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# *Limau Hantu* and *Limau Purut.* the Story of Lime-Leaves *(Citrus hystrix* DC, Rutaceae)?

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**Abstract**

*Limau purut (Citrus hystrix* DC), cultivated throughout SE Asia, appears to be a selected form of the wild *limau hantu (C. macroptera* Montr., i.e. *C. auraria* Michel), though its earliest scientific name may be *C. fusca* Lour. Complete synonymy with types is presented in a provisional arrangement of 'wild' plants and cultivars. Suggestions for further work on *C. hystrix* and its relations with other cultivated citrus are made. X *Citroncirus* is formally reduced to *Citrus* and a new name proposed for the citrange root-stock, **Citrus** x insitorum Mabb. A diagram of the relationships through hybridity of cultivated citrus is presented.

## Introduction

Characteristic of Thai cooking, worldwide, are lime-leaves *(limau purut, Citrus hystrix* DC), chopped fine better to release their oils. The fruits are not used for food, because, unlike those of species and hybrids placed in 'subg. *Citrus',* those of *C. hystrix* and other species placed in 'subgen. *Papeda* (Hassk.) Swingle' are almost inedible due to the acrid oil in the vesicles surrounding the seeds (Mabberley, 1997). They have been used medicinally, and in Sri Lanka the English name is leech-lime because they are used as a leech-repellent. In the Malay Peninsula the fruits were a soap substitute and sold for this purpose (Burkill, 1931), a practice still prevalent in Cambodia (Boeun Sok, Royal Botanic Gardens Sydney, *pers. comm.)* and elsewhere in SE Asia.

## *Limau purut* and *limau hantu*

A plant of *limau purut* grown in Ambon, Indonesia, was drawn for Rumphius (1628—1702) and specimens were collected 1771—2 by Pierre Sonnerat (1748—1814) in the 'hides' and noted some decades later in Lamarck's *Encyclopedic methodique* (1796). It was first grown in Europe at the end of the eighteenth century when it was introduced to France, by an amateur, from Mauritius, where it was being cultivated. A fruit was given to a M. Rol[l]and, through whom a plant reached the botanic garden

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in Montpellier, France, in 1808. However, it did not flower for many years and it was formally described in the sterile state in 1813 (as *'C. histrix').* By 1816 it was in the trade, being grown by the Audibert nursery at Tonelle, near Tarascon (Michel, 1816: 42, t. 18).

In cultivation in Singapore and elsewhere today are forms differing in the amount of toothing of the lamina and the degree of roundedness of its apex, but these features can vary markedly within a single cultivated plant *(pers. obs.).* The pericarp of the fruit is generally somewhat lumpy in appearance. A form with a particularly lumpy pericarp is known as var. *torosa* (Blanco) Merr, and was also described from a cultivated plant, grown in the Philippines.

In recent accounts, these cultivated plants have been considered allied to, but distinct from, *C. macroptera* Montr., described from New Caledonia though not native there. *Citrus macroptera,* which was also figured by Rumphius (the plate being the basis of *C. auraria* Michel, an apparently overlooked earlier name* for *C. macroptera* - see below), is found throughout Malesia, and in Peninsular Malaysia it is known as *limau hantu.* On the whole, such plants tend to have rather more acute leaf apices. Having examined a wide range of material of *limau hantu* and *limau purut* held at BM, F, K, L, NSW, P, PNH, SING and UC, US, however, I am forced to conclude that the cultivated plants called *limau purut* appear to be merely selected forms (cultivars) of *limau hantu.*

This conclusion is not original: Merrill (1923), studying just the Philippine material available to him, amalgamated the 'species', though he used varietal rather than cultivar status for the pomological forms. Moreover, the 'wild' plants throughout their range were formally included in *C. hystrix* by Engler and Harms (in Engl., Nat. Pflanzenfam. Ed. 2,19a: 336, 1931), but these authors have not generally been followed in recent floristic accounts.

The state of affairs is somewhat comparable with that of the cultivar 'Etrog' of *Citrus medica* L., the citron. That cultivar was first formally described as *C. tuberosus* Mill, and has a markedly tuberculate berry surface like *limau purut,* compared with the smoother-skinned 'typical' forms of *C. medica* similar to those in *limau hantu.* Many forms of citrus with lumpy or grotesquely formed fruits were also selected in Europe, notably in Italy, and were fashionable in the orangeries of the rich where they were known as 'agrumi'.

