

How to ensure labelling is appropriate?

- Ensure that lineage is correct!
 - See later discussion
- Ensure that regulations are correct!
 - Avoid mis-representation, e.g. Clementines
 - Avoid over-regulating to allow trade
 - Universal vs. country requirements
 - Need to account for generic names
 - Need to account for hybrids
 - Need to account for synonyms
 - Need to account for trade names

Cultivar

- Variety: A group of plants with distinct characteristics
- Cultivar: A contraction of the phrase "**cultivated variety**"
 - Used inter-changeably, country dependent
- Market-related terminology:
 - "Variety" is often used as a trade designation for fruit with similar characteristics
 - Often made up of more than one selection of the same cultivar! e.g. Navels, Clementines

Background to the citrus labelling issue

- Purpose of the UNECE Standard FFV-14?
 - Concerning the marketing and commercial quality control of CITRUS FRUIT (2012 ed.)
 - Working Party on Agricultural Quality Stds
 - The commercial quality standards developed by the WP on AQS of the UNECE:
 - Help facilitate international trade
 - Encourage high-quality production
 - Improve profitability, and
 - Protect consumer interests
 - UNECE standards are used by:
 - Governments
 - Producers, Traders, Importers, Exporters
 - Other international organizations
 - Considered as global agricultural quality std

How to separate "cultivar" and "variety"?

- Cultivar: A group of cultivated plants with distinct characteristics
 - Example: 'Clementine' mandarin (1890s)
 - A cultivar can be further sub-divided into "selections" (clones or mutations of the original cultivar)
 - Example: 'Nules Clementine' mandarin (1953)
 - In such cases, "cultivar group" may be used
 - Example: Clementines or Clementine group
- Acceptable market-related terminology
 - Depending on the market/country
 - Nules, Clemenules, Clementina de Nules, Nules Clementine, Clementines, Mandarins, Tangerines

Background to the citrus labelling issue

- Interpretation & implementation of this Agricultural Quality Standard (I)
 - By definition, this AQS is a universal std, a global std; an umbrella under which country standards are created
 - Therefore, it cannot be too restrictive (since it is a universal or global standard)
 - Whereas, at final point of purchase, e.g. retailer or supermarket, can impose more restrictive quality requirements ("supermarket standard or specification") vs. wholesale market being less restrictive
 - Country (UK HMI citrus specific marketing standard) or regional (EC Reg no 1221/2008) standards

Background to the citrus labelling issue

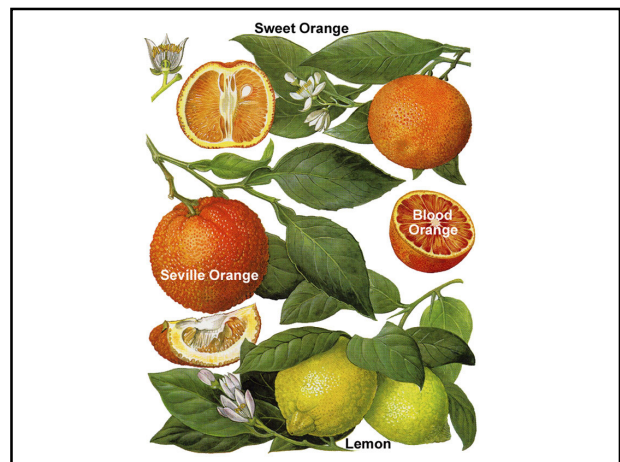
- Interpretation & implementation of this Agricultural Quality Standard (II)
 - Ensure that regulations are correct!
 - Should be clear
 - Not allow mis-representation
 - i.e. don't want to be able to sell a mandarin hybrid as a Clementine
 - Avoid over-regulating to allow trade
 - Universal vs. country requirements
 - Need to account for:
 - Generic names
 - Hybrids
 - Synonyms
 - Trade names

