stamens 15–25. Ovary globose, ± as long as style, 4–6-loculed. Fruit orangish yellow to orangish red, globose, 1.5–2.5 cm in diam., 2–5-seeded; pericarp 1.5–2 mm thick, sweet. Seeds ovoid, base rounded; embryo solitary. Fl. Apr–
May, fr. Nov–Feb.

Oval Kumquat Group

Trees to 3 m tall. Petiole ca. 1.2 cm, wings very narrow; leaf blade ovate-lanceolate to long elliptic, 5–11 × 2–4 cm, base broadly cuneate to nearly rounded, apex obtuse to slightly acute. Flowers 1–3 per fascicle; peduncle 3–5 mm. Petals 6–8 mm. Stamens 20–25. Ovary elliptic; style usually ca. 1.5 × as long as ovary, slender; stigma slightly clavate. Fruit orangish yellow to orangish red, ellipsoid to ovoid-ellipsoid, 2–3.5 cm in diam., oil dots usually slightly expanded, 2–5-seeded; pericarp ca. 2 mm thick, sweet; sarcocarp in 4 or 5 segments, acidic. Seeds ovoid, apex acute; embryo solitary or rarely numerous. Fl. Mar–May, fr. Oct–Dec.

5. Citrus medica Linnaeus, Sp. Pl. 2: 782. 1753.

香橼 xiang yuan

Aurantium medicum (Linnaeus) M. Gómez; *Citreum vulgare* Tournefort ex Miller; *Citrus alata* (Yu. Tanaka) Tanaka; *C.* ×*aurantium* Linnaeus subvar. *amilbed* Engler; *C.* ×*aurantium* subvar. *chakotra* Engler; *C. cedra* Link; *C. cedrata* Rafinesque; *C. fragrans* Salisbury; ?*C. kwangsiensis* Hu; *C.* ×*limon* (Linnaeus) Osbeck var. *digitata* Risso; *C. medica* var. *alata* Yu. Tanaka; *C. medica* var. *digitata* Risso; *C. medica* var. *ethrog* Engler; *C. medica* f. *monstrosa* Guillaumin; *C. medica* var. *proper* J. D. Hooker; *C. medica* var. *sarcodactylis* (Hoola van Nooten) Swingle; *C. odorata* Roussel; *C. sarcodactylis* Hoola van Nooten; *C. tuberosa* Miller; *Sarcodactilis helicteroides* C. F. Gaertner.

Shrubs or small trees. Branches, leaf buds, and flower buds purplish when young. Branches with ca. 4 cm spines. Leaves simple or rarely 1-foliolate; petiole short, not winged; leaf blade elliptic to ovate-elliptic, 6–12 × 3–6 cm or larger, margin serrate, apex rounded, obtuse, or rarely mucronate. Inflorescences axillary, ca. 12-flowered or sometimes flowers solitary. Flowers bisexual or sometimes male by ± complete abortion of pistil. Petals 5, 1.5–2 cm. Stamens 30–50. Ovary cylindric; style long and thick; stigma clavate. Fruit pale yellow, elliptic to subglobose, to 2 kg, surface coarse; pericarp white to pale yellow and soft within, thicker than sarcocarp, removed with difficulty; sarcocarp with 10–15 segments, colorless, nearly pellucid to pale milky yellow, acidic to slightly sweet, fragrant. Seeds small; seed coat smooth; embryo(s) solitary to several; cotyledons milky white. Fl. Apr–May, fr. Oct–Nov. 2*n* = 18, 20.

Cultivated and sometimes naturalized. Guangxi, SW Guizhou, Hainan, Sichuan, E Xizang, Yunnan [native to NE India and possibly Myanmar].

This species is a parent with *Citrus* ×*aurantium* of *C.* ×*limon* and with ?*C. hystrix* of *C.* ×*aurantiifolia*.

The Buddha-hand Citron (佛手 fo shou), with separated segments ± surrounded by pericarp, is best treated as a cultivar, correctly *Citrus medica* ‘Fingered.’