Another ancient cultivar of *C. medica,* for example, is 'Fingered' (the 'Buddha's hand'), where the fruit is split into a number of finger-like sections. Because of its form, in the past it has been afforded not merely varietal (var. *sarcodactylis* (Noot.) Swingle) and specific (C *sarcodactylis*

*As are his *Citrus ventricosa (see* below) and *Citrus mammosa* and C. *nip is* Michel, Traite

Noot.) ranks, but even accommodated in a separate genus (as *Sarcodactilis helicteroides* Gaertn.!)!

## A Provisional Classification for Wild and Cultivated Forms of *Citrus hystrix*

*Note: names not found in* Index kewensis *or other lists are marked with an asterisk.*

**Citrus hystrix** DC, Cat. Hort. Monsp.: 19, 97 (*'histrix'* 1813); Michel, Traite Citronier: 42, t. 18 (1816) & in Duhamel, Traite Arbres Arbustes 7:108, t. 39 fig 1 ('histrix', 1819); DC, Prodr. 1: 539 (1824); Merr., Enum. Phil. Fl. PI. 2: 342 (1923) excl. var. *macrophylla* (Wester) Merr. [cf. *C. maxima* (Burm.) Merr, or *C.* x *aurantium* L. Grapefruit group]; Guillaumin in Gagnep., Suppl. Fl. Gen. Indochine: 653 (1946); Staples & Kristiansen (1999: 27-9), q.v. for description. - *C. echinata* St-Lag. in Ann. Soc. Bot. Lyon 7: 122 (1880), *nom. superfl.*

**Type:** cultivated in Montpellier, France, "Frutex spectabilis [N.B. It was sterile when first described and had still not flowered by 1824 (DC, I.e.)] olim ex insula Mauritiana (ubi forsan cultus) merit. Mercatori Nemauensi [a merchant of Nimes, France] Roland a navarcha quodam allatus, et anno 1808 a D°. Roland horto Monspeliensi humanissime missus" (G-DC fiche! 'de M. Roland', holo?).

(Northeastern India and southern China?), Burma 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. Selected forms are cultivated throughout the warm parts of the world for culinary (leaves - lime-leaves) and medicinal (fruit - leech-lime) use. Indeed all named taxa seem to have been based on cultivated plants, though perhaps the type of *C. celebica* and some other Philippine taxa were truly wild ones.

As with *Clerodendrum chinense* (Osb.) Mabb. (Labiatae), *Cupressus lusitanica* L. (Cupressaceae), *Kerria japonica* (L.) DC. (Rosaceae), *Rhododendron stenopetalum* (Hogg) Mabb. (Ericaceae; Mabberley, 1995) and *Melia azedarach* L. (Meliaceae; Mabberley, 1984), for example, the name *C. hystrix* covers both the wild plant and the cultivar (the type, so far apparently without a formal cultivar name, though Guillaumin's name for it among his 'formes culturales' [in Lecomte, *Fl. Gen. Indochine* 1: 676, 1911, under C. *aurantium]* could be construed as such, though being 'Hystrix', this would not be allowed by the Cultivated Code [Art. 25.2]). It

is notable that the scrappy type at G-DC has leaflets rather more acute than is seen in many cultivated specimens. The only cultivar name published for any plant referable to this group seems to be 'copahan' (see below).

The plants are arranged below as 'wild' *(limau hantu)* followed by *limau purut* (lime-leaves) and other cultivars.

**'Wild' plants (limau hantu)**

*[Lemoen Amds* Valentijn, Amboina 3(1): 190 (1726)]

**Citrus auraria* Michel, Traite Citronier: 43 (1816) & in Duhamel, Traite Arbres Arbustes 7:109 (1819). - *[Limonellus aurarius* Rumph., Herb. Amb. 2: 109, t. 30 (1741)] - *C. limetta* Risso var. *auraria* Risso in Risso & Poit., Orangers: t. 59 (1818).
**Type** [icon]: Rumph, Herb. Amb. 2: t. 30 (1741).