GENETIC CLASSIFICATION & HORTICULTURAL GROUPS

- Ancestral species (original forms of citrus)
 - *Citrus maxima* (pummelo)
 - *Citrus reticulata* (mandarin)
 - *Citrus medica* (citron)
- Initial hybrids (natural)
 - Sweet orange* (*Citrus sinensis*)
 - Sour orange (*Citrus aurantium*)
 - Rough lemon (*Citrus jambhiri*)
- Second-generation hybrids
 - Grapefruit (*Citrus x paradisi*)
 - Lemon (*Citrus limon*)
 - Limes* (*Citrus aurantifolia & latifolia*)

Citrus lineage and nomenclature

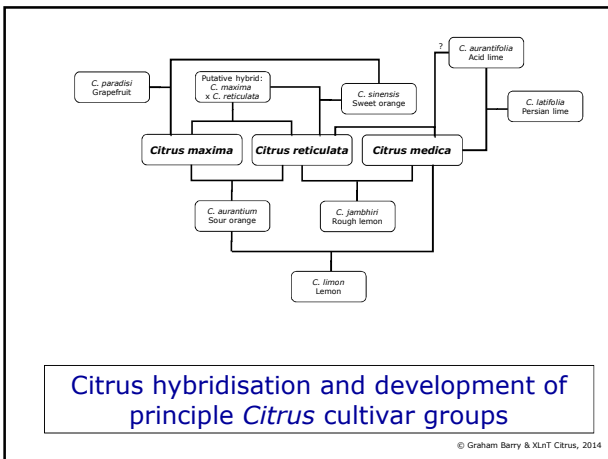
- Ensure that lineage is correct!
 - Need to understand the citrus "family tree"
 - Genetic classification and horticultural groups
 - Species concept:
 - One of the basic units of biological classification = a taxonomic rank
 - Defined as the largest group of organisms capable of interbreeding to produce fertile offspring
 - Horse x Donkey = Mule
 - *Canis lupus familiaris* (2005)
 - Not the final answer in citrus fruit marketing



GENETIC CLASSIFICATION & HORTICULTURAL GROUPS

- Family: Rutaceae (1 of 12)
- Subfamily: Aurantioideae (1 of 6)
- Tribe: Citreae (1 of 2)
- Subtribe: Citrinae (1 of 3)
- Genus: Citrus (1 of 13)
- Species: ???
 - Progenitors (3)
 - Swingle (16)
 - Hodgson (36)
 - Tanaka (162)





Grapefruit cultivars [*Citrus paradisi*]

THE GRAPEFRUIT - Tracing the Development of Present-day Grapefruit Varieties

- Initially developed by natural hybridisation
- Extremely difficult to breed by hybridisation
- All current commercial grapefruit cultivars developed via mutagenesis, except Oroblanco
- Recently, grapefruit hybrids have been developed with grapefruit characteristics
- New grapefruit cultivars (mutations and hybrids) need to be accommodated

- ### PRINCIPLE TAXONOMIC GROUPS (of commercial importance worldwide)
- Sweet orange [*Citrus sinensis*]
 - Lemon [*Citrus limon*]
 - Lime [*C. aurantifolia* (=Mexican), *C. latifolia* (=Persian)]
 - Grapefruit [*Citrus paradisi*]
 - Shaddock (pummelo) [*Citrus maxima/grandis*]
 - Mandarin [*Citrus reticulata*]

Grapefruit and hybrids

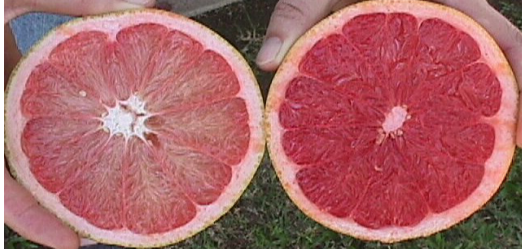
Kind of fruit	Cultivar
White Grapefruit	Marsh Seedless, Duncan, Triumph, Jackson, FE1, Oroblanco, Nartia, Early Marsh
Pink Grapefruit	Ruby (syn. Ruby Red, Redblush), Foster, Henderson, Ray Ruby, Ruben SL, Henderson 13 (syn. SweetHeart)
Red Grapefruit	Star Ruby, Rio Red, Flame, Nelruby, Oran Red (syn. Rouge la Toma), Star Ruby Late, Henderson 17 (syn. Flamingo, RedHeart), UF-914

