

The background of the slide is a dense, overlapping pattern of dried citrus fruit slices. These include various types of oranges, lemons, and limes, shown in cross-section. The slices are arranged in a way that creates a textured, organic feel. The colors range from bright yellow and orange to deep reds and greens, indicating different varieties and stages of drying. The slices are set against a plain white background, which makes the colors of the fruit stand out.

California and USA Citrus Species and Varieties

**By Dr. Robert J McNeil
Professor Emeritus,
CalPolySLO, CA
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References.

<https://ipm.ucanr.edu/agriculture/citrus/#gsc>

Citrus Pest Management Guidelines.

Slices of various citrus fruits

(Plantsusda.gov)



Additional copies can be ordered from:

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Disclaimer: Information provided herein is for the benefit of the citrus grower and student. Techniques described are provided without guarantee as to their effectiveness.

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Foreward

This book has been written for use by my students of citriculture so that they may have concise, complete, and up-to-date information with respect to citrus species and cultivars.

I hope it will also be useful to all others in the citrus industry, such as growers, nurserymen, home gardeners, etc.

This edition has been expanded to include photos or discussions of all United States citrus areas including those from California, Florida, Texas, Arizona, Louisiana, Alabama, Mississippi, Georgia, South Carolina, Hawaii, New Mexico, and Nevada.

Robert J. McNeil, Ph.D. Professor Emeritus, Fruit Science, CalPolySLO

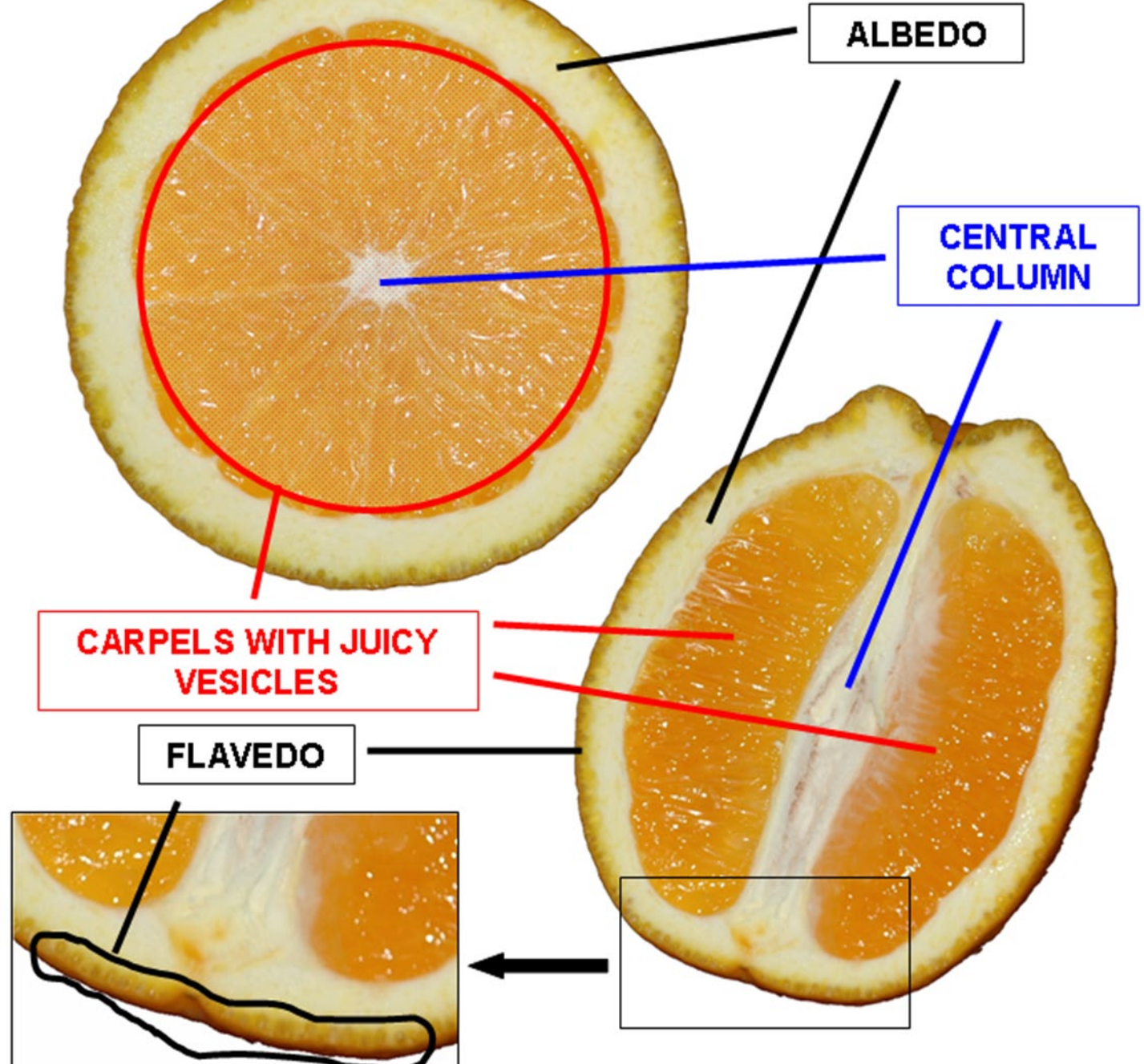
CHAPTER I

The Genera of Citrus

There are three important genera of cultivated citrus, the *Poncirus* (the trifoliate or hardy orange), the *Fortunella* (the kumquats), and the *Citrus* (most other cultivated citrus).

The Citrus fruit is an hesperidium, a specialized berry with a leathery rind.

https://upload.wikimedia.org/wikipedia/commons/6/6f/Orange_cross_section_description.png



Characteristics common to the three genera and their species are as follows (adapted after Ziegler and Wolfe, 1975; Jackson, 1991):

- 1. The fruit is an hesperidium, a specialized berry with a leathery rind. See figure on previous page.**
- 2. There are oil glands in the leaves, bark, and rind.**
- 3. The juice contains sugars, organic acids (citric acid, ascorbic acid, etc.) and pigments.**
- 4. The plants are thorny shrubs or trees with fragrant flowers.**
- 5. The plants are evergreen, except the *Poncirus* which is deciduous. Leaves live for two years on plants of the evergreen species.**

6. The leaves are compound. This is obvious only in *Poncirus* which has trifoliate leaves (three leaflets). Plants of the other genera appear to have simple leaves with one leaflet per leaf but have two additional leaflets in the form of wings, one on each side of the petiole, which makes for a compound leaf.

7. Seeds often contain vegetative embryos in addition to the sexual embryo. This is called polyembryony (having more than one embryo in a seed). The vegetative embryos are derived from the nucellus tissue in the embryo sac and are commonly referred to as nucellar embryos. Since they are vegetative they are true to type (exactly reproduce the parent plant characteristics for propagation). This is especially useful for rootstock propagation or to produce virus-free plant material yet maintain the same variety characteristics.

8. Bud and seed mutations occur frequently. These mutations can be beneficial such as by resulting in new forms or varieties. Examples are the Pink Marsh and the Red Marsh grapefruit, each of which resulted from a bud mutation, the former on a White Marsh tree, and the latter on a Pink Marsh tree. Pink or red fleshed grapefruit varieties have also resulted from seed mutations.

Mutations can also be detrimental such as those called chimeras which may result in malformed fruit. Chimeras are mutations that occur only in a portion of the tissue. Fruit and leaves often show the effects of chimeras. Fruit may have thickened or differing colored strips of rind. Leaves may be variegated. The Valencia orange often produces malformed fruit caused by chimeras.



Citrus chimeras of foliage and fruit:

https://search.aol.com/aol/image;_ylt=AwrE19li34RflEYAaBJpCWVH;_ylu=Y29sbwNiZjEEcG9zAzlEdnRpZAMEc2VjA3Nj?g=chimeras+in+citrus+fruit&v_t=loki-tb-sb#id=18&iurl=https%3A%2F%2Fc.ndtvmg.com%2Fcitrus-fruits_625x300_1530526017922.jpg&action=close

9. Budding and grafting are usually compatible among the three genera. This is valuable in that many scion variety and rootstock variety combinations are therefore possible which would make many choices available to the individual grower to adapt to his orchard situation (climate, soil, pests, etc.).

10. Species within the three genera usually hybridize easily with each other. This has enabled citrus breeders to combine the favorable characteristics of different varieties and thereby produce hybrid varieties, some of which have become extremely important citrus fruiting varieties or rootstocks. Examples are the Minneola and Orlando tangelos as fruiting varieties and the Troyer and Carrizo citranges as rootstock varieties. Listed below are the names used to specify various citrus hybrids and the common names of the citrus species that served as their parentage. Other hybrids do exist. See the website for citrus hybrid names at <http://www.homecitrusgrowers.co.uk/botany/hybridnames.html>

Citrus Hybrids

Citrus Hybrids

Hybrid Name	Parentage
Citranderin	Trifoliate Orange X Mandarin
Citrango	Trifoliate Orange X Sweet Orange
Citremon	Trifoliate Orange X Lemon
Citrumelo	Trifoliate Orange X Pummelo or Grapefruit
Citrumquat	Trifoliate orange X Kumquat
Lemonange	Lemon X Sweet Orange
Lemanderin	Lemon X Mandarin
Limequat	Lime X Kumquat
Orangequat	Sweet Orange X Kumquat
Tangelo	Tangerine X Pummelo or Grapefruit
Tangemon	Tangerine X Lemon
Tangor	Tangerine X Sweet Orange

Chapter II *Poncirus* spp.(The Hardy Orange)

The Hardy Orange (*Poncirus trifoliata* (L.) Rafinesque)

The genus *Poncirus* spp. contains only one species, *Poncirus trifoliata* Rafinesque (Swingle and Reece, 1967)(Ziegler and Wolf, 1975; Jackson, 1991) It is hardy to 0 degrees F. or lower (McNeil, 2001)

It can be distinguished from all other true citrus fruit plants by its deciduous nature and its trifoliate leaves. In addition, it forms its flower buds in the summer similarly as do temperate deciduous fruits. It has small, round, yellow fruit covered with pubescence and containing up to forty seeds. The pulp is very acid and contains a bitter oil which makes it inedible due to its acrid taste. Fruit maturity is in fall or winter. The tree is dwarf and has large thorns. It is the most cold hardy of all citrus, tolerating temperatures as low as 0 F. or lower (McNeil, 2001), or even -22 ([Wikipedia, Cold Hardy Citrus](https://upload.wikimedia.org/wikipedia/commons/thumb/6/62/20130817Citrustrifoliata3.jpg/120px-20130817Citrus_trifoliata3.jpg.com)) when dormant. The author has observed it grown as an ornamental as far north as Trenton, New Jersey.

https://upload.wikimedia.org/wikipedia/commons/thumb/6/62/20130817Citrustrifoliata3.jpg/120px-20130817Citrus_trifoliata3.jpg.com

Trifoliate fruit, flowers, and thorns. Note the pubescence on the green fruit.

(<http://www.scientificlib/en/Biology/Plants/Magnoliophyta/PoncirusTrifoliata01.html>)



Trifoliate orange, mature fruit.

(<http://www.scientificlib/en/Biology/Plants/Magnoliophyta/PoncirusTrifoliata01.html>)



Trifoliate orange with fuzzy fruit; mature fruit (plants.usda.gov)



Trifoliate orange leaves and flowers

([Plants.usda.gov](https://plants.usda.gov) and

https://i.etsystatic.com/25250372/r/il/4d8b50/3609558923/il_794xN.3609558923_i0sr.jpg)



Its cold hardiness is one of the reasons why its primary use (Swingle and Reece, 1967) has been as a rootstock such as in central and northern Florida and the San Joaquin valley of California where cold hardiness is important. As a rootstock it keeps the scion variety dormant during the time of year it would be deciduous, but when the tops are not dormant they are no hardier than when they are on other rootstocks. An additional important rootstock quality of the trifoliate orange is a dwarfing or semi-dwarfing effect on the citrus tree. Popular rootstock varieties are the Rubidoux and Pomeroy, and Rich16-6.

It was introduced into the United States in 1869 by William Saunders for the U.S. Department of Agriculture. It has been grown in China for thousands of years and in Japan since at least the eighth century. It has been used extensively in Japan and moderately so in the United States as a rootstock for the satsuma mandarin and other citrus. It has been used for hedges and is commonly grown as an ornamental in cold areas of Asia, Europe and North America where it may be too cold for other types of citrus. Several dwarfed ornamental varieties are said to exist in Asia (Hodgson, 1967). The most important of these has been the Japanese *hiryo* or Flying Dragon, a highly dwarfed variety grown primarily as a potted plant (Swingle and Reece, 1967; Hodgson, 1967). Swingle introduced it into the United States in 1915. In recent years it has been utilized as a fully dwarfing rootstock for backyard citrus and in limited commercial orchard trials in California. The Chinese have for hundreds of years used the dried fruits as a medicinal ingredient.