6. Citrus maxima (Burman) Merrill, Interpr. Herb. Amboin. 296. 1917.

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Aurantium maximum Burman in Rumphius & Burman, Herb. Amboin. Auctuar. 7: Index [16]. 1755; *A. decumanum* (Linnaeus) Miller; *Citrus* ×*aurantium* Linnaeus subsp. *decumana* (Linnaeus) Tanaka; *C.* ×*aurantium* var. *decumana* Linnaeus; *C.* ×*aurantium* f. *grandis* (Linnaeus) Hiroe; *C.* ×*auran-*

tium var. *grandis* Linnaeus; *C. costata* Rafinesque; *C. decumana* (Linnaeus) Linnaeus; *C. grandis* (Linnaeus) Osbeck; *C. grandis* var. *pyriformis* (Hasskarl) Karaya; *C. grandis* var. *sabon* (Siebold ex Hayata) Hayata; ?*C. kwangsiensis* Hu; *C. medica* Linnaeus subf. *pyriformis* (Hasskarl) Hiroe; *C. obovoidea* Yu. Tanaka; *C. pampelmos* Risso; *C. pompelmos* Risso; *C. pyriformis* Hasskarl; *C. sabon* Siebold ex Hayata.

Trees. Young branches, abaxial surface of leaves, peduncles, and ovaries pilose. Branches usually purplish, flat with ridges when young. Petiole 2–4 × 0.5–3 cm or less, winged; leaf blade broadly ovate or elliptic, 9–16 × 4–8 cm or larger, thick, dark green, base rounded, apex rounded to obtuse and sometimes mucronate. Flowers solitary or in racemes; flower buds purplish or rarely milky white. Calyx 3–5-lobed. Petals 1.5–2 cm. Stamens 25–35, some undeveloped. Style long and thick. Fruit pale yellow and yellowish green, globose, oblate, pyriform, or broadly obconic, usually more than 10 cm in diam., with large prominent oil dots, to 200-seeded or seedless; pericarp spongy; sarcocarp with 10–15(–19) segments, white, pink, reddish, or rarely milky yellow. Seeds irregularly shaped, with conspicuous ridges, undeveloped seeds numerous; embryo solitary; cotyledons milky white. Fl. Apr–May, fr. Sep–Dec. 2*n* = 18, 36.

Cultivated and naturalized in S China [probably native to SE Asia].

Pomelo or shaddock includes cultivars with round to obovoid fruit much favored for festival decoration as well as eating. No truly wild plants (presumably with much smaller fruit) have been seen. *Citrus maxima* is a parent with *C. reticulata* of *C.* ×*aurantium*.

7. Citrus reticulata Blanco, Fl. Filip. 610. 1837.

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Citrus ×*aurantium* Linnaeus f. *deliciosa* (Tenore) Hiroe; *C.* ×*aurantium* var. *tachibana* Makino; *C. daoxianensis* S. W. He & G. F. Liu; *C. deliciosa* Tenore; *C. depressa* Hayata; *C. erythrosa* Yu. Tanaka; *C. madurensis* Loureiro var. *deliciosa* (Tenore) Sagot; *C. mangshanensis* S. W. He & G. F. Liu; *C.* ×*nobilis* Loureiro subf. *deliciosa* (Tenore) Hiroe; *C.* ×*nobilis* var. *deliciosa* (Tenore) Guillaumin; *C.* ×*nobilis* subf. *erythrosa* (Yu. Tanaka) Hiroe; *C.* ×*nobilis* var. *major* Ker Gawler; *C.* ×*nobilis* var. *ponki* Hayata; *C.* ×*nobilis* subf. *reticulata* (Blanco) Hiroe; *C.* ×*nobilis* var. *spontanea* Ito; *C.* ×*nobilis* subf. *succosa* (Tanaka) Hiroe; *C.* ×*nobilis* var. *sunki* Hayata; *C.* ×*nobilis* subf. *tachibana* (Makino) Hiroe; *C.* ×*nobilis* var. *tachibana* (Makino) Ito; *C.* ×*nobilis* subf. *unshiu* (Marcowicz) Hiroe; *C.* ×*nobilis* var. *unshiu* (Marcowicz) Tanaka ex Swingle; *C.* ×*nobilis* var. *vangasy* (Bojer) Guillaumin; *C. ponki* Yu. Tanaka; *C. poonensis* Yu. Tanaka; *C. reticulata* var. *austera* Swingle; *C. reticulata* subsp. *deliciosa* (Tenore) Rivera et al.; *C. reticulata* subsp. *tachibana* (Tanaka) Rivera et al.; *C. reticulata* subsp. *unshiu* (Marcowicz) Rivera et al.; *C. succosa* Tanaka; *C. suhuiensis* Hayata; *C. sunki* Tanaka; *C. tachibana* (Makino) Yu. Tanaka; *C. tachibana* subf. *depressa* (Hayata) Hiroe; *C. tachibana* subf. *ponki* (Hayata) Hiroe; *C. tachibana* subf. *suhuiensis* (Hayata) Hiroe; *C. tachibana* subf. *sunki* (Hayata) Hiroe; *C. tangerina* Yu. Tanaka; *C. tankan* Hayata; *C. unshiu* Marcowicz; *C. vangasy* Bojer.

