



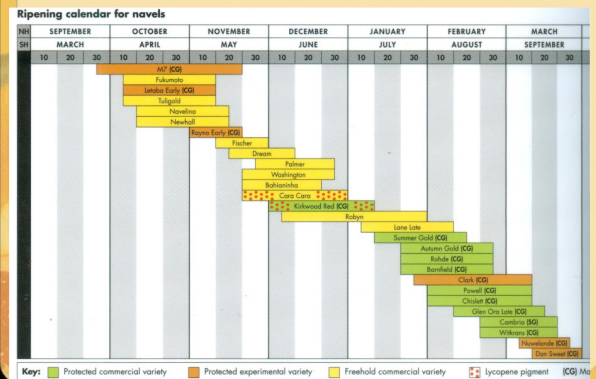
Global trends: Orange varieties

- Very little annual growth (+0.25%); mainly decline due to HLB (Americas)
- Valencia and Navel types continue to predominate, depending on production region, plus numerous well-known juicing oranges (Hamlin, Pera, Natal, etc.)
- Since oranges cannot be bred by conventional breeding techniques, new orange variety development is driven by the selection of natural mutations, and is thus a slow, step-wise process (plus biotech)
- Fruit characteristics essentially the same; time of maturity, seed content, fruit size

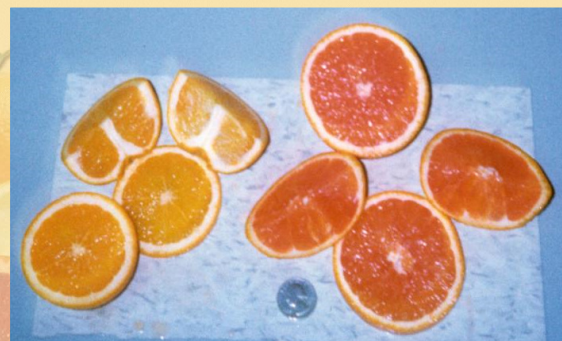
Global trends: Orange varieties

- Navel oranges
 - Ultra-early M7 (Australia) and late-maturing selections from Australia (Powell, Chislett, etc.)
 - South Africa (Cambria, Witkrans, Carninka); red-fleshed (Kirkwood Red, Rosalina)
- Valencia oranges
 - Local selections largely predominate
 - Numerous Valencia selections (South Africa)
 - Improved dual-purpose oranges (Florida)
 - Red-fleshed: Ruby Valencia
- New selections of Tarocco blood orange (Italy)

'Navel' orange selections



'Washington' and 'Cara Cara'





Global trends: Mandarins

- Mandarins have shown tremendous annual growth (5.9%), particularly from China (+60%), Morocco, Turkey, California, Egypt, Peru and South Africa, with a decrease for Argentina

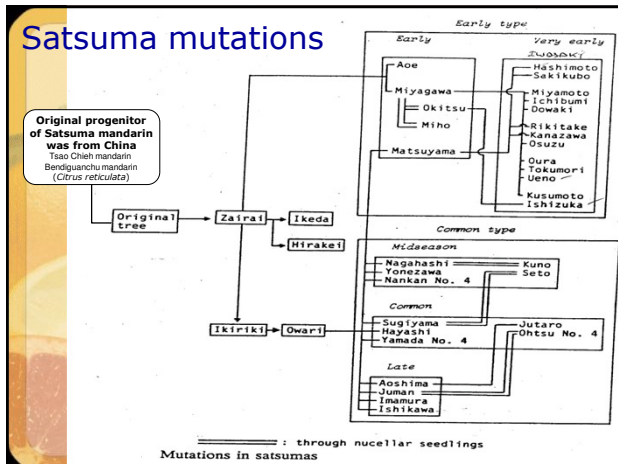


Satsumas: Market opportunities

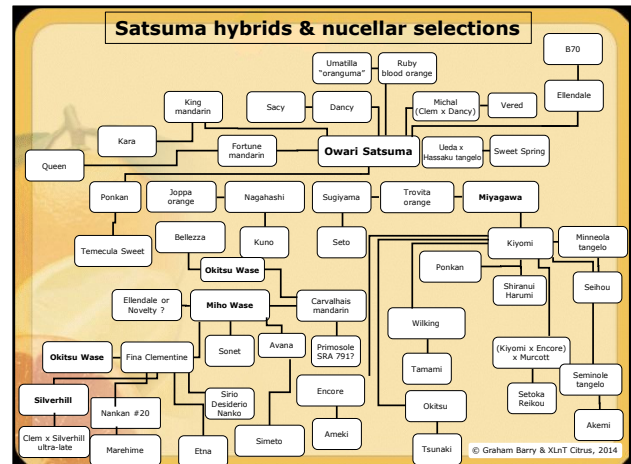
- Limited market demand in the Western markets ("qualitative substitution"); well-respected in Japan, S. Korea, China
- Alternatives gaining popularity
- Opportunity for high-quality, late-maturing var.
 - Numerous selections from Japan (and China)
 - Bela-Late, Aoshima
 - Uruguay selections
- More recently, Satsuma hybrids, e.g.
 - Primosole, Etna, Sonet, Queen, Kiyomi
 - 2nd generation hybrids



Satsuma mutations



Satsuma hybrids & nucellar selections



Global trends: Mandarins

- Active mandarin breeding programs in virtually all regions
- 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
- Consumer needs
 - Convenience
 - Seedless
 - Easy peeling
 - 12-month availability
 - Quality
 - Flavour: good eating experience
 - Appearance: Colour
 - Storability

Consumer Needs!!