Flying Dragon Trifoliate Orange Fruit-a fully dwarfing citrus rootstock.

Tripplebrookfarm.com



Flying Dragon Fully Dwarfing Trifoliolate Rootstock

<https://tripplebrookfarm.com/product/trifoliolate-orange-hardy-orange-flying-dragon-poncirus-trifoliata/>

Flying dragon is distinguished from the ordinary *Poncirus trifoliata*, by spines which curve strongly backward, in claw-like fashion. This interesting, ornamental growth habit is particularly evident when the plant is leafless. Highly prized in the Orient, where it has been cultivated for centuries. 'Flying Dragon' is also a dwarf, growing to a maximum height of 6' (smaller in containers). Commercially used as a dwarfing rootstock for citrus. Should be a good candidate for bonsai training.

The ordinary *Poncirus Trifoliata* is a small, very spiny tree, of interest in being a hardy, deciduous near-relative of citrus fruits. Because the twigs and spines are green, the plant appears green even when it is leafless. Produces attractive, supposedly fragrant, white flowers in spring, which develop by fall into yellow fruits resembling small oranges. These sour, fruits are often considered inedible. Michael Dirr, in his *Manual of Woody Landscape Plants*, however, comments that "Ripe fruits set aside for several weeks become juicy and develop a sprightly, slightly acid flavor. Serves as a substitute for lemon, pulp can be made into marmalade, and peel can be candied. After removing the numerous seeds there is not a whole lot of pulp left over." Used commercially as a rootstock on which to graft other citrus fruits. Considered cold hardy to about -15° F, its range of cultivation can be extended into zone 5 if it is planted in a sheltered location and perhaps given some extra protection.

The author has seen it grown as an ornamental in central western New Jersey.

Flying Dragon trifoliate orange:
Fruit on tree: www.pinterest.com
Bonsai: Smartseedsemporium.com



The trifoliate orange has been crossed with several *Citrus* species making new citrus hybrids, some of which have become important rootstocks. The most notable of these is the citrange. It is probably the most widely used citrus rootstock in California. Hardy to 0 degrees F. ([Wikipedia. Cold Hardy Citrus](#)).

Popular citrange varieties utilized as rootstocks in California have been the Troyer and the Carrizo. A new citrange variety that has rapidly become popular as a rootstock is the C-35. Another new variety is the C-32 which is less popular.

The citrange is partially deciduous, trifoliate, and less cold hardy than the trifoliate orange, but more so than the sweet orange. The fruit are more edible (less acrid) than trifoliate fruit. Fruit maturity is in late fall or winter.



Leaves of *Poncirus trifoliata*, citrange, and sweet orange compared: The citrange (middle figure) appears to be a blend of the other two.

https://web.archive.org/web/20041225160429im_/http://www.saalfelds.freeseve.co.uk/citrangeorangeponcleafB.jpg

**Troyer Citrange Fruit, an important citrus rootstock.
More edible (less acrid) than trifoliolate.**

Fruit: <https://www.mindenpictures.com/search?s=Citrange>

and Tree: www.woodlanders.net



CHAPTER III *Fortunella* spp. (The Kumquats)

This genus contains four species according to Swingle or six species according to Tanaka (Hodgson, 1967). Cold hardy between 10-20 degrees F. (McNeil, 2001) or 14 degrees F. says Wikipedia, Cold Hardy Citrus. (<https://docplayer.net/50953903-Cold-hardy-citrus-for-north-florida-1.html>) Says 10 degrees F.

The kumquats have several characteristics in common:

The fruit are small (less than 2 in. diameter), seeded, and with an oval or round shape. The entire fruit including the rind is edible. The rind has a pleasing, sweet taste. The flesh is mildly acid.

The plants are more shrublike than treelike with a height usually ten feet or less, especially on trifoliate rootstock. Most are thornless or only slightly thorny.

The plants are quite cold hardy, tolerating as low as 10-20°F (McNeil, 2001) when dormant.

They are attractive ornamental plants with many small leaves and many small, colorful fruit.

The attractive foliage with its fruit is used for table decorations and are often included in holiday fruit baskets. The fruit is used to make preserves, marmalade and candied fruits. The fruit is usually mature between October and January in warm inland areas, later in cool coastal areas.

Kumquats are most commonly grown in China, southern Japan, and Taiwan, and a tropical form in Malaya. They are also grown in the United States, in Florida for inclusion in gift packages and in California primarily for use as ornamental plants.

The fruit is larger, juicier, and less acid in Florida and the hot interior areas of California than in the cool coastal areas (Hodgson, 1967).

The Nagami kumquat appears to have been first introduced from China into Europe in 1846 by Robert Fortune of the London Horticultural Society. It is presumed to have been sent to the United States (Florida?) shortly afterwards having been described in Downing's Horticulturist in February 1850.

The Marumi was introduced from Japan into Florida in 1885 and the Meiwa and Hong Kong kumquats were brought in between 1910 and 1912 by the U.S. Department of Agriculture (Hodgson, 1967). It is unknown to the author as to whether the Malayan or the Changshou kumquats have been introduced into the United States or Europe. The Nagami, Meiwa and Marumi are the most popular varieties, in that order, in the United States.

**Nagami/kumquat(*Fortunella/margarita*
Swingle):**

[https://www.ebay.com/sch/i.html? from=R40& trksid=p2047675.
m570.l1313& nkw=nagami+kumquat& sacat=0\)](https://www.ebay.com/sch/i.html?from=R40&trksid=p2047675_m570.l1313&nkw=nagami+kumquat&sacat=0)

1.25-1.75 in. long.



Nagami kumquats

(kumquatusda.org)



Nagami or Oval Kumquat (*Fortunella margarita* Swingle)• This is the Naga or Nagami *kinkan* of Japan. It is the most popular variety in Asia and in the United States. The fruit are oval, 1¼ to 1¾ inches long, with 2 to 5 seeds, four or five segments, and a good flavor including a sweet rind. The leaves and tree are relatively large compared to other kumquats.

The author is not aware of cultivation of any of the other kumquat varieties (Hong Kong, Changshou, Malayan) in the United States, however, specimen plants of the Hong Kong variety can be found in Florida (Jackson, 1991).

Meiwa or Large Round Kumquat *Fortunella crassifolia* Swingle) This is the Ninpo, Meiwa, or Neiho *kinkan* of Japan. It is the best variety for eating fresh and has increased in popularity in the United States. The fruit are orange, round to slightly oval, 1-1½ inches in diameter, nearly seedless, with a thick, sweet rind, seven sections, and a relatively sweet flavor compared to other kumquats. Twigs are nearly thornless. It is slightly less cold hardy than Nagami. Meiwa kumquat (*Fortunella crassifolia* Swingle): (<https://www.ebay.com/itm/153455855949>) The author had one in his kitchen in New Jersey which was full of fruit every winter. Outdoors in summer.

**Meiwa or Large Round Kumquat
Fortunella crassifolia Swingle)
1.5 in diameter.**

<https://www.ebay.com/itm/153455855949>



Marumi or Round Kumquat (*Fortunella japonica* Swingle)

Hardy to 14 degrees F. (Wikipedia, Cold Hardy Citrus)

• This is the Maru or Marumi *kinkan* of Japan. This is the third most popular variety in the United States. The fruit are orange, round or slightly oblate, small (1.25 inch in diameter), one to three seeds, four to seven segments, with a good flavor and thin rind. The tree is slightly thorny, relatively less vigorous, with smaller, less sharply pointed leaves as compared to the latter two kumquats. It is slightly more cold hardy than Nagami.

· Marumi or Round Kumquat:

· https://upload.wikimedia.org/wikipedia/commons/thumb/f/f4/Citrus_japonica.jpg/800px-Citrus_japonica.jpg

· [Marumi kumquat fruit: shutterstock 131386913marumi x85Marumi https://cdn.shopify.com/s/files/1/2336/3219/products0.jpg?v=1531972875](https://cdn.shopify.com/s/files/1/2336/3219/products0.jpg?v=1531972875)



Hong Kong Kumquat (*Fortunella hindsii* Swingle)•

This is the Mame or Hime *kinkan* of Japan. This is the least popular variety in the United States, not in cultivation but existing only as specimen plants in Florida (Jackson, 1991). The fruit are bright scarlet-orange, round (subglobose), very small (less than 1/2 inch diameter), large seeded, contain three or four segments and are less edible (except with sugar) with a spicy flavor. The plants are relatively small, shrublike and spiny. Photo: (https://en.wikipedia.org/wiki/Citrus_taxonomy#Hybrids)



Changshou Kumquat (*Fortunella obovata* Tanaka) • This is the Choju *kinkan* or Changshou or Fukushu of Japan. It is a dwarf variety that has been widely grown as a potted plant in China and somewhat in Japan (Hodgson, 1967). Its existence in the United States is unknown to the author. The fruit are broadly obovate, medium sized (1-inch diameter), have a few seeds, contain five to eight segments, have a thin rind, and a similar flavor as the Marumi./The/plants/are/small/and/thornless.

Malayan Kumquat (*Fortunella polyandra* Tanaka)• This is a little known kumquat, its distribution being restricted to Malaya and Hainan Island (Hodgson, 1967). The fruit are relatively large (1.75 in. diameter), round, containing five or six segments, and are thin-skinned. It is a thornless shrub with long, slender leaves. It is grown for its fruit and as an ornamental but not as a potted plant. Its existence in the United States is unknown to the author.

Kumquat Hybrids • In 1909 the U.S. Department of Agriculture citrus fruit breeding program in Florida made a series of crosses which produced the limequats, orangequats, citrumquat, citrangequats, citrangedins, and other hybrids.

The kumquat was utilized because of its cold hardiness. The most notable of these is the limequat which is commonly planted for backyard use as a more cold hardy lime substitute. The orangequats and citrangequats also seem to have potential horticultural value but have not been widely utilized to the author's knowledge. The orangequat (Satsuma mandarin X Meiwa kumquat) is an attractive ornamental, and the fruit makes excellent marmalade.

Orangequat. Hardy to 16 degrees F.

(Wikipedia,Cold Hardy Citrus) (<https://www.ebay.com/itm/154769872358?hash=item240900d5e6:g:bqoAAOSwb41hyoQt>)



Orangequat, Nippon. (Satsuma mandarin X Meiwa kumquat) (<https://citrusvariety.ucr.edu/citrus/CRC3360.html>)

Parentage/origins: Reported to be Satsuma mandarin x Meiwa kumquat.

Attractive tree with smallish medium to dark orange fruits. Thin rind, juicy, few seeds; but flavor is sour.

According to The Citrus Industry, 1967, Vol 1, p 583, 'Nippon' has "Fruit small (but larger than the kumquat), broadly oval to obovate; orange-colored; rind relatively thick and spongy; flavor mild and pulp acid. Matures early but holds well on tree for several months. Tree slow-growing, medium-small, spreading; foliage dark green...Although it is a somewhat attractive ornamental and the fruit makes excellent marmalade, the orangequat has not become popular and remains an oddity or collection item."

Citrumquat (*Poncirus trifoliata* + Kumquat) No information available. It is not on the UCR website.

(<https://www.gardeningknowhow.com/edible/fruits/limequat/limequat-tree-information>)

Photo: ([Eustis limequat SRA 152 - Oscar Tintori - Nurseries Worldwide - Citrus Plants](#))

**Eustis
Limequat
photo:
Hardy
to 20 F.**



The citrangequats. Hardy to 5 degrees F. ([Wikipedia, Cold Hardy Citrus](#)) Appear to be more cold resistant than the citranges, the calamondin, and the kumquat, thus may be useful in areas too cold for the latter varieties. The fruit resembles the kumquat. Consult references by Swingle and Reece, 1967; Hodgson, 1967; and Jackson, 1991, for further information on these and other kumquat hybrids.

The Thomasville citrangequat and the Glen citrangedin (citrange X calamondin) have been utilized to a limited extent as lime substitutes in areas such as Georgia where it may be too cold for other cold hardy lime-like fruits such as the calamondin (Jackson, 1991).

The citrangequat is a [citrus hybrid](#) of a [citrange](#) and a [kumquat](#), developed by [Walter Swingle](#) at [Eustis, Florida](#), in 1909. Citrangequats are [bitter](#) in taste, but are considered edible by some at the peak of their maturity.

Three named citrangequat cultivars exist:

(<https://en.wikipedia.org/wiki/Citrangequat>)

'Sinton' – Nagami kumquat (*[Fortunella margarita](#)*) x Rusk citrange; named for the city of [Sinton, Texas](#)

'Telfair' – Nagami kumquat x Willits citrange; named for [Telfair County, Georgia](#)

'Thomasville' – most common citrangequat; named for the city of [Thomasville, Georgia](#). 'Thomasville' is considered the most [cold-hardy edible citrus](#) variety. It can tolerate temperatures down to 5 °F.