*Citrus macroptera* Montr, in Mem. Acad. Lyon 10:187 (1860). - *C. combara* **Raf.** var. *macroptera* (Montr.) Tanaka in J. Soc. Trop. Agric. 10: 352 (1938) & Stud. Citr. 9:2 (1939).
**Type:** New Caledonia, He Art "juxta domos indigenarum", *Montrouzier s.n.* (LY, lost [F, photo!]).

*Citrus celebica* Koord. in Meded. 'sLands Plant. 19: 370, 839 (1898).
**Type:** Indonesia, Sulawesi, Minahassa, Menado, 250-275m, *Koorders 18751 fi* (BO, holo-, n.v.; K!, P!, PNH!, iso-).

*Citrus papuana* F.M. Bailey in [Ann.] Rep. Brit. New Guinea 1901-2: 1 (1902) & Contrib. Fl. Brit. New Guinea: 1 + t. (1903).
**Type:** Papua New Guinea, Milne Bay, *Le Hunte s.n.* (BRI, n.v. holo?; P, fragm.!).

*Citrus* x *aurantium* L. subsp. *saponacea* Saff. in Contrib. U.S. Nat. Herb. 9: 226 (1905), *e descr.*
**Type:** [Guam, cult.] not indicated.

*Citrus southwickii* Wester in Phil. Agr. Rev. 8: 16, tt. 3c *['C limao'],* 4c (1915). - C. *hystrix* DC. var. *southwickii* (Wester) Merr., Enum. Phil. Fl. PI. 2: 343 (1923). - *C. macroptera* Montr, var. *southwickii* (Wester) Tanaka in Trans. Nat. Hist. Soc. Formosa 22: 430 (1932). - C. *celebica* Koord. var. *southwickii* (Wester) Swingle in J. Wash. Acad. Sci. 28: 533 (1938).

**Type:** Philippines, cult. Luzon, Lamao, Mar 1915, *Wester* 2049 (PNHt, holo?;K!,PNH!).

*Citrus hystrix* DC. var. *hoholensis* Wester in Phil. Agr. Rev. 8: 19, tt.. 4a, 5a (1915). - C. *macroptera* Montr, var. *hoholensis* (Wester) Tanaka in Trans. Nat. Hist. Soc. Formosa 22: 430 (1932). - C. *combara* Raf. var. *hoholensis* (Wester) Tanaka, Stud. Citr. 9: 3 (1939). - *C. *hoholensis* (Wester) Tanaka, Syst. Pomol. : 140 (1951), nom.nud., **synon. nov.**

**Type:** Philippines, Bohol, cult. Lamao, Mar. 1915, *Wester* 2525 (PNHt, syn?; PNH!, isosyn.), Bohol, cult., 1914, *Wester* 4824 (PNHt, syn?; PNH! isosyn).

*Citrus vitiensis* Tanaka in Bull. Soc. Bot. Fr. 75: 715 (1928).

**Type:** Fiji, Viti Levu, Namoso/Namura R., 1866, *Seemann* 58 (K!, holo [F, photo!]; BM!, P!, iso).

*Citrus macroptera* Montr, var. *annamensis* Tanaka in Bull. Mus. Hist. Nat. Paris II, 2: 164 (1930). - *C. hystrix* DC. var. *annamensis* (Tanaka) Guillaumin in Gagnep., Suppl. Fl. Gen. Indochine: 654 (1946) .

**Type:** Vietnam, massif Co Inh, pres de Nhatrang, 18 Sept. 1922, *Poilane* 4650 (P!, holo [F, photo]; UC!).

*Citrus macroptera* Montr, var. *kerrii* Swingle in J. Wash. Acad. Sci. 32: 34 (1942) - *C. *kerrii* (Swingle) Tanaka, Syst. Pomol.: 140 (1951), **synon. nov.**

**Type:** Thailand, Nalawn Sawan, Kampeng Pet, Me Lamung, 7 June 1922, *A.F.G. Kerr* 6081 (ABD, holo; BM!, K!, iso)

Rumphius (I.e.) discussed the disarticulating of the lamina from the broad winged petiole and the use of the fruit in washing, recording that it occurs in Sulawesi and that it is the Lemoen Amas of Valentijn. It should be noted that although the plants arranged above resemble morphologically the presumed wild ancestor of the cultivars below, several of them are described from plants in cultivation, often far beyond the putative natural range, and in that sense are perhaps cultivars in their own right. The concept of 'wildness', so obscured in cultivated plants such as these, is clearly linked to human perceptions of human actions as somehow 'above' or 'different from' the dispersal activities of other animals' selecting 'superior' forms in terms of fruit or seed size, colour, taste, texture, etc. and is therefore perhaps an inappropriate one (Mabberley, 1999).