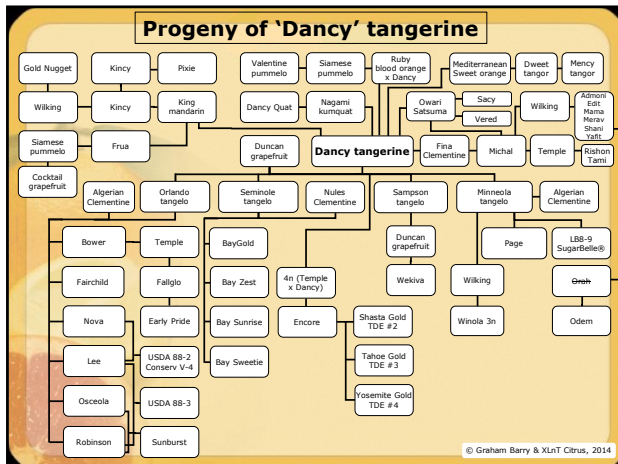


Market opportunities: Mandarins

- Increased supply of the currently-produced good-quality varieties
 - Need broader market penetration
 - Difficulties with introducing a new "line" into retail
- Time-slots
 - Early window (Sept/Oct = Mar/Apr)
 - Mid-maturing (Nov/Dec = May/June)
 - Late window (Jan/Feb = July/Aug)
 - Ultra-late (Mar/Apr = Sep/Oct)
- Climatic suitability
 - Product quality

Common mandarin (*Citrus reticulata*)

- 'Ponkan' mandarin
 - Most widely planted mandarin worldwide
 - Progenitor of modern mandarins?
- 'Dancy' mandarin
 - Could be a natural hybrid of Ponkan
 - Used extensively in breeding; tangelos
 - See: **Progeny of Dancy tangerine**
 - Carrier of *Alternaria alternata* gene
- 'Clementine' mandarin group

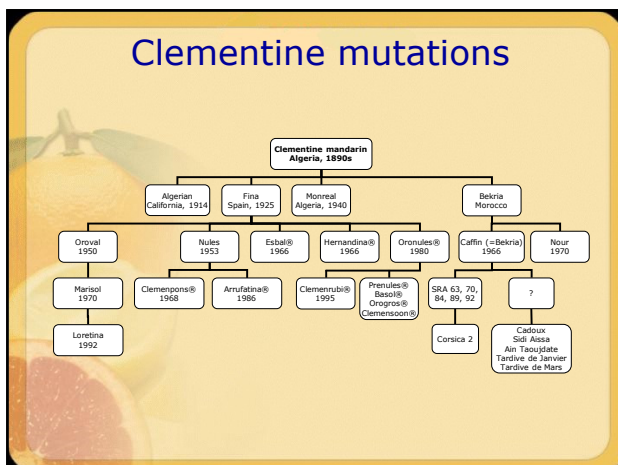


Clementine selections

- All current commercial Clementine selections developed via natural mutation
- More recent (experimental) selections developed by induced mutation
- Numerous selections; predominantly from Spain, (also Morocco and Corsica)
 - Early-maturity: Basol, Clemenubi, Clemensoon, Clemenz (Andes-1), ...
 - Late-maturity: Tardivo, Sando
 - IVIA mutations

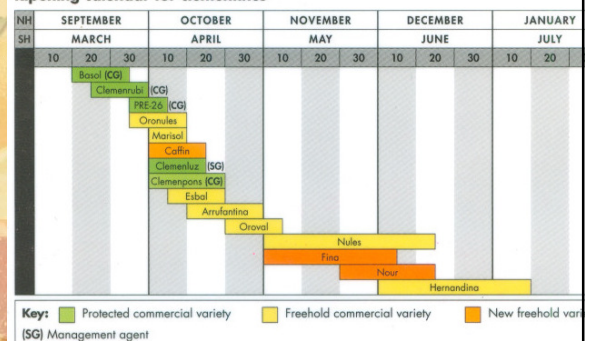


Clementine mutations



Clementines

Ripening calendar for clementines





Pigmented mandarin hybrids (Clem x Tarocco)



'Tacle'
'Mandared'

'Ota 9'

Global trends: Lemons

- +6% annual growth in sales
- Continue to be dominated by a few cultivars
 - e.g. Lisbon and Eureka (Spain), Femminello
 - Meyer lemon hybrid
- Seedless lemons (Eureka, Lisbon, etc.) are popular in Africa and Australia have
- Pink-fleshed lemons – but not popular
- Lemons do not hybridise easily. Therefore, almost all cultivars developed via mutagenesis and selection
- Numerous marketing names are used according to time of flowering or time of harvest, e.g.
 - Primofiore, Verdelli, PGI denominations