Thomasville citrangequat tree and fruit

(garden.org) Hardy to 5 degrees F. (Wikipedia,
Cold Hardy Citrus)

Fruit (<https://agrumilenzi.it/>) and (<https://www.ekozahradnictvi>)



Thomasville citrangequat

(<http://citruspages.free.fr/kumquats.php#citrangequat>)

Thomasville becomes edible when fully mature, though it is relatively seedy. It is very juicy, valued for eating fresh, for marmalade and for flavouring soft drinks. The tree is strongly resistant to citrus canker and is very ornamental.

Citrangequat Thomasville is an Oval kumquat and Willits citrange hybrid and was first fruited at Thomasville, Georgia. The cross was made in 1909, and the variety was named and described in 1923. Fruit medium-small, globose to oval; colour yellow to orange-yellow.

The tree is very vigorous, upright and thorny. Leaves are variable but mainly trifoliate. Presumably because of the larger size and edibility of the fruit, it is much the most popular citrangequat variety.

Sinton citrangequat “Fruit small, round to oval; often necked; color deep reddish orange; sharply acid; nearly seedless. Tree moderately vigorous, upright, nearly thornless; leaves mainly unifoliate. This Oval kumquat and Rusk citrange hybrid first fruited at Sinton, Texas, and was named and described in 1923 by Swingle and Robinson. It is an attractive ornamental and the fruit is beautifully colored but highly acid.”

(https://crfg.org/piwigo/data/i/galleries/fruit_shoot_2009/V07_Sinton_Citrangquat-me.JPG) and ([idtools.org](http://tools.org) and <https://citrusvariety.ucr.edu/citrus/sinton.html>)
(text only)



Sinton citrangequat

(<http://citruspages.free.fr/kumquats.php#citrangequat>)

Citrangequat Sinton is an Oval kumquat and Rusk citrange hybrid first fruited at Sinton, Texas, and was named and described in 1923. It is an attractive ornamental and the fruit is beautifully coloured but highly acid.

Fruit is small, round to oval; often necked; colour deep reddish orange; sharply acid; nearly seedless. Tree moderately vigorous, upright, nearly thornless; leaves mainly unifoliate.

Glen citrangedin (<https://agrumilenzi.it/>)

Glen citrangedin has the sour taste of calamondin but lacks the pleasant scent and sweet peel. It is a pretty fruit as they get a very deep orange bordering on red. (citrus.forumup.org) and (hardycitrus.blogspot.com)



Glen citrangedin

Cold hardy to 14 degrees F.

(<https://agrumilenzi.it/en/negozio/citrusen/citrus-glen-citroncirus-x-citrangedin/>)

Parentage/origins: Willits citrange x *Citrus madurensis* (calamondin).

Upright, open tree; not particularly attractive. Fruit is about kumquat sized, spherical, orange in color, orange flesh, 2 to 4 seeds per fruit, juicy but sour and unpalatable.

Season October to November.

([glen_citrangedin \(ucr.edu\)](http://glen_citrangedin.ucr.edu))

Chapter IV *Citrus* spp. (The Citrus) and *Citrus sinensis* Osbeck (The Sweet Orange)

This genus contains sixteen species according to Swingle and between 145 and 159 according to Tanaka (Ziegler and Wolfe, 1975; Swingle and Reece, 1967; Hodgson, 1967; Jackson, 1991). Swingle's classification scheme is probably too conservative while Tanaka's too liberal. The actual number of species in the genus *Citrus* probably should lie somewhere between these numbers. The author will describe specific citrus as species based on what seems to be their most commonly and widely utilized scientific species name in the United States. Those species and varieties of importance for commercial production or for backyard planting in California will primarily be discussed. Citrus from other states are described in the Appendix.

The Sweet Orange (*Citrus sinensis* Osbeck)

This is the leading citrus species in the world, the United States, and California. The relative cold hardiness of the tree when dormant (20 degrees F., McNeil, 2001)) allows it to be grown in most subtropical areas of the world (and, of course, tropical areas). No other citrus fruit is so widely liked and used with the exception of the mandarin which is preferred in Asia. The sweet orange is primarily used as a fresh fruit in most countries of the world. Although fresh eating is very important in the United States, the principal use is for juice either fresh or preserved by refrigeration, pasteurization, and/or concentration. Juice has also increased in importance elsewhere in the world such as in Brazil and Mexico. Important byproducts obtained from the rinds of fruit juiced at processing plants are essential oil, pectin, and cattle feed (dried citrus pulp). The bulk of the orange processing in the United States is practiced in Florida, while California produces oranges primarily for fresh market. There were 145,000 bearing acres of acres of sweet oranges in California in 2020 (Anonymous, 2020).

There are four types of sweet oranges with respect to their fruit characteristics: (Hodgson, 1967):

<https://www.naturehills.com/customer/account/login/referer/aHR0cHM6Ly93d3cubmF0dXJlaGlzbHMuY29tL2N1c3RvbWVvL2FjY291bnQ%2C/>

1. The common or normal oranges which usually have orange-colored (sometimes yellow) rind and flesh and have no navel. They are the most widely grown type and include more cultivars than any other type. The most important cultivar example is the Valencia orange:



2. The navel oranges which usually have orange-colored rind and flesh but have a navel or very small secondary fruit located in the blossom-end of the primary fruit. The most notable cultivar example is the Washington navel orange. The navel oranges rank as second only to the common oranges in commercial importance in the world.

(<https://www.naturehills.com/orange-washington-navel>):



3. The pigmented or blood oranges which have pink or red flesh or streaks in the flesh and sometimes a pink or red rind or blush on the rind. They consist of two types: (i) the deep blood oranges and (ii) the light blood oranges. Important deep blood (the preferred type) examples are Spanish Sanguinelli, Tarocco, and Moro. The blood oranges are the third most important type of orange grown commercially, primarily grown in Mediterranean countries.

<https://www.naturehills.com/media/catalog/product/cache/4c3133013f454b0b5d2d4ebb36fea89d/m/o/moro-blood-orange-cut-in-half-425x425.jpg>):



4. The sugar or acidless oranges which are so sweet and so lacking in acid that they are almost tasteless and are therefore not widely grown and of only minor importance. They also have a cream-colored chalazal spot on their seeds, which is darker on the more acid citrus and chestnut brown for the normal sweet oranges and light blood oranges, but purplish red for the deep-blood oranges. Countries where their culture has been important are Spain, Egypt, Brazil and Mexico. Their unusual flavor is favored in Spain and Portugal and their former colonies, and in most Arabic-speaking countries. Cultivar examples are the Lima of Brazil, the Succari of Egypt, and the Sucrefia of Spain.

Selected characteristics that the sweet oranges have in common are as follows (adapted after Swingle and Reece, 1967):

- 1. Medium sized trees with a rounded top. Hardy to 20 degrees F. (McNeil, 2001).**
- 2. Twigs angular when young usually with slender, somewhat blunt spines in the leaf axils.**
- 3. Leaves medium-sized, pointed at the tip, rounded at the base.**
- 4. Petioles narrowly winged, articulated with the twig and the leaf blade.**
- 5. Medium-sized, white flowers, single or in small clusters in the leaf axils, distinct fragrance.**
- 6. Calyx with 5 lobes, petals 5, stamens 20-25.**
- 7. Ovary with 10-13 locules, yielding 10-13 fruit segments.**
- 8. Fruits medium-sized (5-9 cm. diam.), subglobose, oval, or flattened globose, pulp sweet.**
- 9. Peel thin, smooth, bright orange, usually tight, not bitter, core solid.**
- 10. Seeds white inside, embryos usually numerous, cuneate (wedge shaped), ovoid.**

Sweet orange foliage (small wings on petioles).

(http://itp.lucidcentral.org/id/citrus/citrusid/key/Citrus/Media/Html/images/Berna_Sweet/Berna_Sweet_Orange_IMG_8353.JPG) Orange

Navel Orange tree: (<https://www.thetreecenter.com/wp-content/uploads/washington-navel-orange-2.jpg>)



There are only two primary sweet orange cultivars grown commercially in California, the Valencia orange and the Washington navel orange. The Valencia is the summer orange and the navel is the winter orange, however, the maturity, harvest, and marketing for each extend both earlier and later than those seasons. This is true especially because of California's variability of climatic areas in which they are grown and because fruit of each cultivar can be stored on the tree for several months after they are first mature. On-tree storage saves the high expenses of long-term refrigerated storage. This allows California, with only two main orange cultivars, to harvest and market oranges all year round.

This can be contrasted with Florida where several early, mid-season and late maturity sweet orange cultivars are grown in order to extend the harvest and marketing season. This is because the climate between different orange districts in Florida is more uniform than in California making for a relatively short season (3 to 4 months) for each cultivar. The three major sweet orange cultivars in Florida are the Hamlin (early maturity), the Pineapple (mid-season), and the Valencia (late season) (Jackson, 1991).

MAJOR SWEET ORANGE CULTIVARS IN CALIFORNIA

The Valencia orange is the leading cultivar in the world. It is of major importance in the United States (both Florida and California), South Africa, Australia, and Mexico and also quite important in Israel, Algeria, Morocco and Brazil (Hodgson, 1967).

With the recent decrease in orange bearing acreage in Florida from citrus greening disease I would expect California Valencia acreage to increase.

Although the Valencia can be traced back to the Azores, it is more probable that it came from Portugal since an old variety, indistinguishable from Valencia, named Don Joao was found there. The first commercial orchard in California was established near Placentia about 1880 by R.H. Gilman (Hodgson, 1967).

Cultivars that are indistinguishable from the Valencia are Lue Gim Gong, Pope, and Hart's Late of Florida (Jackson, 1991), Natal of Brazil, Calderon of Argentina, and Harward of New Zealand (Hodgson, 1967). Cultivars that have resulted from bud mutation of the Valencia are Armstrong and Perry of California, Muden of South Africa, Seedless Valencia of Australia, and Ksiri of Morocco (Hodgson, 1967).

In recent years most of the trees planted in California have been of nucellar budlines which are virus-free, more vigorous, and more productive than old Valencia or previously used budlines. The most popular of these are the Olinda, Frost, Cutter and Campbell (Hodgson, 1967). The Olinda is the most-planted budline and from recent studies appears to be the most productive (McNeil, 1990, unpublished data).

The Valencia orange is grown in all main citrus areas of California. It has a wide climatic range of adaptation from the cool, coastal areas to the hot, dry deserts. Best quality fruit are produced in Southern California. San Joaquin Valley fruit are adequate but have coarser rind texture. The harvest periods are February to May in the desert, mid-March to July in the San Joaquin Valley and April to November in Southern California coastal and intermediate areas.

There were 26,924 bearing and 412 nonbearing acres of Valencias in California in 2020. (Anonymous, 2020) Bearing acreage decreased by 61% since 1992, down by 42,778 acres. 27.8 % of Valencia oranges are processed in California (Anonymous, 2019a). The Valencia is an excellent fresh-eating orange but also yields premium quality juice. Valencia orange fruit:

(http://utm_source=bing&utm_medium=cpc&utm_campaign=*Shopping%3A%20Fruit%20Bearing%20%20JF&utm_term=4580771605560676&utm_content=Orange)



Valencia orange tree

https://lemoncitrustree.com/store/media/catalog/product/cache/1/image/1200x1200/9df78eab33525d08d6e5fb8d27136e95/v/a/valencia-orange_11.jpg

And fruit.



https://search.aol.com/aol/image?p=valencia+orange&s_it=img-ans&v_t=loki-tb-sb&fr=loki-tb-sb&imgurl=https%3A%2F%2Fspecialtyproduce.com%2Fsppics%2F121.png#id=0&iurl=https%3A%2F%2Fspecialtyproduce.com%2Fsppics%2F121.png&action=click



The Valencia tree is large and vigorous. The fruit are medium to large with average crops, but small with heavy crops caused by an alternate bearing tendency. Fruit thinning chemicals (NAA) can be used to increase fruit size in heavy crop years. The rind is medium thick, tough, leathery and smooth to faintly pebbled. Fruit have only a few seeds, sometimes none. It peels and segments poorly. The juice is abundant and of good flavor but somewhat acid.

The tough fruit stores and ships well. The on-tree fruit storage is excellent and may be practiced for several months. This is the preferred long-term storage method since long-term refrigerated storage would be more expensive. The fruit is well-colored at maturity in the spring but regreens if left on the tree in the warm summer months. This can be reduced by ethylene degreening treatments after harvest. The fruit are subject to granulation (drying of the pulp vesicles) if stored on the tree too long.