- ### RELATED GENERA (of commercial importance)
- Other citrus species
 - Citron [*Citrus medica*]
 - Sour orange [*Citrus aurantium*]
 - Fortunella spp.
 - Kumquat
 - Nagami
 - Marumi
 - Meiwa
 - Microcitrus spp.
 - Finger limes
 - Various cultivar names or marketing names
 - ...
 - Not part of this discussion



Grapefruit cultivars

Rosé Star Ruby



Pummelo (or Shaddock) cultivars
[*Citrus maxima* or *grandis*]



Pummelo cultivars [*Citrus maxima*]

- *Citrus maxima*, one of the original three progenitors of citrus
- Pummelos hybridise very readily (monoembryonic)
- Numerous cultivars of varying flesh and rind colour, size, shape and other characteristics
- Relatively few commercially traded pummelo cultivars in the western hemisphere
- Numerous cultivars produced in China (and other south-east Asian countries); about 10 principle cultivars

Pummelo (or Shaddock) cultivars
[*Citrus maxima* or *grandis*]



Pummelos and hybrids

Kind of fruit	Cultivar
White Pummelo	Goliath, Melogold, Oroblanco, numerous cultivars from China
Pink and Red Pummelos	Chandler, Java Shaddock, X202 (syn. Pomelet) , numerous cultivars from China

Lemon cultivars [*Citrus limon*]

- Initially developed by natural hybridisation
- Lemons do not hybridise readily (polyembryonic)
- Almost all current commercial lemon cultivars developed via mutagenesis and selection
- Fruit characteristics are typical of lemons
- Numerous marketing names are used according to time of flowering or time of harvest, e.g.
 - Primofiore
 - Verdelli
 - PGI denominations



Lemons

Kind of fruit	Cultivar
Lemon	Eureka, Lisbon, Limoneira 8A, Fino (syn. Primofiori), Verna, Genoa (syn. Genova), Eureka Seedless (syn. Eureka SL), Femminello, Interdonato, Küttdiken, Villafranca

Lime cultivars [*C. aurantifolia* (=Mexican); *C. latifolia* (=Persian)]



Mexican lime
(syn. West Indian lime)



Persian lime
(syn. Tahiti or Bearss lime)

Lime cultivars

[*Citrus latifolia*, *C. aurantifolia* & *C. limettioides*]

- Initially developed by natural hybridisation
- Limes do not hybridise readily (polyembryonic)
 - In fact, Persian lime is a natural triploid (almost always seedless)
- Three distinct types with no commercially traded mutations, but with different synonyms
 - Persian lime (syn. Tahiti, Bearss)
 - Mexican lime (syn. West Indian, Key)
 - Sweet lime (syn. Indian or Palestine)
- Limequat (Marumi kumquat x Mexican lime); probably only ornamental value or home production
- Typically traded as "Limes" or "Fresh Limes"

Sweet orange cultivars [*Citrus sinensis*]

- Initially developed by natural hybridisation
- Sweet oranges are extremely difficult to breed by hybridisation (polyembryonic)
- Almost all current commercial sweet orange cultivars developed via mutagenesis and selection
- Grouped into four principle types
 - Common round orange
 - Navel orange
 - Pigmented or blood orange
 - Acidless or sugar orange

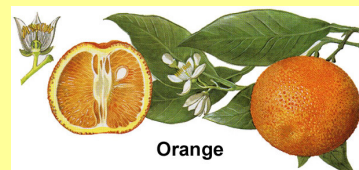
Limes:

large- & small-fruited limes, and sweet lime

Kind of fruit	Cultivar
Large-fruited limes	Persian, Tahiti, Bearss
Small-fruited limes	Mexican, West Indian
Acidless or sweet limes	Indian, Palestine

Sweet orange cultivars [*Citrus sinensis*]