Small trees. Branchlets numerous, with few spines. Leaves 1-foliolate; leaf blade lanceolate, elliptic, or broadly ovate, basal articulated part to leaf blade usually narrow or only a remnant, midvein furcate near apex, margin apically obtusely crenulate or rarely entire, apex emarginate. Flowers solitary to 3 in a fascicle. Calyx irregularly 3–5-lobed. Petals usually 1.5 cm or less. Sta-

mens 20–25. Style long, slender; stigma clavate. Fruit pale yellow, orange, red, or carmine, oblate to subglobose, smooth or coarse; pericarp very thin to thick, easily removed; sarcocarp with 7–14 segments or rarely more, sweet to acidic and sometimes bitter, with few to many seeds or rarely seedless; pulp vesicles plump, short, rarely slender and long. Seeds usually ovoid, base rounded, apex narrow and acute; embryos numerous, rarely solitary; cotyledons dark green, pale green, or milky white; chalaza purple. Fl. Apr–May, fr. Oct–Dec. 2*n* = 18, 27, 36.

Extensively cultivated in China S of the Qin Ling [possibly native to SE China and/or S Japan (see below)].

Tangerine or mandarin orange is the parent with *Citrus maxima* of *C.* ×*aurantium*, with *C. japonica* of *C.* ×*microcarpa*, and possibly with *C. cavaleriei* of *C.* ×*junos*. The recently recognized subspecies are perhaps better considered as cultivar groups to which most of the synonyms would be referred. However, some names in the synonymy may be referable to those cultivars of *C.* ×*aurantium* that are repeated backcrosses with *C. reticulata*. Trees referred to *C. tachibana* may represent true wild forms and have the following characteristics:

Trees to 3 m tall. Branchlets numerous, with short spines. Petiole 8–10 mm, very narrowly winged; leaf blade elliptic, 6–7 × 3.5–4 cm, secondary veins inconspicuous, base broadly cuneate, margin crenulate, apex narrow, obtuse, and conspicuously emarginate. Flowers solitary, 1.2–1.4 cm in diam.; flower buds subglobose. Pedicel ca. 2 mm. Petals white. Stamens ca. 20. Fruit yellow, oblate, 2–2.5 × 2.5–3.4 cm, smooth; pericarp 1.5–2 mm thick; sarcocarp with 7–9 segments, yellow, very acidic and bitter, 5- or 6-seeded. Seeds broadly ovoid, ca. 1 cm; seed coat smooth; embryos numerous; cotyledons greenish.

Hillside forests; low elevations. Taiwan [Japan (Ryukyu Islands)].

Hybrid taxa sometimes naturalized in China

8. Citrus ×aurantiifolia (Christmann) Swingle, J. Wash. Acad. Sci. 3: 465. 1913 [*"aurantifolia"*], pro sp.

来檬 lai meng

Limonia ×*aurantiifolia* Christmann, Vollst. Pflanzensyst. 1: 618. 1777 [*"aurantifolia"*], pro sp.; *Citrus* ×*acida* Persoon; *C.* ×*aurantiifolia* subsp. *murgetana* Garcia Lidón et al.; *C.* ×*aurantium* Linnaeus subsp. *aurantiifolia* (Christmann) Guillaumin; *C.* ×*aurantium* var. *proper* Guillaumin; *C. hystrix* Candolle subsp. *acida* Engler; *C.* ×*javanica* Blume; *C.* ×*lima* Macfadyen; *C. medica* Linnaeus subf. *aurantiifolia* (Christmann) Hiroe.