'Eureka' lemon



Eureka Seedless



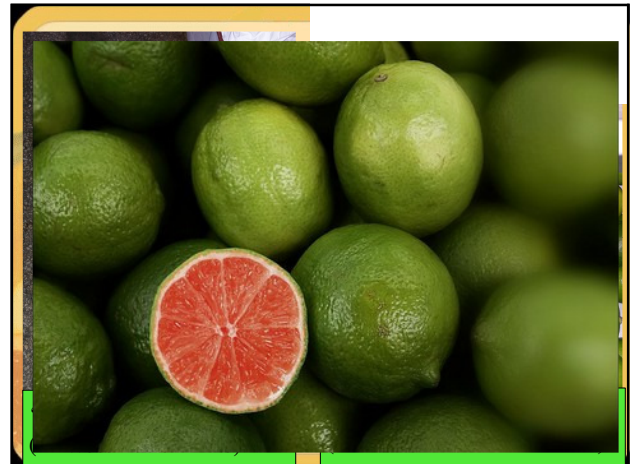
Pink-fleshed lemons



Limes

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

- Limes do not hybridise readily (polyembryonic)
 - In fact, Tahiti/Persian lime is a natural triploid (almost always seedless)
- Two distinct types with no commercially traded mutations, but with many synonyms
 - Persian lime (syn. Tahiti, Bearss)
 - Mexican lime (syn. West Indian, Key, Sutil)
- Fresh export limes
 - Tahiti/Persian
- Mexican/WI limes
 - Mostly propagated as seedlings
 - New varieties: triploids, larger fruited selection
 - Tristeza virus, HLB



Global trends: Grapefruit & Pummelos

- 2.6% annual growth mainly due to 50% increase in pummelo production from China, whereas Florida's grapefruit declined to 20% of 2002 levels
- Production in the different regions is typically dominated by specific varieties, e.g.
 - Redblush in Florida, Rio Red in Texas and Turkey, Star Ruby in South Africa and Israel
- All current commercial grapefruit cultivars developed via mutagenesis/somatic hybrids
- Recent grapefruit developments
 - Texas Red (deeply pigmented mutant)
 - SweetHeart and RedHeart (low naringin selections)
 - Jackson (FE1)
 - Also grapefruit-like hybrids have been developed with grapefruit characteristics (FL-914 grapefruit) pummelo hybrid with low FCs
- Relatively little recent innovation in new GFT varieties

Grapefruit cultivars



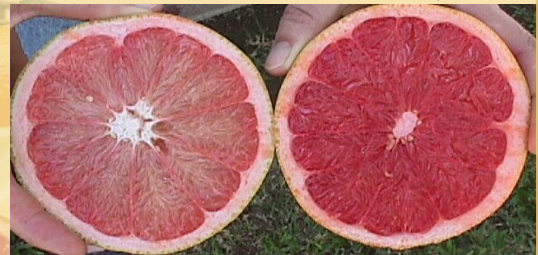
'Star Ruby' grapefruit



Grapefruit

'Redblush'

'Star Ruby'



"Texas Red" Rio Red sport



Jackson FE1 (Sweet Sunrise™)



Pummelo cultivars [*Citrus maxima*]

- 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
 - Recent releases: Dawn & Valentine (CA), 5-1-99-5 & C2-5-12 red pummelos (FL)
- Numerous cultivars produced in China (and other south-east Asian countries); about 10 principal cultivars (Honey pomelo)



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



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



ARBITRARY RATING SYSTEM

		DOGS	CASHCOWS	STARS
		-	0	+
LEMONS	- SEEDY		✓	
	- SEEDLESS			**
	- ELONGATED			*
	- PINK			*
NAVELS	- EARLY (fall)	✓		
	- MID (early-winter)	✓		
	- MID LATE (winter)		✓	
	- LATE (late-winter)			***
	- CARA CARA			*
VALENCIA-TYPES	- SEEDY	✓		
	- MIDKNIGHT		✓	
	- DELTA		✓	
	- TURKEY		✓	
BLOOD ORANGES	- TAROCCO-TYPES			*
	- OTHER	✓		

		DOGS	COWS	STARS
		-	0	+
MANDARINS	- SATSUMAS		✓	
	- MID (fall)		✓	
- CLEMENTINES	- MARISOL	✓		*
	- Pre-ORONULES			
	- NULES		✓	
	- OROVAL		✓	
	- CLEM LATE/Hernand	✓		
	- NOVA		✓	
	- KIYOMI	✓		
	- FAIRCHILD			*
	- TEMPLE	✓		
	- WINOLA	✓		
	- NADORCOTT (and derivatives)			*****
	- ORRI			**
	- MOR		✓	
	- MINNEOLA	✓		

		DOGS	COWS	STARS
		-	0	+
GRAPEFRUIT	- RED		✓	
	- BLUSH			
	- WHITE	✓		
SHADDOCKS			✓	



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