N.B. Merrill (1917) suggested that yet another plant described and figured by Rumphius should be referred to *C. hystrix* (i.e. Herb. Amb. 2: t. 26 f. 3), for which the flowers and leaves look right, but not the fruit (cf. *C. ventricosus* below, where the opposite is true). Moreover Burkill (1931) also referred to it, the Indochinese *'C. cavalierei* Leveille', a *nomen nudum*, and the Chinese *C. ichangensis* Swingle, of which var. *latipes* Swingle has been given specific rank as *C. latipes* (Swingle) Tanaka.

However, there are a number of more distinctive taxa, all apparently certainly cultivars, the first now widely spread in the Old World Tropics, the others grown principally in central Malesia, notably the Philippines.

**'Copahan' (and unnamed cultivar[***x* DC. 'Copahan', Wester in Phil. Agric. Rev. 8: t. 5b (

*Citrus hystrix* DC. (1813), *sensu stricto.* - *C. limetta* Risso var. OC Risso & Poit, Hist. Nat. Orangers: 123 (1819). - *C. aurata histrix* Risso, Hist. Nat. Eur. Medit. 1: 409 (1826). - C. x *aurantium histrix* Jacquemont-Bonnefont, Cat. Prix Courants: 51 (1833). - *C.* x *aurantium* L. *hystrix* ['forme culturale'], Guillaumin in Lecomte, Fl. Gen. Indoch. 1: 676 (1911).

*[Lemoen Porot* Valentijn, Amboina 3(1): 189 (1726)]

*1 Citrus fusca* Lour., Fl. Cochinch: 467 (1791).
**Type:** not found (see below).

*Citrus decumana* L. '4. Le citronnier de Combara ou citron a la grecque' Poir. in Lam., Enc. Meth. 4: 580 (1796), **synon. nov.** - *Citrus combara* Raf., Fl. Tell.: 142 (1838) *e descr.*, **synon. nov.** - *C macroptera* Montr, var. *combara* (Raf.) Tanaka in J. Ind. Bot. Soc. 16: 238 (1937) *nom. superfl. pro* var. *annamensis.*

**Type:** [Indes, *Sonnerat s.n.],* (P-LAM!).

*l*Citrus ventricosa* Michel, Traite Citronier: 43 (1816) & in Duhamel, Traite Arbres Arbustes 7:109 (1819); - [ *Limo ventricosus* Rumph., Herb. Amb. 2: 102 (1741)] - Risso in syn. C x *bergamia* Risso & Poit. var. *ventricosa* M. Roem., Fam. Nat. Syn. Monogr. 1: 61 (1846, nom superfl. (G *limetta* var. *auraria* Risso in syn.).

**Type:** not indicated. Note that Rumphius's associated plate (t. 26 fig 2, 1741) does not match his (or Michel's) text at all and apparently represents the sambal, *C. amblycarpa* (Hassk.) Ochse, a plant whose relationships are as yet unclear.

*Papeda rumphii* Hassk. in Flora 25, Beibl. 2: 42 (1842). - *Citrus papeda* Miq., Fl. Ind. Bat. 1(2): 530 (1859), non *C. rumphii* Risso *QrhumphW,* 1844), i.e. *C.* x *aurantium* L. cv. - *[Limo agrestis* Rumpf, Herb. Amb. 2: 104, t. 27 (1741)].