Small trees. Branchlets numerous and irregular, with short stout spines. Leaves slightly stiff with a short, conspicuous petiole; leaf blade broadly ovate to elliptic, 5–8 × 2–4 cm, base rounded, margin crenulate, apex obtuse and sometimes mucronate. Inflorescences with ca. 7 flowers or rarely flowers solitary. Calyx cup-shaped; lobes 4 or 5. Petals (4 or)5, white, 1–1.2 cm, rather thick. Stamens 20–25. Ovary globose; style short, ± as long as stigma; stigma large. Fruit greenish yellow, globose, ellipsoid, or obovoid, usually 4–5 cm in diam., smooth, with prominent oil glands, apex with a papilla; pericarp thin; sarcocarp with 9–12 segments, very acidic. Seeds few, ovoid; seed coat smooth; cotyledons milky white. Fl. Apr–May, fr. Sep–Dec. 2*n* = 18, 27.

Trailsides; low elevations. Occasionally naturalized in Yunnan.

As a common name, lime covers a number of different *Citrus* species and hybrid species. Those referred to as *C.* ×*aurantiifolia* are hybrids involving *C. medica* and possibly *C. hystrix*.

9. Citrus ×limon (Linnaeus) Osbeck, Reis Ostindien China, 250. 1765 [*"limonia"*], pro sp.

柠檬 ning meng

Citrus medica Linnaeus var. *limon* Linnaeus, Sp. Pl. 2: 782. 1753; *C.* ×*aurantium* Linnaeus subsp. *bergamia* (Risso) Engler; *C.* ×*aurantium* var. *bergamia* (Risso) Brandis; *C.* ×*aurantium* var. *mellarosa* (Risso) Engler; *C.* ×*bergamia* Risso; *C.* ×*bergamia* subsp. *mellarosa* (Risso) Rivera et al.; *C.* ×*bergamota* Rafinesque; *C.* ×*limodulcis* Rivera et al.; *C.* ×*limonum* Risso; *C. medica* Linnaeus f. *limon* (Linnaeus) Hiroe; *C. medica* subsp. *limonum* (Risso) J. D. Hooker; *C. medica* var. *limonum* (Risso) Brandis; *C.* ×*mellarosa* Risso; *C.* ×*meyeri* Yu. Tanaka; *Limon* ×*vulgaris* Ferrarius ex Miller (1754), not *C.* ×*vulgaris* Risso (1813).

Small trees. Branches ± spiny. Young leaves and flower buds reddish purple. Leaf blade ovate to elliptic, 8–14 × 4–6 cm, margin conspicuously crenulate, apex usually mucronate. Flowers solitary or several in fascicles. Flowers bisexual or male by ± complete abortion of pistil. Calyx cup-shaped; lobes 4 or 5. Petals 1.5–2 cm, outside purplish, inside white. Stamens 20–25 or more. Ovary subcylindric or barrel-shaped; stigma clavate. Fruit yellow, ellipsoid to ovoid, narrowed at both ends, surface usually coarse and lemon scented, apex usually with a mammilla; pericarp thick, difficult to remove; sarcocarp in 8–11 segments, pale yellow, acidic. Seeds ovoid, small, apex acute; seed coat smooth; embryo usually solitary but sometimes numerous; cotyledons milky white. Fl. Apr–May, fr. Sep–Nov. 2*n* = 18, 36.

Cultivated and sometimes naturalized in S China.

The parents of the lemon are *Citrus* ×*aurantium* and *C. medica*. Backcrosses with either parent give a range of sour to sweet lemons which go under various names and perhaps would best be considered as forming cultivar groups, e.g., Bergamot Group. The rough lemon, *C.* ×*taitensis* Risso (*C.* ×*aurantium* subsp. *jambhiri* Engler; *C.* ×*jambhiri* Lushington; *C.* ×*sinensis* subsp. *jambhiri* (Lushington) Engler), sometimes included here, is perhaps *C. medica* × *C. reticulata*.

The name *"Citrus limonia"* has been misapplied to other *Citrus* taxa.