The California Valencia orange yield per acre from 2018 to 2020 ranged from a low of 286 boxes (75 lbs.) to a high of 352 boxes (Anonymous, 2020).

**Rosy Red
Valencia, a
New Variety.
([https://rosy
redvalencia.c
om/photo-
gallery](https://rosyredvalencia.com/photo-gallery))**





Star Ruby
Grapefruit
June 10, 2023

Rosy
Red Valencia
June 10, 2023

OLINDA
Valencia
June 10,
2023

Cara Cara
Navel
June 10,
2023

Rosy Red vs Olinda Juice



The Washington navel orange and its strains is the premium quality fresh eating orange extensively grown in California. Plantings exceed that of even the Valencia orange especially in the San Joaquin Valley where there has been a large citrus expansion in the last two or three decades. In Florida, navels make up only a very small portion of the orange acreage, however, the navel acreage is increasing to some extent because of good prices for early season "salad" fruit (Jackson, 1991). Washington may have good quality but suffers from poor production in Florida, and will have large, coarse, often dry fruit with an unsightly navel when the crop is very light (Jackson, 1991). Popular navel strains in Florida have been Summerfield, Glen Improved and Dream. Popular navel strains in California are the Parent, Eddy, and Warren.

(https://citrusvariety.ucr.edu/citrus/parent_1241B.html) Frost nucellar Washington navel had been the first, and much the most important, nucellar budline of Washington navel but suffers from small fruit size and coarser rind texture, and more acid fruit of later maturity. The Parent navel strain with good fruit size has been more popular recently.

(<https://citrusvariety.ucr.edu/citrus/frostwashington.html>)

Important navel orange-producing countries are the United States (California), Brazil, Spain, South Africa, Australia, Morocco and Algeria.

In 1870 twelve budded trees were obtained from Bahia, Brazil, by William O. Saunders, superintendent of gardens and grounds, U.S. Department of Agriculture, Washington, D.C. It was this introduction that led to the adoption of the name Washington. A number of persons in California and Florida received trees several years later.

The planting of three of these trees by L. C. Tibbets of Riverside in 1874 resulted in the name Washington becoming attached to this variety. The Washington proved to be superior to other navels previously imported (1870) into California from Australia. It became the leading variety for many years in California from which it spread to other citrus growing areas of the world (Hodgson, 1967).

The origin of the Washington or Bahia variety is not definitely known, but it is thought by some to have originated as a limb sport (bud mutation) of the Selecta variety in the state of Bahia, Brazil, and first propagated between 1810 and 1820 (Dorsett, Shamel and Popenoe, 1917). Hodgson (1967) felt that it was more likely that it originated somewhat earlier and the parent variety was the Portuguese navel orange (Umbigo). It was introduced in Australia in 1824 and Florida in 1835. Trees were sent from Australia to California as early as 1870. The latter three introductions may, in the author's opinion, have been different strains of the Bahia from Brazil specifically but not the Washington navel which was introduced and named as described in the following account. The reason for this opinion is that the performance of these previous introductions (Australia, 1824; Florida, 1835; California from Australia, 1870) of the Bahia navel is reported (Hodgson, 1967) to have not equaled the quality of the later introduction (California from Washington, 1870) of the Bahia into California which was given the name Washington navel. One could also speculate that the original Washington navel was a superior strain of the Bahia navel. It was propagated from only two of the three original Tibbets trees. One of the original three trees had died.

The Washington navel orange has a number of budlines or strains which vary throughout citrus growing areas of the world. In California these can be separated into three groups as to time of maturity: early, midseason, and late. Early maturing strains are Skagg's Bonanza, Tulegold, Fisher, Atwood, Thompson, Beck, Newhall, and Fukumoto. Popular mid-season strains (same season as old-line Washington navel) are Frost nucellar and Parent. The most popular late maturing strain currently is the Lane Late. Several other late navel strains are being tested.. The Cara Cara navel is a pink-fleshed strain that is being grown to a limited extent in both California and Florida. Its fruit mature mid-season. Prices thus far have been very good for this variety. A number of other named budlines may be available in California. Many are being tested by the University of California. Local recommendations as to the performance of these and the above-mentioned strains should be investigated before deciding to plant them. Farm and Home Advisors' offices in major citrus producing counties of California often have this type of information available.

The Washington navel orange has a narrower climatic range of adaptation than the Valencia orange. Areas of best growth and production in California are the San Joaquin Valley and Southern California intermediate areas. Navels do not perform well for commercial production in cool summer, mild winter coastal areas nor in hot summer desert areas. Fruit grown in coastal areas suffer from poor color development (due to mild winters), delayed maturity, thicker rinds and lessened peelability. Backyard plantings in sheltered areas may be adequate, however. Navels grown in the desert have low yields, low acidity, and less than optimum flavor.

The navel harvest periods in California are November to May in the San Joaquin Valley and mid-December to May in Southern California intermediate areas.

There were 112,589 bearing and 2,895 nonbearing acres of navel oranges in California in 2020 (Anonymous, 2020). Bearing acreage has remained stable since 1992. 25% of the navel crop was processed in 2019 (Anonymous, 2019a). Although the juice can turn bitter, a new debittering process was patented by Sunkist Growers, Inc. on December 10, 1957(<https://patents.google.com/patent/US28160en33A/>).

The navel is an excellent fresh eating orange and the juice is also excellent if immediately consumed after extraction but will develop a bitter taste if stored in any manner (fresh or frozen). For this reason the juice is not highly valued for commercial marketing. Juicing grade navel fruit, however, are still processed for juice and byproducts in the same manner as are the same grade of Valencia fruit. The bitter juice may be blended with other varieties used for other citrus products or marketed in areas (domestic or foreign) where the bitter taste is not objectionable. It has been said that consumers in England do not object to the bitter taste in stored navel orange juice. It should be noted that a debittering process has been developed for navel orange juice. Commercial implementation of the process could conceivably make navel orange juice of greater value in U.S. and world markets.

The Washington navel orange tree has been known to be weaker and less productive than that of the Valencia orange, however, some of the newer strains may be comparable to the Valencia in productivity. The tree is medium in size and vigor. The navel fruit is unexcelled as a dessert (fresh eating) orange, having a rich flavor with abundant juice. The fruit are large (with normal crops), can develop a deep orange color, are seedless, and peel and segment well. The navel orange has more consistent medium to large fruit size and production than the Valencia orange because it has less of an alternate bearing tendency. The rind is medium-thick, somewhat coarsely pitted, moderately pebbled, and somewhat tender. The fruit store and ship well. Mature fruit can be stored on the tree for several months. This is the preferred long-term storage method since it is more economical than long-term refrigerated storage. The fruit contains a secondary fruit (the navel) on the blossom end. This sometimes protrudes or causes the apex to slightly protrude in some fruit both of which can..make fruit unsightly or misshapen.. These fruit would be culled for processing.. Splitting of the rind near the edge of the navel may occur in some fruit which also may call for culling.

The California Washington navel orange yield per acre from 2018 to 2020 ranged from a low of 304 boxes (75 lbs.) to a high of 379 boxes (Anonymous, 2020).

MINOR SWEET ORANGE CULTIVARS

Blood Oranges • These are orange cultivars whose fruit are capable of developing a deep red flesh color and a reddish coloration of the rind. They are grown primarily for backyard use in California and the United States and only to a very limited extent commercially. There were 858 bearing, 93 nonbearing, acres in California in 2020 (Anonymous, 2020). New acreage planted consisted entirely of the Moro cultivar. They are commercially grown more extensively in Mediterranean and other citrus regions (Italy, Spain, Algeria, Morocco, Tunisia) where they are in greater demand by consumers more accustomed to seeing them with their peculiar color in the marketplace. They are well received in European markets. Consistently red flesh and rind color may be obtained primarily in the San Joaquin valley and desert areas of California. Both relatively hot summers and cold winters are needed for these fruit to develop this color. Flesh and rind color may be poor or absent in cool summer, mild winter or coastal climates and in other mild winter climates such as Florida.

Another problem with blood oranges is the development of an unattractive juice color because of deterioration of the anthocyanin pigment which gives the peel and flesh their red color. This does not seem to have discouraged their use in retail fresh citrus juicing machines which the author has observed in Sicily.

Moro • Medium to medium-large fruit size, orange-colored at maturity with light pink blush or red streaks at advanced maturity, deep red flesh in favorable climate with a high percentage of fruit dark-blooded; seeds few or none, purplish and red chalazal spot, juicy, pleasant flavor, very early maturity, holds well on tree, stores and ships well; tree of medium size and vigor, spreading, very productive, fruit in clusters. Probably the best cultivar for a high percentage and earliness of internal color. It has a high percentage of dark-blooded fruit at Exeter, California. It develops blood coloration even on the California coast.

Moro blood orange:

(<https://www.naturehills.com/media/catalog/product/cache/429326693ee8b1c5f8feef3778eb2ea4/m/o/moro-blood-orange-bulk--600x600.jpg>)



Tarocco • Medium-large to large fruit, rind medium to medium-thick, moderately adherent, finely to moderately pebbled, yellowish-orange, blushed with red at full maturity, flesh usually well-colored in favorable climate, seeds few or none, purplish-red chalazal spot, juicy, rich-flavored, mid-season maturity, loses quality and drops if left on tree, ships and stores well, tree medium-sized, moderately vigorous, irregular shaped, open, sensitive to wind and neglect, moderately productive.

Tarocco blood orange:

(https://search.aol.com/aol/search?q=moro%20blood%20orange%20trees%20for%20sale&s_it=loki-tb-sb)



Tarocco is a leading deep blood orange cultivar of Italy. The flesh of the Tarocco seedling budline is usually well-pigmented in California. It rarely develops blood coloration on the California coast unless there is a cold winter.

Sanguinello Comune • Medium-sized fruit, rind medium-thick, moderately adherent, moderately to strongly pebbled, orange-colored with some red at maturity, seeds few or none, flesh deep red at maturity, juicy, pleasant flavor, midseason, stores and ships moderately well, tree medium-sized, medium vigor, productive.

It is an old Italian cultivar and was one of the most important in Sicily for many years (Hodgson, 1967).

Sanguinello Moscato • Medium-large fruit, rind medium-thick, somewhat pebbled, moderately adherent, orange-colored, apical portion very red-blushed, seeds few or none, flesh usually well blood-colored, very juicy, very good flavor (aromatic), midseason, holds well on tree, ships well, tree large and symmetrical, vigorous, very productive, most of crop borne inside which favors protection from cold and sunburn and makes for more uniform color.

It has been a leading light blood orange of Italy. It is thought to be a superior subvariety of Sanguinello Comune which caused it for many years to be the principal cultivar in the Mount Etna region of Sicily (Hodgson, 1967). It is called the Paterno orange in the export trade since it has been grown extensively near Paterno, Sicily. It probably has too light of a flesh color for California (faint to light at Exeter for the Sanguinello, a Pignuseedling budline).

Sanguinelli:

(<https://www.naturehills.com/media/catalog/product/cache/a2e04e62f34cd497d476f102801b665f/s/a/sanguinelli-blood-orange-425x425.jpg>)

Sanguinelli (Spanish Sanguinelli)

Small to medium-sized fruit, deep red color, seeds few or none, purplish-red chalazal spot, flesh orange streaked with deep red, juicy, very good flavor, late mid-season, holds well on tree, stores and ships well, tree small to medium, almost thornless, light green foliage, productive, bears fruit on outside of tree.

It has been the leading deep blood orange cultivar in Spain. It originated as a limb sport of the Spanish cultivar, Doublefina, which it replaced because of its better color and flavor (Hodgson, 1967).



Ruby (Ruby Blood) • Medium-sized fruit, rind medium-thick, finely pitted, lightly pebbled, with reddish blush under favorable conditions, seeds few, flesh orange streaked with red under favorable conditions, tender, juicy, rich flavor, mid-season, tree medium-large, compact, moderately vigorous, productive.

This cultivar was introduced from the Mediterranean (possibly Italy) to Florida in approximately 1880 and to California soon thereafter (Hodgson, 1967). It is very variable in its blood coloration in both California and Florida. It never develops blood coloration on the California coast and develops best color, however, variable, and excellent quality in hot interior areas. A number of budlines have existed which differ in blood coloration development. The Ruby nucellar budline has exhibited highly uncertain blood coloration at Exeter, California.

Other Sweet Orange Cultivars • All of these are either not grown commercially to any extent in California or are grown to a limited extent but may be available for backyard or trial commercial use, but possibly in other states.

Cara Cara

Lane Late

Diller

Hamlin

Marrs (Marrs Early)

California Mediterranean Sweet

Parson Brown (Parson)

Pineapple

Robertson navel

Seedless Valencia Shamouti

Summer navel (Workman)

Trovita

Zimmerman

Cara Cara navel. This variety is the first pink-fleshed navel (Lang and Eyre, 1996; Walheim, 1996). It originated from a bud mutation (limb sport) on a Washington navel tree in Venezuela. It was introduced in Florida in 1987 and several years later in California. It is being grown commercially to a limited extent in both California and Florida. Prices have been very good thus far.