- Grouped into four types
 - Common round orange
 - Navel orange
 - Pigmented or blood orange
 - Acidless or sugar orange

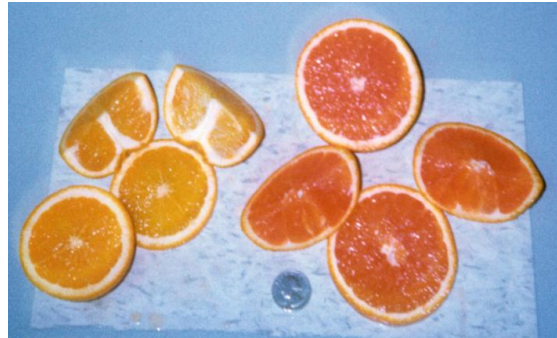


Orange

Common round orange cultivars [*Citrus sinensis*]

- Also referred to as blond or white orange cvs.
- **'Valencia'** orange cultivar group
 - Most commonly produced orange cultivar
 - Commercially important for juicing
 - Numerous selections of 'Valencia' orange
- **Other common round orange cultivars**
 - Early-, mid- and late-season cultivars, e.g.
 - Clanor, Pineapple, Hamlin, Salustiana, Shamouti, Jincheng, Pera, ...

Washington and Cara Cara Navel oranges



'Navel' orange group [*Citrus sinensis*]

- Distinguished by the styler-opening of the secondary fruitlet
- Commercially NB as a fresh (dessert) fruit
- Originally from the Far East, commercially developed from Bahia (Brazil) in 1870 to USDA, then to CA and FL (1873)
- Numerous selections of 'Navel' orange (genetically unstable)

Pigmented orange cultivars [*Citrus sinensis*]

- Also referred to as blood oranges (*sanguine*)
- Similar to common oranges, except for presence of anthocyanin pigments
- Not commonly traded, "niche" markets
- Principle cultivars
 - Sanguinelli, Spain
 - Sanguinello, Sicily, Italy
 - Moro, Sicily
 - Tarocco, Sicily (now with numerous selections)
 - Maltaise, Tunisia
- Lightly pigmented
 - Tomango, South Africa

'Navel' orange selections



Tarocco blood orange selections [*Citrus sinensis*]



Acidless or sugar orange cultivars [*Citrus sinensis*]

- **Distinguished by their lack of acidity**
 - About 10% acid content of common round oranges
- **Common names: Dolce, Succari, Sucreña**
 - Lima from Brazil
 - Succari from Egypt
 - Imperial Grano de Oro from Spain
 - Vainiglia from Sicily, Italy
 - Vainiglia Sanguigno pink acidless
- **Not commercially important**
 - Produced for local consumption in Brazil and Egypt, possibly other Middle Eastern countries

Mandarin cultivars [*Citrus reticulata*]

- *Citrus reticulata*, one of the original three progenitors of citrus
- Initially developed by natural hybridisation, mutagenesis and selection
- Some mandarins hybridise readily (monoembryonic), whereas others are extremely difficult to breed by hybridisation (polyembryonic)
- Currently, innumerable mandarin cultivars and hybrids with varying parentage and characteristics
- Grouped into five principle types (plus their hybrids)
 - King mandarin
 - Mediterranean mandarin
 - Small-fruited mandarin
 - Satsuma mandarin
 - Common mandarin

Sweet oranges and hybrids

Kind of fruit	Cultivar
Navel oranges	Atwood, Bahianinha, Dream, Fischer, Fukumoto, Leng, M7, McClean, Navelina, Newhall, Palmer, Tulegold, Washington, Autumn Gold, Barnfield Summer, Cambria, Carninka, Chislett Summer, Gillemberg, Glen Ora Late, Gloudi, Lane Late, Navelate, Powell Summer, Robyn, Royal Late (Rustenburg), Summer Gold, Witkrans, Cara Cara, Kirkwood Red
Pigmented oranges	Maltaise, Moro, Sanguinelli, Sanguinello, Tarocco (numerous selections), Tomango, Ruby Valencia