10. Citrus ×aurantium Linnaeus, Sp. Pl. 2: 782. 1753, pro sp.

酸橙 suan cheng

Aurantium ×*acre* Miller; *A.* ×*corniculatum* Miller; *A.* ×*distortum* Miller; *A.* ×*humile* Miller; *A.* ×*myrtifolium* Descourtilz; *A.* ×*sinense* Miller; *A.* ×*vulgare* (Risso) M.

Gómez; *Citrus* ×*amara* Link; *C.* ×*aurantium* subsp. *amara* Engler; *C.* ×*aurantium* var. *bigaradia* (Loiseleur) Brandis; *C.* ×*aurantium* var. *crassa* Risso; *C.* ×*aurantium* var. *daidai* Makino; *C.* ×*aurantium* var. *dulcis* Hayne; *C.* ×*aurantium* var. *fetifera* Risso; *C.* ×*aurantium* var. *lusitanica* Risso; *C.* ×*aurantium* var. *myrtifolia* Ker Gawler; *C.* ×*aurantium* subf. *nobilis* (Loureiro) Hiroe; *C.* ×*aurantium* var. *sanguinea* Engler; *C.* ×*aurantium* subf. *sinensis* (Linnaeus) Hiroe; *C.* ×*aurantium* subsp. *sinensis* (Linnaeus) Engler; *C.* ×*aurantium* var. *sinensis* Linnaeus; *C.* ×*aurantium* subsp. *suntara* Engler; *C.* ×*aurantium* var. *vulgaris* (Risso) Risso & Poiteau; *C.* ×*aurata* Risso; *C.* ×*bigaradia* Loiseleur; *C.* ×*changshan-huyou* Y. B. Chang; *C.* ×*communis* Poiteau & Turpin; *C. decumana* (Linnaeus) Linnaeus var. *paradisi* (Macfadyen) H. H. A. Nicholls; *C.* ×*dulcis* Persoon; *C.* ×*florida* Salisbury; *C.* ×*humilis* (Miller) Poiret; *C. maxima* (Burman) Merrill var. *uvacarpa* Merrill; *C.* ×*myrtifolia* (Ker Gawler) Rafinesque; *C.* ×*paradisi* Macfadyen; *C.* ×*sinensis* (Linnaeus) Osbeck; *C.* ×*sinensis* var. *brassiliensis* Tanaka; *C.* ×*sinensis* subsp. *crassa* (Risso) Rivera et al.; *C.* ×*sinensis* subsp. *fetifera* (Risso) Rivera et al.; *C.* ×*sinensis* subsp. *lusitanica* (Risso) Rivera et al.; *C.* ×*sinensis* var. *sanguinea* (Engler) Engler; *C.* ×*sinensis* var. *sekkan* Hayata; *C.* ×*sinensis* subsp. *suntara* (Engler) Engler; *C.* ×*taiwanica* Tanaka & Shimada; *C.* ×*tangelo* Ingram & H. E. Moore; *C.* ×*vulgaris* Risso.

Small trees. Branches with spines up to ca. 8 cm. Petiole obovate, 1–3 × 0.6–1.5 cm, base narrow; leaf blades dark green, thick. Inflorescences racemes, with few flowers or flowers solitary. Flowers perfect or male by ± complete abortion of pistil; buds ellipsoid to subglobose. Calyx lobes 4 or 5. Petals 2–3.5 mm in diam. Stamens 20–25, usually basally connate into bundles. Fruit orange to reddish, globose to oblate, surface coarse; pericarp thick, sometimes difficult to remove; sarcocarp with 10–13 segments, acidic and sweet or sometimes bitter. Seeds numerous, large, with ridges; embryo(s) solitary to numerous; cotyledons milky white. Fl. Apr–May, fr. Sep–Dec. 2*n* = 18.

Cultivated and sometimes naturalized in most of China S of the Qin Ling.

Oranges and grapefruit are *Citrus maxima* × *C. reticulata* and the backcrosses with the parental species. Many of these hybrids arose in China, although others were synthesized, especially in the U.S.A., and introduced in China. The cultivars can be arranged in groups: Sour Orange Group (the sour or bitter orange most like the original cross), Sweet Orange Group (the commercially most important being backcrosses with *C. reticulata*), and Grapefruit Group (representing backcrosses with *C. maxima* and first being made in the Caribbean).