**Type** [icon]: Rumph., Herb. Amb. 2: t. 27 (1741).

**Citrus tuberoides* J.W. Benn., Sel. Rare Fr. Ceylon: t. 1 (1842) & Ceylon: 142 [tt] (1843).

**Type:** not indicated. The plate should serve as iconotype in the absence of any specimen found.

*Citrus* x *bergamia* Risso var. *unguentaria* M. Roem., Fam. Nat. Syn. Monogr. 1: 61 (1846). - *[Limo unguentarius* Rumph., Herb. Amb. 2:103, t. 26, fig 1(1741)].

**Type:** not indicated.

The commonly seen cultivated plants tend to have more rounded leaf apices and bumpier fruit than the 'wild' forms do. It is possible that a number of distinctive cultivars, so far none named, are included here. Rumphius described the use of his *Limo agrestis* as a condiment, and both *Limo unguentarius* and *Limo ventricosus* for shampooing and washing, for example.

**Notes:** *Citrus fusca* Lour, may be an earlier name for *C. hystrix.* Loureiro cited a Rumphian plate (Herb. Amb. 2: t. 33,1741) which is referable to *C.* x *aurantium* L. Bitter Orange group, so that later authors have referred C. *fusca* to that. However he said that it is widespread in 'Cochinchina' but rarer in China and described its contorted branches, its unpleasantly scented leaves, the characteristic wide petiole and rough green-brown fruits, all typical of C. *hystrix,* and discusses the medicinal properties of the peel. As no Loureiro specimen is known, it is perhaps best to consider it a *nomen dubium:* if it should prove conspecific, it will be in the interests of nomenclatural stability to propose its rejection.

*Citrus combara* Raf. appears to be based on information in Lamarck's *Encyclopedic Methodique,* hence its specific epithet and placement here.

**'Torosa'** ***(kolobat)***

*Citrus torosa* Blanco, Fl. Filip.: 609 (1837); cf. Merr., Sp. Blanc: 204 (1918). - *C. hystrix* DC. var. *torosa* (Blanco) Wester in Phil. Agric. Rev. 8: 19 (1915).

**Type:** Philippines, Luzon, Batangas Prov., Aug. 1914, *Merrill, Sp. Blancoanae* 46 (US [sheet 903713 'Sept. 1914' - Dan Nicolson *pers. comm.],* **neo, designated here** [Nicolson and Arculus (2001) have argued the case for the US set of Merrill's *Species Blancoanae* being considered as appropriate choices for neotypes]; F!, K!, L!, **P!,** iso).

**'Balincoiong'** ***(balinkolong)***

*Citrus micrantha* Wester 'Balincoiong', Wester in Phil. Agric. Rev. 8: t. 7c (1915).

*Citrus micrantha* Wester in t.c. : 16, tt. 5c, 6b (1915). - *C. hystrix* DC. var. *micrantha* (Wester) Merr., Enum. Phil. PI. 2: 343 (1923). - C *macroptera* Montr, var. *micrantha* (Wester) Tanaka in Trans. Nat. Hist. Soc. Formosa 22: 430 (1932). - *C combara* Raf. var. *micrantha* (Wester) Tanaka, Stud. Citr. 9: 3 (1939).

**Type:** Philippines, *Wester s.n.* (PNH f, photo F! [? = (Lamao), Mar. 1915, *Wester 2049* (P, ?iso!)]).

*Citrus hystrix* var. *balincoiong* Tanaka in Trans. Nat. Hist. Soc. Formosa 22: 429 (1932). - *Citrus balincoiong* Tanaka, Syst. Pomol.: 139 (1951), nom. nud. **synon. nov.**

**Type:** 'Phlippines', Bohol, 1914, *Wester* 4834 (PNHt; PNH, iso!).

A cultivar with small flowers. Although it was referred to *C. hystrix* by Merrill (1923), he conceded that it might be of hybrid origin: this has yet to be tested. I have seen material from only the Philippines so far.

**'Samuyao sa Amoo'** ***(samuyau)***

*Citrus micrantha* Wester 'Samuyao sa Amoo', Wester in Phil. Agric. Rev. 10: t. 7d (1917).