Cara Cara red navel orange fruit:

https://cdn.shopify.com/s/files/1/0062/8532/8445/products/orange-cara-cara-1-400_1024x1024.jpg?v=1547663105



Cara Cara:

The flesh is reddish-pink with a dark orange rind, medium-sized with a small navel, and usually seedless. Flavor is similar to Washington navel as is the maturity season. Fruit hold well on the tree but color may fade. Fruit from some limbs may be normal orange-colored. Color does not develop well near the coast.

The tree is small to medium in size. Lightly variegated leaves occur on some trees.

There were 7,041 bearing acres of Cara Cara and 1241 nonbearing acres in California in 2020.

Cara Cara tree:

<https://bloximages.newyork1.vip.townnews.com/victoriaadvocate.com/content/tncms/assets/v3/editorial/5/9f/59f66f70-1ff7-11e9-a00e-3f6d75d5448b/5c49eb7bca566.image.jpg?resize=1200%2C800>



The Lane Late navel orange. It was discovered in Australia in 1950 and is named for the tree's owner.

Lane Late navel orange, is a late maturing bud sport of Washington navel orange, and was the first of a number of late maturing Australian navel orange bud sport selections of Washington navel imported into California. The tree characteristics are very similar to those of Washington navel orange. The fruit is of similar size and shape, but it has a smoother peel and a slightly smaller navel. The fruit matures four to six week later than the Washington navel orange and stores on the tree for several months after reaching maturity before the quality deteriorates (<https://citrusvariety.ucr.edu/citrus/lanelate.html>).” It is available from the California Citrus Clonal Protection Program.

Photos: <https://www.naturehills.com/orange-lane-late-citrus>



Other late season navel oranges available in California are:
https://citrusvariety.ucr.edu/citrus/late_navels.html

Autumn Gold navel orange

Barnfield navel orange

Chislett navel orange

Powell navel orange- no longer available in California.

Rohde navel orange- no longer available in California.

Wiffen navel orange

**All six are being evaluated by the California Citrus
Nursery Society since 1997.**

**"New late-season navel orange varieties evaluated
for quality characteristics".**

California Agriculture. 2007.

Kahn, T., Bier O., Beaver, R. Volume 61, Number 3.

**There were 18,616 bearing acres, 72 nonbearing acres of
late navel varieties in 2020 in California.**

Other/sweet/orange/cultivars:

Diller • Small to medium fruit, a few seeds, bright orange rind, well-colored flesh, rind medium thick, moderately pebbled, juicy, good flavor, early maturing, tree moderately vigorous, productive in the desert, above average in cold hardiness.

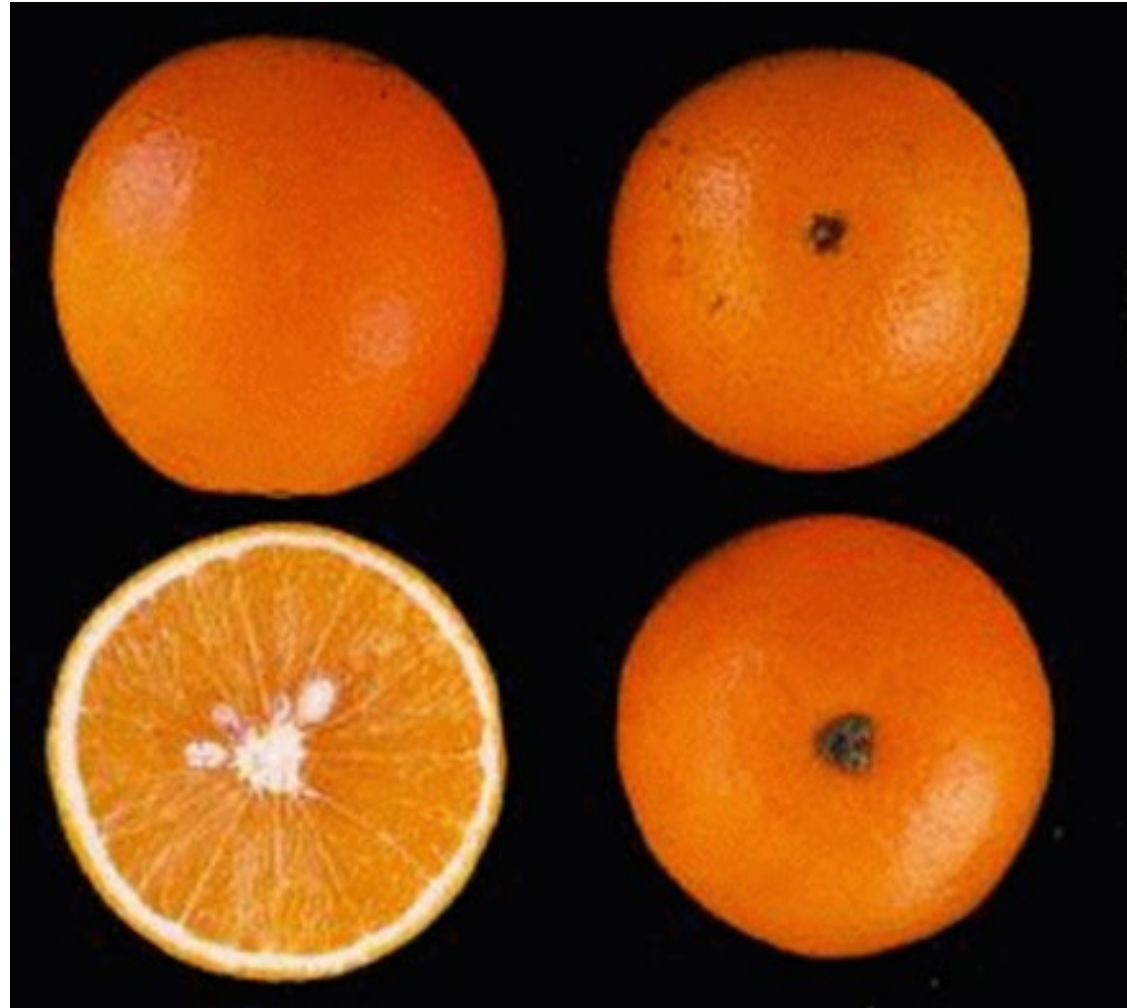
An important Arizona cultivar in the Salt River Valley, originated as a seedling from Florida in the Phoenix orchard of Daniel Diller (Hodgson, 1967). Selected 1910 introduced 1920. See <https://citrusvariety.ucr.edu/citrus/dillar.html> for photos. Season January to March in Riverside, Ca.

Hamlin (Norris) • Medium-small fruit, seeds very few or none, well-colored rind, thin rind smooth, finely pitted, flesh well-colored, tender, juicy, low acidity, sweet, very early maturity, tree medium-large, moderately vigorous, productive, more cold hardy than most. Harvest October to January in Florida.

It is the leading early maturing orange cultivar in Florida and also important in Arizona, Brazil and somewhat in South Africa. It originated as a chance seedling in A. G. Hamlin's orchard near DeLand, Florida, which was planted in 1879 by Judge Isaac Stone, the previous owner (Jackson, 1991). Produces fruit of acceptable fresh market size in hot, humid semi tropical climates but of disappointing eating quality. Fruit size is smaller in arid, subtropical climates, but quality is acceptable.

Hamlin (Norris) orange:

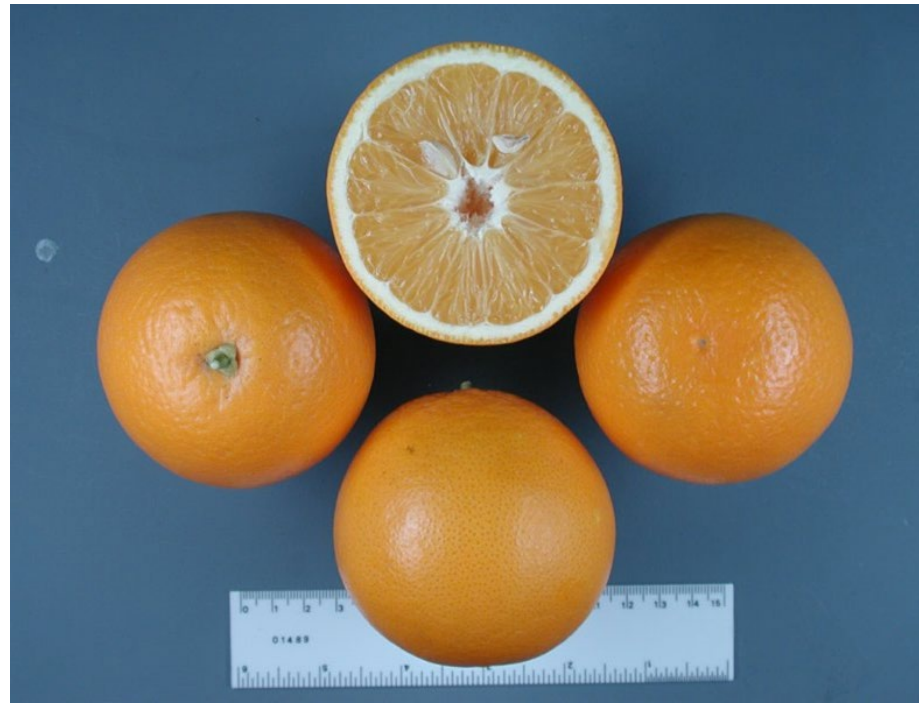
(Ultimatecitrus.com photo.)



Marrs (Marrs Early) • Medium-large fruit, moderately seedy, well-colored rind, medium thick rind, smooth, finely pitted, well-colored flesh, juicy, low acidity, sweet, holds on tree well, very early maturity, small tree, vigorous, productive, bears fruit in clusters.

It is an important early maturing fresh market cultivar in Texas. In California it is slightly earlier than the Parent and Frost navel strains but later than Fisher. It is poor for processing because of low acidity. It was discovered in 1927 as a navel orange limb sport on the property of O. F. Marrs, Donna, Texas (Hodgson, 1967). It has potential as an early juice cultivar, particularly for home use.

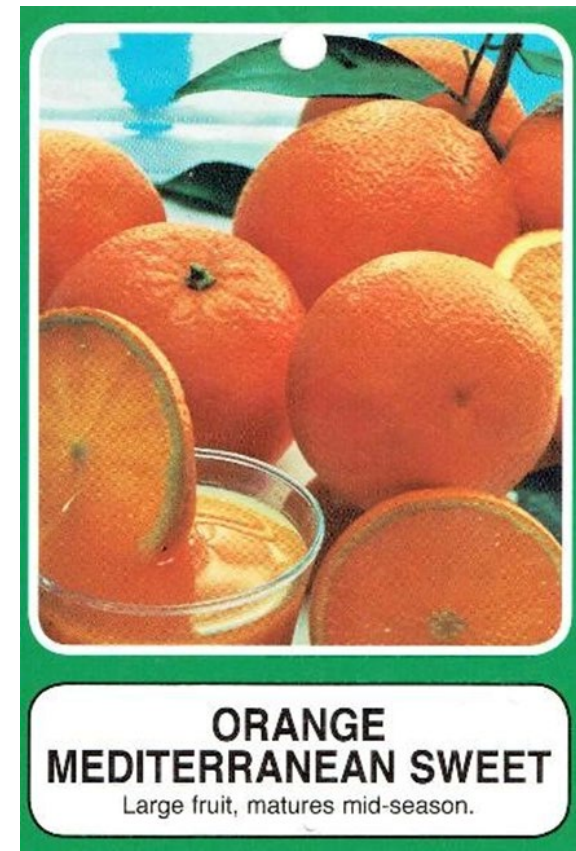
([Marrs aggie-horticulture.tamu.edu](http://Marrs.aggie-horticulture.tamu.edu) photo):



(California) Mediterranean Sweet (Maltaise Ovale, Maltese Oval, Garey's Mediterranean Sweet) • It is an old Mediterranean cultivar which was introduced into California about 1870 by T. A. Garey (Hodgson, 1967). It was an important midseason cultivar, maturing after the Washington navel but before the Valencia, until California navel and Valencia orange acreage expanded into areas of differing times of maturity. It was also grown in Florida under the name Maltese Oval, but it is not the same as the Mediterranean Sweet later introduced into Florida. It was also important as a midseason cultivar in South Africa.

Medium-sized fruit, few seeds, pale rind color, some regreening tendency, medium-thick rind, somewhat pebbled, easy to peel, flesh, moderately juicy, mild flavor, medium-late maturity, large, vigorous, spreading, drooping, somewhat pale color of leaves; long, narrow leaves.