Sweet Orange Group

Petiole long and narrow; leaf blade ovate, ovate-elliptic, or rarely lanceolate, 6–10 × 3–5 cm or larger. Calyx lobes 3–5. Petals white or rarely purplish, 1.2–1.5 cm. Style stout; stigma large. Fruit orangish yellow to orangish red, globose, depressed globose, or ellipsoid; sarcocarp with 9–12 segments, yellow, orange, or purplish, sweet or slightly acidic. Seeds few or absent; seed coat slightly ridged; embryos numerous; cotyledons milky white. Fl. Mar–Jun, fr. Oct–Dec but some cultivars Feb–Apr. 2*n* = 18, 27, 36, 45.

Below 1500 m. Cultivated S of the Qin Ling, as far NW as SE Gansu and as far SW as SE Xizang.

Grapefruit Group

Branches glabrous. Leaves similar to those of *Citrus maxima* but leaf blade smaller and narrower, midvein ciliate. Flowers smaller than those of *C. maxima*. Calyx lobes glabrous. Fruit yellow, depressed globose to globose, smaller than those of *C. maxima*; pericarp thin; sarcocarp with 12–15 segments, yellowish white or pink, tender, juicy, slightly fragrant and acidic. Seeds few or absent; embryos numerous. Fr. Oct–Nov. 2*n* = 18, 20, 27, 36.

11. Citrus ×junos Siebold ex Tanaka, Sieb. Sens. Tor. Hyakun. Kin. Ronbunshu, 65. 1924.

香橙 xiang cheng

Citrus ×*aurantium* Linnaeus subsp. *junos* (Siebold ex Tanaka) Makino; *C.* ×*hsiangyuan* Tanaka; *C. medica* subf. *junos* (Siebold ex Tanaka) Hiroe; ?*C. sechen* Kokaya; *C. sechen* subsp. *sjanshen* Kokaya; ?*C.* ×*wilsonii* Tanaka.

Small trees. Branches often with long stout spines; branchlets, leaves, and petioles sparsely pubescent when young. Petiole obovate-elliptic, 1–2.5 × 0.4–1.5 cm, base cuneate, apex rounded to obtuse; leaf blade ovate to lanceolate, 2.5–8 × 1–4 cm, thickly papery, base rounded to obtuse, margin apically finely dentate or rarely entire, apex acuminate, mucronate, or often obtuse and emarginate. Flowers solitary, shortly pedicellate. Calyx cup-shaped; lobes 4 or 5, broadly ovate, apex acute. Petals white, sometimes outside purplish, 1–1.3 cm. Stamens 20–25. Style ca. 2 × as long as ovary. Fruit pale yellow, oblate to nearly pyriform, 4–8 cm in diam., surface coarse and with large oil dots, apex grooved; pericarp 2–4 mm thick, easily removed; sarcocarp with 9–11 segments, pale yellowish white, very acidic and bitter. Seeds ca. 40, broadly ovoid, smooth; cotyledons milky white; embryo(s) solitary to numerous. Fl. Apr–May, fr. Oct–Nov.

Cultivated and sometimes naturalized. S Anhui, S Gansu, Guizhou, Hubei, Hunan, S Jiangsu, S Shaanxi, Sichuan, Yunnan, Zhejiang.

The parents of this hybrid species are possibly *Citrus cavaleriei* and *C. reticulata*.

Additional Hybrid Taxa Cultivated to a Limited Extent in China

Citrus ×microcarpa Bunge, Enum. Pl. China Bor. 10. 1833.

×*Citrofortunella microcarpa* (Bunge) Wijnands; ×*C. mitis* (Blanco) J. Ingram & H. E. Moore; *Citrus* ×*mitis* Blanco.

Calamondin or calamansi is hybrid between *Citrus reticulata* and *C. japonica*.

Citrus ×latifolia (Tanaka ex Yu. Tanaka) Tanaka, Kwaju Bun-

ruigaku [Systematic Pomology], 140. 1951.