*Citrus micrantha* Wester var. *microcarpa* Wester in op. cit. 8: 21, t. 7b (1915). - C. *hystrix* DC. var. *microcarpa* (Wester) Merr., Enum. Phil. Fl. PI. 2: 343 (1923). - *C. *westeri* Tanaka, Syst. Pomol.: 139-140 (1951, 'western'), non C. x *microcarpa* Bunge (1833), **synon. nov.**

**Type:** Philippines, *Wester s.n.* (PNHf [F, photo!]).

A cultivar with small leaflets and small aromatic fruits, which in overall appearance resembles the Chinese *C. ichangensis* included in the synonymy of *C. macroptera* by Burkill (1931).

## Further work

The hypothesis above is that from a widespread 'wild' form *{limau purut)* a number of cultivars have been selected and that the greatest diversity of these is in central Malesia. With DNA techniques now available, it should be relatively easy to test this hypothesis and to show whether or not any of the cultivars has arisen through hybridization with other species.

It also needs to be ascertained whether *C. ichangensis* is conspecific with C. *hystrix* or not and, if it is, whether it would best be treated as a geographical subspecies of *C. hystrix.* According to Needham (1986: 375—6), *C. ichangensis* was crossed with *C. maxima* long ago to produce 'C *hsiangyuan'* (i.e. *C. wilsonii* Tanaka [1932], ? = *C. xjunos* Sieb. ex Tanaka [1924]), a plant discussed in Han Yen Chih's *Chu Lu* of AD 1178.

If this is true, the value of recognizing *C. hystrix* and its allies as a distinct subgenus comes into question, particularly with the re-inclusion in *Citrus* of *Eremocitrus* Swingle, *Fortunella* Swingle and *Microcitrus* Swingle (Mabberley, 1998). Recent chemical work (Samuel *et al,* 2001) has confirmed the close-knit nature of these plants and also brings back in *Poncirus* Raf., long excluded because of its trifoliolate leaves. Elsewhere in *Aurantieae* Rchb. (Citreae), e.g. *Luvunga Wight &* Arn. (Mabberley, 1998), there are also both unifoliolate and trifoliolate species. With the inclusion of P. *trifoliata* (L.) Raf., so comes in x *Citroncirus,* the last surviving of the hybrid genera recognized by Swingle and followers with a narrow generic concept:

**Citrus** L., Sp. PL: 782 (1753).
**Type:** *C. medica* L.

*Poncirus* Raf., Sylva Tell.: 143.
**Type:** *P. trifoliata* (L.) Raf. = *C. trifoliata* L.

X *Citroncirus* J. Ingram & H. Moore in Baileya 19:171 (1975), **synon. nov.** Type: x *C. webberi* J. Ingram & H. Moore, I.e., non *Citrus webberi* Wester (?= *C. hystrixIC. ichangensis* x *C.* x *aurantium* L.), = **Citrus x insitorum** Mabb., **nom. nov.**

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

The new epithet means 'grafters' citrus' because this is the citrange, an important tristeza-resistant rootstock for citrus. The cross was first made in 1897 and cultivars include 'Morton' and 'Rusk', which were grown from the same individual fruit (Swingle 1948: 371).

Within the cultivated citrus, it is now possible to draw up a scheme linking putative wild species with their hybrid offspring and to point up where there are still uncertainties and areas for further analysis (Fig. 1). These include:

- What the putative unknown parent species of the lemon and the lime are
- Whether or not the Tahiti Lime (C. x *latifolia* Tanaka) is a cross between the lime and the lemon or citron
- Whether or not the Meyer lemon (C. 'Meyeri') and sweetie (C. *limetta* Risso) are crosses between C. x *aurantium* and the citron (in which case they are cultivars referable to C. x *bergamia)* or the lemon.
- Where *C. amblycarpa* (sambal) fits in this scheme.

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*Note added in proof:* According to O. Gulsen & M.L. Roose (2001), 'Chloroplast and nuclear genome analysis of the parentage of lemons', Journal American Horticultural Science **126:** 210-215, the unknown parent (CITRUS SP 1 in Fig. 1) of *C.* x *limon* is C. x *aurantium.* If this is so, *C.* x *bergamia* is best treated as a cultivar group of C x *limon* to which C. x *taitensis,C.* x *limetta* and *C.* x 'Meyeri' would also be referred as cultivar groups, if they have the lemon rather than the citron as a parent. Hybridization experiments should now be performed to confirm the DNA work.