<https://www.blericktreefarm.com.au/product/orange-mediterranean-sweet/> photo:

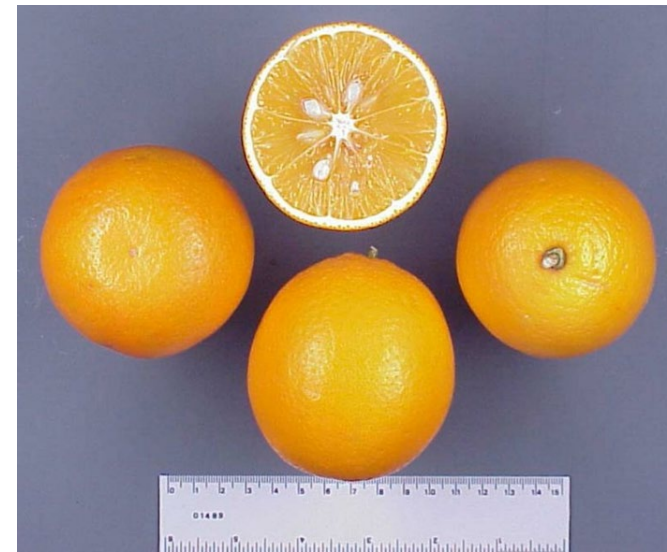


**ORANGE
MEDITERRANEAN SWEET**
Large fruit, matures mid-season.

Parson Brown (Parson) • It is an important early cultivar in Florida but not elsewhere because it is moderately seedy. It originated as a chance dooryard seedling of Reverend N. L. Brown near Webster, Florida, and was planted in 1856 (Hodgson, 1967). It was the leading early cultivar in Florida until 1920 after which Hamlin replaced it because it was seedless and not seedy as was the Parson Brown (Jackson, 1991).

It has been observed to produce adequate crops but with an alternate bearing tendency near Exeter, California. Flavor and color were good with peak maturity in February. It is probably too seedy for the California commercial fresh market.

Medium-large fruit, moderately seedy, well-colored rind, medium-thick rind, finely pitted, moderately pebbled, dull orange flesh, firm, juicy, good flavor, very early maturity, large tree, vigorous, productive. Parson brown orange photo: (aggie-horticulture.tamu.edu)



Pineapple • This is the major mid-season orange cultivar in Florida, and also has been important in Arizona, Brazil and South Africa. It originated as a seedling from seeds planted about 1860 on the property of J.B. Owens at Sparr, near Ocala, Florida (Hodgson, 1967; Jackson, 1991).

Medium-sized fruit, moderately seedy, well-colored rind, medium-thick rind, finely pitted, slightly pebbled, light orange flesh, tender, juicy, rich flavor, sweet, mid-season, limited on tree storage life, excellent for processing, tree medium-large, vigorous, thornless, very productive, relatively frost sensitive. **Pineapple orange fruit photo:** www.onlyfoods.net and on tree floridaprolific.wordpress.com



Robertson Navel • This navel cultivar is popular primarily as a dooryard or container-grown patio tree in California because of its small tree size, early maturity (ten days to two weeks before Washington), and heavy production. It was discovered by Roy Robertson in 1925 as a limb sport in an old Washington navel tree near Redlands, California (Hodgson, 1967). The fruit are similar to Washington navel except for medium-large (not large) size, earlier maturity, slightly lower quality, and are borne in tight clusters which distort the shape by causing flat areas. The tree is small lacking in vigor, heat resistant (young fruits develop more rapidly thus avoid potential later hot and dry weather which could cause severe dropping during fruit set), and very productive. Fruit on tree: www.fast-growing-trees.com and fruit: www.fourwindsgrowers.com



Seedless Valencia• This cultivar is an Australian bud sport of Valencia that sometimes may be found growing backyard in California and formerly was in limited commercial production in Australia. It was discovered between 1920 and 1925 at North Richmond, New South Wales, Australia, in the orchard of W. Eathers (Hodgson, 1967).

The fruit are less seedy (usually zero, sometimes one or two), mature earlier, and are more oval than Valencia. The tree is upright, vigorous, and strongly alternate bearing. Fruit on tree: (www.virginianurseries.com.au) and fruit (idiggreenacres.com)



Shamouti (Palestine Jaffa, Jaffa)• It is the principal cultivar of the eastern Mediterranean. It is the leading cultivar in Israel and Syria, also important in Lebanon, Turkey, and Cyprus, and grown somewhat in Greece and Egypt. It is much exported to Europe, especially England, where it is highly esteemed for its quality, seedlessness, and size. It originated prior to 1844 as a limb sport in an orchard tree of the local seedling or "beledi" variety near Jaffa, Palestine (Israel) (Hodgson, 1967). The tree is sensitive to heat and dryness during bloom (as is the Washington navel), thus is not adapted to hot desert or semitropical climates since production would be low. It has been available for backyard use in California, particularly for areas where the Washington navel is adapted. Its primary drawbacks causing its lack of consideration for California commercial .production have been inferior quality and productivity compared to other cultivars (Hodgson, 1967). It appears to develop and excessively thick tough rind in trees of Shamouti seedling No. 1 budline near Exeter, California, but quality, otherwise, is adequate.

The fruit is medium-large to large, nearly seedless or seedless, well-colored, thick rind, tough, leathery, finely pitted, smooth, easy to peel and section, flesh light orange, firm, tender, juicy, fragrant, sweet, ships and stores extremely well, does not process well, midseason, tree upright, moderately vigorous, thornless, leaves large and wide with small wings, somewhat dwarfed and regularly productive on Palestine sweet lime rootstock, but larger and less productive with alternate bearing tendency on sour orange rootstock, prone to the occurrence of limb sports.

Shamouti orange fruit.

<https://arabamericantribe.files.wordpress.com/2015/10/1306768360351.jpg>



Summer Navel (Workman) • It is a budsport found in the orchard of J. A. Workman at Riverside, California, about 1934 (Hodgson, 1967). It is similar to the Washington navel except the rind is thicker and rougher and the fruit matures much later and holds on the tree very well. The tree is more vigorous, low, and spreading and has larger leaves and russet brown twigs. It has been utilized primarily for home plantings in California. Summer navel orange tree: (www.picamonfruits.com) and fruit (chislettfarms.com.au)



Trovita • It is believed to be a seedling of a fallen Washington navel fruit discovered at the Citrus Research Center, Riverside, California, in 1916 and released in 1935. The fruit is smaller (medium-small), juicier, and of milder flavor (but pleasant) than the Washington navel. The fruit matures early (as the navel) and has only a few seeds. The tree is more productive in the desert than the navel, but also does well near the coast. The tree is upright growing, vigorous and productive, but with an alternate bearing tendency. It has been utilized primarily for backyard planting in California. It has potential as an early juice cultivar, at least for home use.

Trovita bloom and fruit:

(www.flickr.com)



Zimmerman • There were 117 bearing and 215 nonbearing acres of this orange cultivar in California in 1992 (Tippett, 1993a). It is of minor importance.

**CHAPTER V *Citrus limon* Burmann (The Lemon) and other Lemon-like Fruit Hardy to 25 degrees F. (McNeil, 2001).
The Cal PolySLO Lemon Orchard, 10.9 acres of Lisbon lemons (Limoneira8A) on Carrizo, Macrophylla, C-35 rootstocks. Double density 12.5 x 25 feet (McNeil, 2020). 1518 trees. Two wind machines for frost protection.**



The Lemon (*Citrus limon* Burmann) The lemon tree is much more cold sensitive (25 degrees F. when dormant)(McNeil, 2001) than the other major citrus fruits (orange, grapefruit, mandarin), thus its commercial production is limited to mild winter areas of subtropical regions. It is, however, more resistant to cold than the lime and citron. The trees have an ever-blooming tendency which is perpetuated in mild winter, cool summer growing areas. Harvestable fruit will be available all year long in such areas making for more efficient marketing as demand requires and lessening the need for the expense of long-term refrigerated storage. The majority of the crop matures and is harvested during the late spring and summer in these mild subtropical areas at which time prices are relatively high. Relatively green fruit are placed in long-term 50-60°F storage rooms for later marketing during lighter crop periods such as late summer and early fall.

The primary commercial lemon growing areas of the world are in coastal areas of southern California and in the leading Mediterranean areas (Spain, Sicily, Greece). On the other hand the bloom in colder winter, hotter summer interior areas, such as the San Joaquin valley of California, occurs primarily in the spring which causes most of the crop to mature and be harvested in the fall and winter when prices are relatively low and longer, more expensive storage would be required to extend the marketing season into the spring and summer months. The use of gibberellic acid to delay maturity of these winter fruit may be advisable to have them mature later when prices are higher. The Verdelli method of withholding irrigation water to induce a second, more valuable crop of lemons that matures in summer has been tested with some success in the San Joaquin valley of California and should also be considered. It has been utilized in Sicily for many years.

Lemons are grown very little in tropical and semitropical areas because of the severity of rind diseases, too large a fruit size in relation to fresh market demand, and storage would be difficult and expensive (Hodgson, 1967). Florida has very little, other than local, lemon production primarily because of the greater freezing hazard for lemons than oranges which reduces the areas suitable for lemons (Jackson, 1991). The freeze of 1977 and several freezes in the 1980's reduced Florida lemon acreage from 10,000 acres to less than 1,300 acres (Jackson, 1991).

Most of the commercial lemon production in the United States is in California and Arizona. California had 42,928 bearing, and 5,730 nonbearing acres of lemons in 2020 (Anonymous, 2020). 37.2% of the California lemon crop was processed in 2019 (Anonymous, 2019a).

Specialized harvesting, handling, and storage methods that have been developed for lemons in California and which have aided the success of better coordination of the supply of mature lemons with market demand are as follows (Hodgson, 1967):

1. Harvesting by fruit size. Lemons are harvested from two to five times per season. At a given harvest all fruit that have reached a specified (based on demand for certain sizes) minimum steel ring size are picked. Many of these fruit are still green and of high acid and thereby will have maximum storage life.

2. Color sorting of fruit (maturity grading). Four or five color grades are separated by electronic eye: yellow (tree-ripe), yellowish green (silver), light green, and dark green. The yellow fruit will store for only a few weeks so it is either packed right away or processed. The greenest fruit will store at 50 to 60°F and 75-85% relative humidity for up to five or six months, while the yellowish-green and light green will store somewhere in between, perhaps one or two months for yellowish-green, and three or four months for light green.

3. Curing and coloring of fruit prior to packing: Curing conditions include storage at 50 to 60°F and 75 to 85% relative humidity. Under these conditions the rind loses moisture, becomes thinner, tough and leathery and thereby more resistant to handling injuries which will allow for better storage and success of long distance shipments. The fruit will turn yellow during these curing conditions. Rapid curing and coloring of green fruit can be accomplished (as the market demands) by increasing to a specific temperature and injecting ethylene gas (at certain concentrations) into the storage rooms. This process is termed "sweating."

4. Long-term storage. Green fruit can be stored at 50° to 60°F and 75 to 85% relative humidity for up to five or six months as the market demands. Fungicides and waxing of fruit will be utilized to prevent rot and excessive moisture loss, respectively. Yellow fruit is brought out of storage first and packed. As mentioned above, "sweating" can be used to accelerate curing and coloring of fruit in storage as the market demands.

The lemon is primarily used as a fresh fruit, however, the use of lemon juice is also important. The primary byproducts obtained from the fruit are lemon oil and pectin from the rind and citric acid from the juice. Fresh lemon fruit production is the primary and more profitable emphasis in California. Returns from processing rarely equal or exceed the costs of production of the fruit. Processing grade fruit (that which is too small, too large, or excessively scarred but not decayed), however, is juiced and extracted for byproducts to earn growers a few extra pennies. The California lemon yield from 2018 to 2020 ranged from a low of 451 boxes (80 lb) to a high of 514 boxes per acre (Anonymous, 2020).

Selected characteristics that the true lemons have in common are the following (adapted after Swingle and Reece, 1967):

- 1. Tree medium to large, vigorous, upright-spreading, open, usually with short, slender thorns. Hardy to 25 degrees F. (McNeil, 2001).**
- 2. New growth and flower buds purplish.**
- 3. Leaves pale green, large, ovate, pointed at the tip, margins serrated.**
- 4. Petiole wings minute, articulated with the blade.**
- 5. Petals white above, purplish below, stamens numerous 20-40.**
- 6. Flowers single, or in clusters, occur throughout the year.**
- 7. Fruit oval with a broad apical mammilla (nipple), 8-10 straw-colored segments, acid.**
- 8. Peel yellow when ripe, moderately thick, tightly adherent and dotted, fragrant.**
- 9. Seeds small, ovoid, pointed, smooth, white inside.**

There are two principal lemon cultivars grown in California, the Eureka and the Lisbon. They are not marketed by name but as lemons since their fruit are usually indistinguishable especially to the consumer as are most other commercial lemons, even those grown in the Mediterranean. The Eureka has been the most widely grown over the years, however, the Lisbon has become increasingly more widely grown. In fact, its acreage almost equalled that of Eureka in 1992.