Mandarin cultivars [*Citrus reticulata*]

- **No universal classification system**
- **Categorised by various scientists (or for convenience!)**
 - **King mandarin** (*Citrus nobilis*)
 - **Mediterranean mandarin** (*Citrus deliciosa*)
 - **Small-fruited mandarins** (*Citrus tangerina* and numerous other "species")
 - **Satsuma mandarin or Unshiu mikan** (*Citrus unshiu*)
 - **Common mandarin** (*Citrus reticulata*)
- **Mandarin hybrids**
 - Tangerine x Tangerine
 - Tangerine x Orange (tangor)
 - Tangerine x Pummelo or Grapefruit (tangelo)
 - Higher order, complex hybrids



Tangerine

Sweet oranges and hybrids

Kind of fruit	Cultivar
Common oranges	Ambersweet, Barberina, Clanor, Hamlin, Jincheng, Kiyomi, Pera, Pineapple, Salustiana, Shamouti, Tomango
Valencia oranges (numerous selections)	Delicia, Delta Seedless (syn. Delta), Gusocora, Midnight, Turkey, Limpopo Seedless, Bennie, Alpha, Lavalle, Amanzi, Du Roi, Kleinhans, Maroc Late, McClean, McClean SL, Olinda, Valencia Late, Valentine

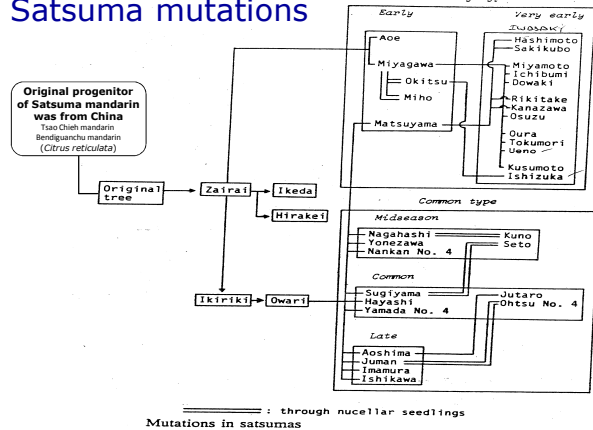
King mandarin [*Citrus nobilis*]

- Of little or no commercial significance
- Breeding parent of a few older mandarin cultivars (King x Willowleaf), but generally low commercial significance (except Kinnow in Pakistan)
 - Kinnow
 - Wilking
 - Encore
- However, next generation King mandarin hybrids, e.g. Kinnow or Wilking as parents, are of commercial significance
 - Orri/Orah (Temple x Kinnow)
 - Shani, Mama, Merav, etc. (Wilking x Michal)
 - Gold Nugget

Mediterranean mandarin [*Citrus deliciosa*]

- First mandarin introduced into the Med from China (early 1800s), possibly from Canton mandarin
 - Various local common names
 - Mediterranean, Bodrum, Avana, Comun, Chios, Baladi, Imperial, Empress, Willowleaf
 - Drooping, willow-like growth habit, narrow leaves, distinct aroma (leaf & rind) and flavour = original "tangerine" flavour; very seedy, poor shelf-life
- Of little commercial significance (except Italy, Brazil, Uruguay)
- Natural hybrids with Mediterranean mandarin as parent are of commercial significance, e.g.
 - Imperial (Australia)
 - Clementine (Algeria); Med mandarin x Granito sour orange, or directly from Canton mandarin
- Breeding parent of a few mandarin cultivars (King x Willowleaf), but generally low commercial significance
 - Kinnow (Pakistan)
 - Wilking
 - Encore (Japan, Crete, Portugal, New Zealand)
- However, second and third generation Mediterranean mandarin hybrids are of commercial significance
 - Orri/Orah, Shani, Mama, Merav, etc.
 - Mandalate
 - Clementine hybrids
 - Fremont, Fortune, Nova, Lee, Robinson, Osceola, Fairchild, Page