Citrus ×*aurantiifolia* (Christmann) Swingle var. *latifolia* Tanaka ex Yu. Tanaka, Iconogr. Jap. Citrus Fruits 1: 57. 1946; *C.* ×*aurantiifolia* subsp. *latifolia* (Tanaka ex Yu. Tanaka) S. Ríos et al.

Seedless lime is a hybrid between *Citrus* ×*aurantiifolia* and possibly *C.* ×*limon*.

Citrus ×floridana (J. Ingram & H. E. Moore) Mabberley, Telopea 7: 337. 1998.

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

Limequat is a hybrid between *Citrus japonica* and *C.* ×*aurantiifolia*.

Citrus ×georgiana Mabberley, Blumea 49: 490. 2004.

Citrangequat is a hybrid between *Citrus* ×*insitorum* and *C. japonica*.

Citrus ×insitorum Mabberley, Gard. Bull. Singapore 54: 193. 2002.

×*Citroncirus webberi* J. Ingram & H. E. Moore, Baileya 19: 171. 1975, not *Citrus* ×*webberi* Wester (1915).

Citrange, a hybrid between *Citrus* ×*aurantium* and *C. trifoliata*, is widely grown in China as a rootstock.

Doubtful Taxa

Citrus ×polytrifolia Govaerts, World Checkl. Seed Pl. 3(1): 15. 1999.

富民枳 fu min zhi

Poncirus ×*polyandra* S. Q. Ding et al., Acta Bot. Yunnan. 6: 292. 1984, not *Citrus polyandra* Tanaka (1928).

Trees to 2.5 m tall, evergreen. Young branches green, triangular but becoming cylindric with age. Leaves palmately 3-foliolate; petiole 1–2 cm, narrowly winged; lateral leaflet blades 2.7–3.8 × 0.7–1.7 cm; central leaflet blade 3.5–5 × 0.9–1.4 cm, dark green, base cuneate, margin sinuate crenulate, apex mucronate. Flower solitary, 6.4–7 cm in diam. Pedicel 3–7 cm, ca. 2 mm in diam. Calyx lobes 5, broadly ovate, ca. 7 × 5 mm. Petals white, 5–9, 3.2–3.4 × 1.6–1.9 cm, broadly elliptic, lanuginous with more trichomes especially at margins. Stamens 35–43; filaments ca. 4 mm, distinct; anthers yellow with milky white subpellucid dots. Ovary oblate, ca. 6 mm in diam., lanuginous, 10-loculed; style ca. 2 mm; stigma green, clavate, ca. 2 mm, apex emarginate. Fruit green, oblate, lanuginous when young. Fl. Mar–Apr, fr. Aug–Sep.

● Forests on mountain slopes; ca. 2400 m. SE Yunnan (Funing).

This appears to be a *Citrus trifoliata* hybrid with another *Citrus* species. Such hybrids are commonly found where the parents are grown together.

Fortunella bawangica C. C. Huang, Guihaia 11: 8. 1991.

霸王金橘 ba wang jin ju

Trees to 4 m tall. Young branches flat; spines ca. 4 cm. Petiole 3–5(–17) mm; leaf blade elliptic to ovate, (2–)4–7(–10) × (1–)2–3 cm, base rounded to obtuse, margin conspicuously crenulate on basal half, apex rounded. Flowers solitary. Pedicel ca. 5 mm but ca. 1 cm in fruit. Calyx lobes ca. 1 mm. Petals elliptic to lanceolate, ca. 7 mm. Stamens 20–25; filaments cohering into bundles; anthers mostly fertile. Ovary ovoid, 5–7-loculed, with 1 or 2 ovules per locule; style short; stigma clavate. Fruit pyriform, 2.2–2.5 × 1.8–2.2 cm, 1- or 2-seeded; carpopodium ca. 2 mm thick. Seeds ovoid, base rounded, apex acute; seed coat smooth; embryo solitary; cotyledons green.

● Scrub; ca. 1200 m. Hainan.

Recent field studies show that populations morphologically in accordance with *Fortunella bawangica* are widely distributed in Hainan Island. The only character that can be used to distinguish this entity from typical wild populations of *Citrus japonica* is its pear-shaped fruit. Further study is needed to ascertain whether *F. bawangica* is a separate species or only a geographical race of *C. japonica*.

Fl. China 11: 90–96. 2008.