Eureka matures most of its fruit later and over a longer period (most in late winter, spring, and early summer) which gives it a market advantage over Lisbon which matures most of its fruit earlier and over a shorter time span (winter and early spring) at which time prices are relatively low. Green fruit of both cultivars, however, can be placed in long-term storage to extend the season for later marketing. The Eureka tree and fruit are more cold sensitive and recommended for relatively frost-free areas such as southern California coastal areas. The Lisbon tree and fruit are more cold resistant so it is recommended for all citrus growing areas in California.

There are two natural groups of true lemons with respect to their fruit characteristics (Hodgson, 1967): 1) the common or acid lemons, and 2) the sweet or low-acid lemons. Both the acid and sweet groups have similar tree characteristics such as purple flower buds, purple new growth and purple chalazal spots on the seeds. The acid lemons are the principal commercial types with many commercial cultivars such as the Eureka and Lisbon of the United States (California), the Berna of Spain, and the Femminello Ovale of Italy. Hodgson (1967) notes only one named cultivar of the true sweet lemon, the Dorshapo, which has been grown under the name of *citron doux* in Tunisia and probably locally grown in other Mediterranean countries.

Acid Lemon Cultivars Grown in California:

Eureka• This is one of the two major lemon cultivars grown commercially in California. It also is a major cultivar in most important lemon-growing countries except some of the Mediterranean areas such as Spain and Italy. The fruit differ from Lisbon fruit by being smaller (medium-small), more prominently ridged, with a slightly rougher rind and a smaller and less pronounced nipple (rounder) and neck. These fruit differences may not be obvious since they may vary more between different growing area climates or different blooms than between cultivars.

Eureka lemon:

https://i.etsystatic.com/24068242/r/il/8a82a9/2510366509/il_794xN.2510366509_r7m1.jpg

Eureka lemon trees are less vigorous (medium vigor) than Lisbon, spreading, less thorny (virtually thornless), smaller (medium-sized), less densely foliated (more open), less insect, cold and heat resistant, less productive, more everbearing, leaves are darker in color and less sharply pointed, and are somewhat more crenate (having rounded serrations), and bear fruit more on the outside of the tree on the tips of branches where it is subject to sunburn, wind, and frost damage. The Eureka tree is more neglect-sensitive and shorter-lived due to its susceptibility to shell bark and dry bark diseases (except the Frost nucellar and other strains) and sieve tube necrosis (except for certain strains).



Other Eureka characteristics are seeds few to none, yellow color at maturity, medium-thick rind, surface finely pitted with sunken oil glands, rind tightly adherent, slightly rough, about 10 segments, core small and usually solid, flesh color greenish-yellow, tender, juicy, highly acid flavor, productive. The Eureka cultivar originated in Los Angeles, California, from a group of seedlings planted in 1858. The seeds were said to be from fruit of Italian origin and possibly related to the Lunario cultivar (Russo, 1955). Thomas A. Garey, a Los Angeles nurseryman, propagated it in 1877 and later introduced it as Garey's Eureka (Hodgson, 1967).

It is difficult to make recommendations about which Eureka budlines or strains are best to grow since their performance varies from area to area. Local recommendations, such as from County Farm Advisors (University of California Cooperative Extension Service) in each county would be best. Some of the more popular Eureka budlines in California have been as follows (Burns, 1975): Allen nucellar, Cascade nucellar, Cook nucellar, Frost nucellar, UCLA nucellar. All of these have been originally produced through nucellar seedlings, thus are superior in vigor and production to old line Eureka selections which are no longer planted (Anonymous, 1977). The Frost nucellar Eureka has been reported to be prone to sieve-tube necrosis (Anonymous, 1977), as other Eureka budlines may be in general, but it may be productive in many commercial plantings.

Lisbon lemon • This is the other major lemon cultivar grown commercially in California and also important in some other countries. It has been increasingly popular in the last few decades because of its vigor, hardiness, and high productivity and now has acreage almost equalling that of Eureka in California. Lisbon lemon: ([LEMON-Lisbon-Lemon-Citrus-limon/264678922345?hash=item3da017d869:g:FwwAAOSwgcgNZDijv](https://www.lemontrees.com/264678922345?hash=item3da017d869:g:FwwAAOSwgcgNZDijv))

Lisbonlemon trees (Limoneira 8A) at CalPoly SLO (McNeil, 2020). Planted 1996.



The Lisbon fruit are smoother and less ribbed than Eureka, with a more prominent nipple; and a more gradual taper. They are medium-sized, with few to no seeds, medium-thick rind, finely pitted, tightly adherent, yellow at maturity, about ten segments, core small and solid, flesh pale greenish-yellow, fine-grained, tender, juicy, very acid.

The tree is larger than Eureka, more thorny, denser, more vigorous, has more pointed and lighter green leaves, and is more cold hardy. It is upright-spreading, highly productive, and bears fruit more inside the canopy. It is relatively resistant to adverse conditions such as frost, heat, wind and neglect.

The Lisbon cultivar is believed to be a selection of the Gallego seedling clonal group in Portugal, but is not known by the name Lisbon in Portugal. It was brought from Massachusetts to California about 1849 by J. L. L. F. Warren. Two other introductions into California, both from Australia, were in 1874 by S. P. Stowe and 1875 by J. W. North of Riverside. Nurserymen Thomas A. Garey of Los Angeles and D. N. Burnham, respectively, gained access to the latter two introductions (Hodgson, 1967).

Popular Lisbon budlines have been Limoneira 8A, Monroe nucellar, Prior 14-18 (inland only), Dr. Strong, and Rosenberger (Burns, 1975). The Frost nucellar Lisbon is no longer recommended because of its susceptibility to sieve-tube necrosis (Burns, 1975). Local budline recommendations such as from County Farm Advisors (University of California Cooperative Extension Service) are best when choosing.

Villafranca • This is a very minor cultivar in California and of little importance. Its fruit are very similar to Eureka, but with the crop mainly in winter like the Lisbon. The tree is similar to Lisbon but more open, less upright, not as thorny, and less densely foliated.

The Villafranca cultivar was introduced into Florida from Sicily by H. S. Sanford about 1875 and into California soon afterwards (Hodgson, 1967).

Certain budlines of Eureka and Lisbon, specifically, the Galligan and Rosenberger Lisbons and the Corona foothill and Ross Eureka, may in actuality be Villafranca selections (Hodgson, 1967).

Sweet or Low-acid Lemon Cultivars

Dorshapo • This cultivar was introduced by the U.S. Department of Agriculture from Brazil in 1914. It was named after those that introduced it, Dorsett, Shamel, and Popenoe (Hodgson, 1967). It is of minor importance in the United States but similar fruit are said to be of local importance in Tunisia, Morocco, Turkey, and possibly other Mediterranean countries.

Other Lemon-like Cultivars and Species

The Meyer Lemon, Improved Meyer Lemon (*Citrus meyeri* Tanaka)

• This is a dwarf, cold hardy (20 F., McNeil, 2001) lemon-like plant utilized primarily for backyard planting. The fruit are too tender to withstand the shipping, handling, and storage of commercial use plus they do not have the high acidity of true lemons which consumers desire. Commercial attempts have not gotten it established other than for local marketing, such as in Texas, Florida, South Africa, New Zealand and Algeria. Backyard use attributes are high productivity, dwarfness making it suitable for small spaces or for planter boxes, tubs, or pots; attractive dark green foliage and colorful, yellow-orange fruit almost year-round, and greater cold hardiness (about 20°F) than true lemon and lime trees.

Meyer lemon: Hardy to 20 F. (McNeil, 2001)

https://cdn.shopify.com/s/files/1/0059/8835/2052/products/Meyer_Lemon_Tree_4_FGT_99185240-0001-49ca-acbc-55885198b9fc_1024x1024.jpg?v=1599034996



Dwarf Meyer lemon tree:

(<https://www.starkbros.com/images/dynamic/2238.jpg>)



The Meyer lemon was found by Frank N. Meyer near Peking, China, where it was grown as a potted plant. He was a plant explorer for the U.S. Department of Agriculture. It was introduced in 1908 (Hodgson, 1967). Some people believe it may be a lemon hybrid with orange or mandarin being that it exhibits less acidity, rounder shape, and more cold hardiness than lemon and it has some orange color of the rind and flesh.

A serious problem associated with Meyer lemon has been that it is a symptomless carrier of the tristeza (quick decline) virus of citrus which can severely weaken citrus trees or even kill trees especially if they are on sour orange rootstock.. For this reason only the Improved Meyer lemon can legally be propagated and sold in California and is subject to other quarantine regulations and procedures.

Other Meyer lemon characteristics are as follows (Hodgson, 1967): medium-sized fruit, more rounded than true lemon, apex rounded or with low-broad nipple, thin rind, soft, very smooth, tightly adherent, lacking lemon aroma, color yellow-orange to orange, ten segments, core small and solid, flesh light orange-yellow, tender, very juicy, acid (but less so than true lemon), moderately seedy, crop year-round but mainly in winter, small to medium-sized tree, moderately vigorous, spreading, nearly thornless, hardy, productive, flowers and new shoots purplish, ever flowering, but mainly in spring.

**Ponderosa Lemon
(American-Wonder
Lemon or Wonder
Lemon)**

This is a dwarf tree with grapefruit-sized lemon-like fruit that can be used like a lemon. It is used as a backyard or potted patio plant and as an oddity or ornamental.

Ponderosa lemon: Hardy to mid 20's F. (McNeil, 2001). 26 degrees F. ?

<https://www.citrus.com/product/ponderosa-lemon-tree/>



It originated as a chance seedling grown by George Bowman of Hagerstown, Maryland, in 1887, and was named and introduced in 1900 (Hodgson, 1967). It is believed by some to be a hybrid between lemon and citron, presumably from seeds of Italian origin.

Other Ponderosa lemon characteristics are as follows (Hodgson, 1967): Medium-large fruit, obovoid, short neck, apex with low broad nipple, lemon-yellow color, seedy, monoembryonic, medium-thick rind, smooth surface, slightly bumpy, some ribbing, pale green flesh, juicy, acid, mature fruit year-round, small tree, thorny, large citron-like leaves, flowers and new growth purplish, ever flowering, less cold hardy than lemon but more than lime (26°F?), productive.

The author has noticed it has some imperfect flowers, some male, some female, but mostly perfect.

Rough Lemon (*Citrus jambhiri* Lush.) • This is a lemon-like fruit which has been important as a rootstock in many countries of the world, such as India, South Africa, Australia, Argentina, Brazil and the United States. It has particularly been useful as a stock on sandy soils in California but a serious drawback in its use has been susceptibility to foot rot (brown rot gummosis). It has been the principal stock in Florida, especially on the deep sandy soils of central Florida, however, the occurrence of blight on trees budded to it have restricted its recent use (Jackson, 1991). It is also the principal stock in India and South Africa (Jackson, 1991). It can be used as a lemon substitute but lacks the quality of true lemons being only moderately juicy and only of moderate acidity.

Rough lemon fruit: Tree hardy to 25 degrees F. Same as true lemons (Reuther et al, 1967, p 572)
Some say 29 degrees F. (McNeil, 2001)



The rough lemon is believed to be native to northeastern India and Pakistan and may still grow wild there (Hodgson, 1967; Swingle and Reece, 1967). It is believed to have been taken to southeast Africa by the Portuguese in the late 1400's or early 1500's and from there to Europe from which it may have reached the New World soon thereafter (Hodgson, 1967). No other specific information is available concerning its introduction into the United States. Webber (1943) believes it was introduced to the West Indies in the 1600's. Jackson (1991) believes it must have reached Florida in the early 1800's.

Other rough lemon characteristics are as follows (Hodgson, 1967): medium-sized fruit, usually oblate, broad nipple on apex, medium-thick rind, deeply pitted, rough or bumpy, sometimes ribbed, easy to peel, lemon-yellow to brownish-orange, ten segments, large, hollow core, flesh light yellow to pale orange, moderately juicy, moderately acid, many seeds, small, highly polyembryonic, cotyledons light green, year-round crop but mostly in winter, large vigorous tree, upright-spreading, very thorny, medium-small leaves, blunt pointed, light green, flowers small, purplish, ever flowering, but with most in spring and late summer, new growth purplish, cold hardiness similar to true lemons (25 F.)(Reuther et al, 1967, p 572).