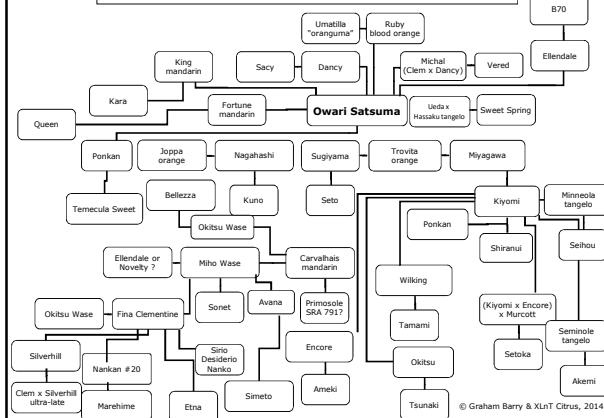
Satsuma mutations



Small-fruited mandarin [*Citrus tangerina*]

- Hungchieh (syn. Hongju = red tangerine or scarlet tangerine)
- Dancy tangerine (similar or identical to Obeni-mikan from Japan); thought to originate in India, then to southern China and Japan
 - Synonym: Obeni-mikan (Japan); closely related to Ladu and Keonla mandarins (India)
 - One of the oldest mandarin varieties known in Florida; originated 1867 as a seedling tree of Moragne tangerine in the orchard of Col. G.L. Dancy. The parent tree was Moragne "tangerine" on the property of Mr. Moragne, reportedly introduced from Tangiers (Morocco); very seedy
 - Dancy probably a nucellar selection of Moragne tangerine
 - Selections: Frost nucellar Dancy, Weshart nucellar Dancy
- Dancy tangerine is of little commercial significance (except in Florida), but Hongju is important in China
- Natural hybrids and man-made hybrids are of commercial significance, e.g.
 - Michal (Clementine x Dancy)
 - Tangelos (Duncan x Dancy)
- Important as a breeding parent of numerous mandarin cultivars
 - Orlando tangelo hybrids: Nova, Fairchild, Lee, Osceola, Robinson, Bower, Fortune
 - Minneola tangelo hybrids: Page, Sugar Belle, Winola
- Second and third generation Dancy mandarin hybrids are of commercial significance
 - Fortune, Orri/Orah, Shani, Mama, Merav, Tami, etc.
 - Fortune hybrids: Daisy, Mandalate, Safor, Garbi, ForEll, Queen
 - (Temple x Dancy) x Encore = TDEs

Satsuma hybrids & nucellar selections

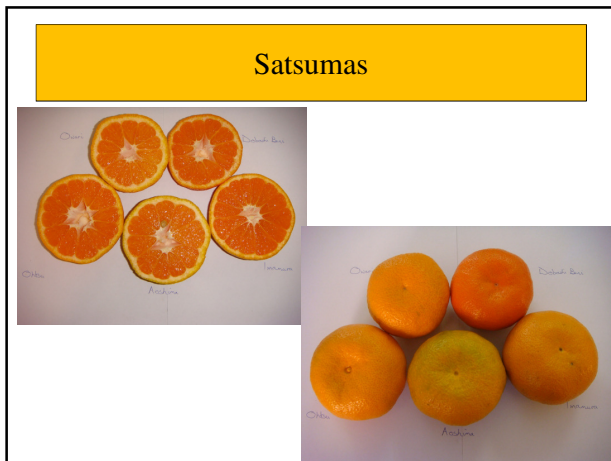


Satsuma mandarin group [*Citrus unshiu*]

- Originated as a commercial cultivar in Japan, after being introduced from China
- Grown initially in Japan, China and Spain, more recently in South Korea, Turkey, Georgia, California, Louisiana, Alabama, Peru, Argentina, Uruguay, Zimbabwe, South Africa
- Numerous selections of Satsuma mandarin, predominantly from Japan
- More recently, hybrids with Satsuma mandarin, e.g. Primosole, Kiyomi, Sonet, Etna, Queen
 - Many of which have Satsuma-like fruit characteristics