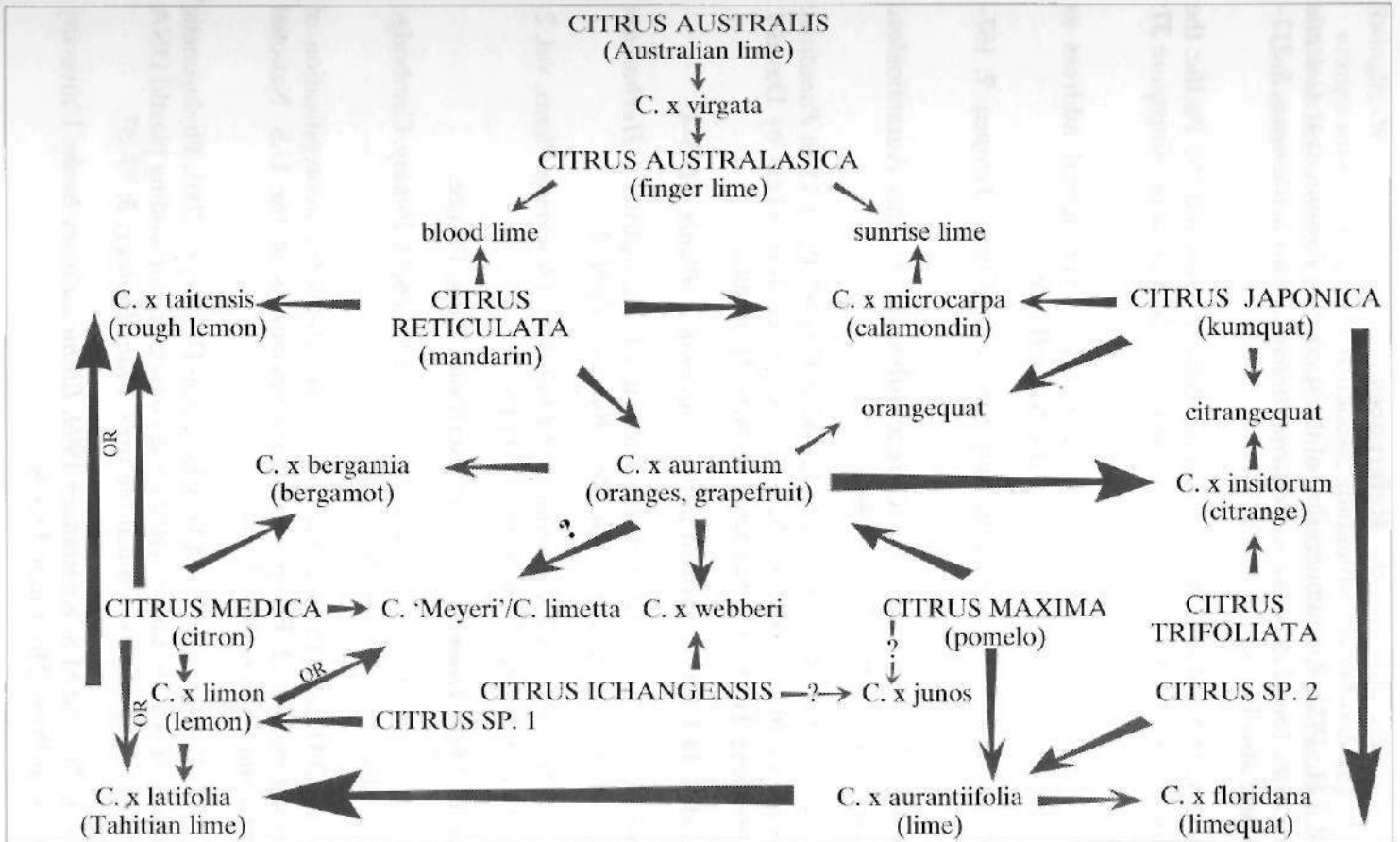


**Figure 1.** The relationships of cultivated citrus (based on materials from Mabberley 1997, 1998, 2001). Names of putative wild species are in block capitals, the arrows indicating their involvement in hybridization to give most of the commonly cultivated citrus fruits. (see 'Note added in proof')

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