Satsuma mandarins and their hybrids

Kind of fruit	Cultivar
Satsuma mandarin	Aoshima, Bela, Dobashi-Beni, Imamura, Kuno, Miho Wase, Miyagawa Wase, Ohtsu, Okitsu Wase, Owari, Ueno, Primosole, Queen, Sonet, Etna, Sugiyama, Kiyomi



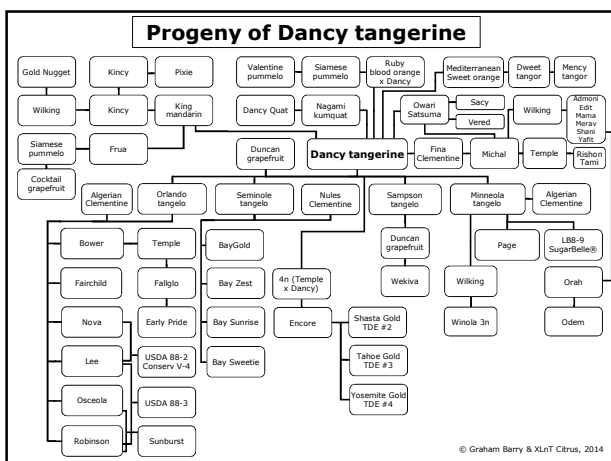
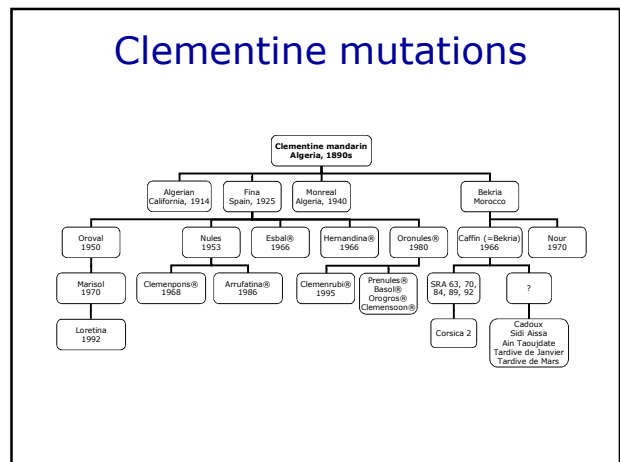
Clementine mandarin group

[*Citrus reticulata*, not *C. clementina*]

- **Originated in Algeria in late 1890s, then introduced to Spain**
 - Initially developed as a natural hybrid of Mediterranean mandarin (*Citrus deliciosa*)
 - Mediterranean mandarin x Granito sour orange
 - Or, directly from Canton mandarin (*Citrus reticulata*)
 - Extremely difficult to breed by hybridisation
 - All current commercial Clementine selections developed via natural mutation
 - More recent experimental Clementine selections also by induced mutation
 - Numerous selections of Clementine mandarin, predominantly from Spain, also Morocco
- **Grown initially in Spain and “French” North Africa (Morocco, Algeria), more recently in Corsica (France), Italy, Greece, California, Chile, Peru, Argentina, Uruguay, Australia, Zimbabwe, South Africa**

Common mandarin (*Citrus reticulata*)

- **Ponkan mandarin**
 - Most widely planted mandarin worldwide
 - Progenitor of modern mandarins??
- **Dancy mandarin**
 - Could be a natural hybrid of Ponkan
 - Now considered as *C. tangerina*
 - Traditional Christmas tangerine in USA
 - Used extensively in breeding; tangelos
 - See: **Progeny of Dancy Tangerine**
 - Carrier of *Alternaria alternata* gene
 - Deep-red rind colour
 - Sexually self-compatible, i.e. very seedy
- **Clementine mandarin group**



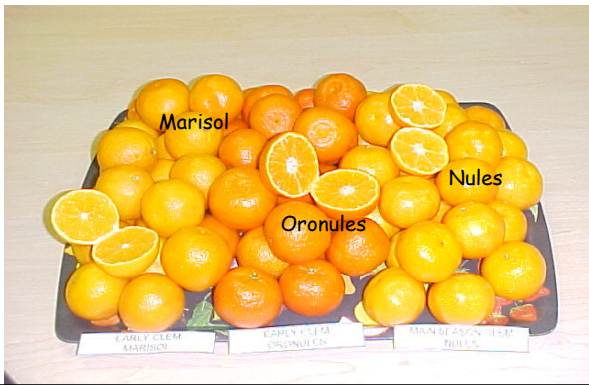
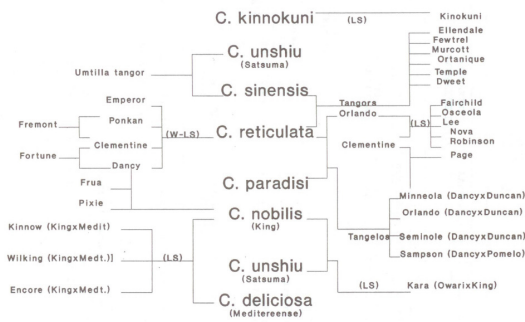
Clementine mandarins

Kind of fruit	Cultivar
Clementine mandarin	Andes-1, Arrufatina, Basol, Cadoux, Caffin, Clemenpons, Clementard, Clem Late, Corsica 2, Esbal, Fina, Guillermina, Hernandina, Marisol, Nour, Nules, Orogrande, Oronules, Oroval, SRA selections, Sidi Aissa, Ain Taoujdate, Tardive de Janvier, Tardive de Mars

Early-maturing Clementine selections



Natural and man-made mandarin hybrids



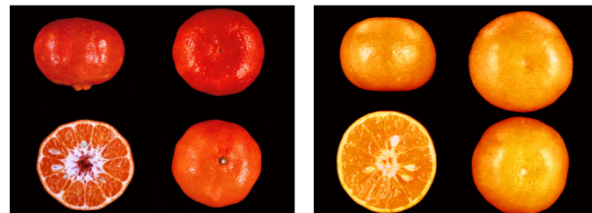
Mandarin and their hybrids

Kind of fruit	Cultivar
Mandarins	ARCCIT 1519 (B24), ARCCIT 1614 (B17), Ambersweet, Bay Gold, Daisy, Dancy, Early Pride, Fallglo, Fairchild, Fortune, Furr (syn. Clemcott [Murcott x Clem]), Ellendale, Garbi, Gold Nugget, Hadas, Kinnow, Kiyomi, Mandalate, Mor (syn. Moriah), Minneola, Murcott (syn. Honey tangerine), Nadorcott (syn. Afourer, Clemengold, Delite), Nectar, Nouvelle, Nova, Nova ARC, Orri (syn. Or), Ortanique (syn. Tambor, Topaz, Mandora, Ortaline), Page, Primosole, Rishon, Roma, Safor, Shani, Sonet, Sunburst, Sunset, Sweet Spring, Tango, Temple (syn. Sue Linda Temple, Thoro Temple), Winola

Other mandarin cultivars [*Citrus reticulata*]

- Mandarin hybrids of:
 - *C. nobilis* (King mandarin)
 - *C. deliciosa* (Mediterranean mandarin)
 - *C. tangerina* (Dancy tangerine)
 - *C. unshiu* (Satsuma mandarin)
 - *C. reticulata* (Common mandarin)
- Combined with:
 - Other mandarins
 - Oranges (*C. sinensis* & *C. aurantium*) = tangors
 - Natural tangors: Temple, Ortanique, Ellendale, Murcott, Clementine
 - Man-made tangors: Kiyomi
 - Pummelo (*C. maxima*) or Grapefruit (*C. paradisi*) = tangelos
 - Ugli, Minneola, Orlando, Sweet Spring
 - Subsequent generation hybrids
 - Tangelos, e.g. Nova, Fairchild, Page, Sugar Belle, Winola, Sunburst, Fallglo
 - Tangors, e.g. Shiranui, Orak/Orri, Nadorcott, Furr (syn. Clemcott), African Sunset, Valley Gold, TDEs

Mandarin hybrids



Dancy mandarin

Murcott tangor