Alemow or Colo (*Citrus macrophylla* Wester)• Hardy to 30 degrees F. (McNeil, 2001). This somewhat lemon-like fruit is chiefly important as a lemon rootstock in California, particularly because of its foot rot, salinity and boron tolerance. It is less cold tolerant than rough lemon, however. It has a dry, acid, bitter pulp which is considered to be inedible. It is believed to be native to the Island of Cebu in the Philippines (Hodgson, 1967) and has sometimes been cultivated there (Swingle and Reece, 1967).

Alemow:(<https://search.aol.com/aol/image; ylt=A0geKI5bK4dfSc8AJEdpCWWH; ylu=Y29sbwNiZjEEcG9zAzIEdnRpZAMEc2VjA3Nj?q=alemow&v t=loki-tb-sb#id=196&iurl=https%3A%2F%2Fw>)



Other alemow characteristics are as follows (Hodgson, 1967): medium-large fruit, oblong to obovate with a slight neck, often with prominent nipple, seedy, polyembryonic, medium thick rind (but thin in relation to fruit size), somewhat rough and bumpy (somewhat similar to Ponderosa lemon), adherent, greenish-yellow, flesh greenish-yellow, about 15 segments, low in juice, strongly acid, bitter core, large and solid; vigorous spreading tree, very thorny, leaves small to medium, pale green, blunt pointed, broadly winged petioles, new growth and flowers purplish. Hardy to 30 degrees (McNeil, 2001).

CHAPTER VI *Citrus paradisi* Macfadyen (The Grapefruit) Hardy to the low 20's F. (McNeil, 2001)

Ruby grapefruit:

([https://upload.wikimedia.org/wikipedia/commons/d/d0/Citrus paradisi %28Grapefruit%2C pink%29 white bg](https://upload.wikimedia.org/wikipedia/commons/d/d0/Citrus_paradisi_%28Grapefruit%2C_pink%29_white_bg))



Grapefruit on tree:

(<https://upload.wikimedia.org/wikipedia/commons/thumb/c/c2/Grapefruit.ebola.jpeg/800px-Grapefruit.ebola.jpeg>)



The grapefruit is believed to have originated in the West Indies as a possible natural hybrid or mutant of the pummelo (Hodgson, 1967). The first introduction into the United States was in Florida in 1823 by Count Odette Phillippe, a Frenchman who brought seeds or seedlings from the Bahama Islands or from Cuba and planted them near Safety Harbor on Tampa Bay (Ziegler and Wolfe, 1975; Hodgson, 1967).

The original name assigned to the grapefruit was the "forbidden fruit" in Barbados, West Indies, in 1750 (Webber, 1943). The species designation, *paradisi*, was based on this name and given in 1830 (Hodgson, 1967). The first known use of the term grapefruit occurred in Jamaica in 1814 and is thought to have been chosen either because the fruit were thought to taste somewhat like grapes or because the fruit occurred in small clusters as do grapes (Hodgson, 1967).

The first commercial grapefruit industry in the world began in Florida about 1885 because of increased demand for fruit from New York and Philadelphia where trial shipments had previously been made (Hodgson, 1967). With increased demand over the next few decades, the grapefruit industry first spread to California, Arizona, and Texas and later to other countries which were also to be major producers, such as Israel, Argentina, and South Africa. The West Indies (including Jamaica and Cuba) have also been major producers. Other but more limited producers would be Spain, Morocco, Australia, Algeria, and Cyprus.

The grapefruit tree exhibits a wide range of climatic adaptation, tolerating the extreme heat of the desert, but also having quite good cold tolerance (low 20's F.) (McNeil, 2001). The fruit, however, have a very high heat requirement, the highest of all citrus fruit, for acceptable fruit maturity. Their commercial culture, therefore, is restricted principally to hot desert, warm subtropical, and humid subtropical or tropical climates. Pink and red-fleshed grapefruit obtain best color in areas with hot summers. Cool, or even cold winters, are not necessary but can accentuate this color especially for the Pink Marsh and Red Marsh cultivars grown in California.

Grapefruit growing areas in California are Southern California deserts (Coachella and Imperial valleys), southern California intermediate areas (Riverside, interior San Diego County, and interior Ventura county), and the San Joaquin valley.

Grapefruit are harvested from November 10 to June 10 (mostly in winter and spring) in the southern California desert, April 15 to October 25 (mostly late spring and summer), in southern California intermediate areas, and March 15 to June 15 (mostly in spring) in the San Joaquin valley. Best quality would be in the desert, secondly in the San Joaquin valley, and lastly the intermediate areas. Quality in the intermediate areas is marginal, but harvest occurs at a time of good prices. Rind blemishes frequently develop in cold, damp-winter areas such as the San Joaquin valley. Best color for pink and red-fleshed grapefruit is in the San Joaquin valley, second best in the desert, and poor in intermediate areas.

Grapefruit in general have good on-tree storage of fruit (several months) and ship and store well. These favorable storage characteristics make for more orderly and economical marketing. Flesh color will fade on the tree if pink and red-fleshed cultivars are on-tree stored for too long.

Commercial production and marketing of grapefruit in California is oriented toward the fresh market. Good quality (color, flavor, and freedom from rind blemishes) and good-sized fruit must be produced to get good fresh market prices. Seedless fruit and that with deep pink or red flesh also are in greater demand and therefore, bring higher prices. The Marsh cultivar (White Marsh, Pink Marsh and Red Marsh) form the bulk of the California industry because of their seedlessness, good quality and production. Consumers favor the red-fleshed cultivars (such as the Red Marsh, which also has a red blush to the rind) over the white, thus there is more acreage of the Red Marsh than the White Marsh in California. The Pink Marsh acreage has gradually been replaced by the Red Marsh and other red-fleshed cultivars since they have deeper flesh color and have a red blush to the rind which the Pink Marsh does not have. All three of the Marsh cultivars have a similar taste since they are genetically the same other than their color differences which were formed by bud mutation.

Red-fleshed cultivars consisted of 5,778 reported bearing and 198 non-bearing acres, while other cultivars had 2250 bearing and 72 non-bearing acres. Acreage of grapefruit was 8,028 bearing and 109 nonbearing acres in 2020 (Anonymous, 2020), Bearing acreage has been down 54.9% since 1992 (Tippett, 1993a). Bearing acreage in 2020 consisted of 1491 acres of Rio Red, 791 acres of Ruby, 1152 acres of Ruby Red, 2343 acres of Star Ruby, and 2250 acres of other varieties (Anonymous, 2020). Pummelos and hybrids consisted of 1,029 bearing and 111 nonbearing acres in 2020 (Anonymous, 2020). Bearing pummelo acreage consisted of 563 acres of Chandler, 123 acres of Melogold, 289 acres of Oroblanco, and 143 acres of other varieties(Anonymous,2020). Grapefruit production in California is oriented toward the fresh market in order for growers to potentially make a profit. Returns from processing would never be profitable in California since they have always been much less than the total costs of production, harvesting, hauling and juicing. Juicing grade fruit such as that which is undersized or has excessive scarring will be processed in order to earn the growers a few extra pennies per carton. The three year percentage based on quantity of each use from 2018 through 2020 was a low of 61.2% fresh in 2019 and a high of 81.6 % fresh in 2020 (Anonymous, 2020).

The principal fresh uses for grapefruit are fresh halves or fresh juice for breakfast. Other fresh uses are in fruit salads or desserts. Principal processed products are canned juice (single strength) and canned segments. Principal byproducts of processing are essential oil and pectin, both obtained from the rind, and some seed oil (Hodgson,1967).

The California grapefruit yield from 2018 to 2020 was a minimum of 409 boxes and a maximum of 467 boxes per acre (Anonymous, 2020). 18.4% were processed in 2020 and38.1%in2019.

Characteristics that the grapefruit have in common are as follows (adapted from Swingle and Reece, 1967):

- 1. Large, round-topped tree; dense foliage. Hardy to low 20's F. (McNeil, 2001).**
- 2. Twigs angular when young.**
- 3. leaves (larger than sweet orange, smaller than pummelo),. ovate, blunt tipped; large wings on petioles (but smaller than those of pummelo) but not subcordate.**
- 4. Large flowers, single or in small clusters, calyx 5-lobed.**
- 5. Fruits large, 9-13 cm. diameter (but smaller than pummeios), pulp vesicles rather large, coherent, very juicy and tender fleshed; peel adherent, thicker than sweet orange but thinner than pummeio.**
- 6. Seeds smooth, white, polyembryonic, smaller than those of pummelo (not yellow, nor ridged as those of pummeio).**

CALIFORNIA GRAPEFRUIT CULTIVARS

Marsh (White Marsh, Marsh Seedless) This is the leading yellow-skinned, white-fleshed cultivar grown in California. It is also popular in Florida, Arizona, Texas and other countries such as Brazil and Australia (Rouse *et al*, 1988). Its medium-sized fruit, oblate to spherical, few to no seeds, pale to light yellow, medium-thin, very smooth, tough rind; white flesh, tender, very juicy, good flavor, holds very well on the tree, ships and stores well, late maturity, high heat requirement for acceptable fruit maturity; vigorous, spreading, large, productive tree (Hodgson, 1967).

Marsh Seedless grapefruit

<https://www.briteleaf.com/wp-content/uploads/2016/02/marsh-seedless-grapefruit.jpg>



It originated as a seedling planted about 1860 on a farm near Lakeland, Florida (Webber, 1943; Hodgson, 1967). It was first propagated and introduced by E. H. Tison of the Lakeland Nursery Company. It was named a few years later by C. M. Marsh who had become the owner of the latter nursery.

The Marsh was the first seedless grapefruit cultivar discovered and because of consumer demand for seedless fruit became extensively planted in Florida and other grapefruit growing areas of the United States and the world. It is still important, but in the last few decades has been surpassed in acreage in most of these areas (Jackson, 1991), by red fleshed cultivars such as the Red Marsh since consumer demand and prices are relatively high for the pigmented cultivars.

Popular Marsh Seedless budlines in California have been Brown old budline, Kelly old budline, Whitney old budline, Frost nucellar, Miami nucellar, and Reed seedling (Nauer *et al*, 1976). The Reed seedling has been the most popular budline and may be slightly earlier in maturity in some seasons, as may also be the Miami nucellar (Nauer *et al*, 1976). Look into local recommendations, such as the County Farm Advisor, to be sure of the best selection for your area.

Pink Marsh (Thompson). This seedless, pink-fleshed cultivar was at one time extensively planted in Texas and Florida and to some extent in California and Arizona. Consumers were attracted to its pink flesh and seedlessness. It has been replaced in all these areas by the Red Marsh cultivar which is more attractive, having a deeper flesh color and a red or pink blush on the rind, and it is also seedless.

Pink Marsh grapefruit:

[https://cdn.shopify.com/s/files/1/2077/6015/products/Pink Grapefruit Tree-50_500x500.jpg?v=1548816527](https://cdn.shopify.com/s/files/1/2077/6015/products/Pink_Grapefruit_Tree-50_500x500.jpg?v=1548816527)



Pink Marsh on tree (http://tropicalfruit.com/assets/images/cart_images/thom10.jpg)



The Pink Marsh was discovered in 1913 by S. A. Collins as a limb sport (bud mutation) in a White Marsh tree in the orchard of W. B. Thompson at Oneco, Florida. It was named (Thompson) and introduced in 1924 by the Royal Palms Nurseries, Oneco. It was soon extensively planted in Texas, and somewhat in Florida, where it replaced the new pink fleshed but seedy Foster cultivar (Hodgson, 1967).

The Pink Marsh is similar to the White Marsh in all respects other than its pink flesh color. The pink color will fade if fruit are left on the tree too long. Jackson (1991) states that its fruit matures earlier than Marsh (in Florida), but the author is not aware of this in California.

Red Marsh (Redblush, Ruby, Ruby Red, Red Seedless)• This was the first grapefruit with deep red flesh color (Jackson, 1991). It is the most extensively grown cultivar in California, Florida, Texas and Arizona. It is the principal cultivar in most areas because it brings the best fresh market prices being in relatively high demand by the consumer because of its red flesh color, pink or red blushed rind color, and seedlessness.

Ruby was discovered in 1929 by A. E. Henninger of McAllen, Texas, as a limb sport (bud mutation) of Pink Marsh (Thompson). He patented it in 1934. Redblush was found in 1931 by J.B. Webb of Donna, Texas, also as a limb sport of Pink Marsh (Thompson) and was introduced in 1934. These Red Marsh budlines and others that would appear quickly became the most extensively planted pigmented cultivar, a leading cultivar and replaced the Pink Marsh (Thompson) (Hodgson, 1967). The Ruby and Redblush were considered to be identical in their characteristics as were many similar bud mutations that have occurred over the years. All of these red-fleshed Marsh budlines are considered to be the Red Marsh.

Trees and fruit of the Red Marsh and its budlines are similar to White Marsh and Pink Marsh (Thompson) in all respects except for a deep pink or red flesh, red blush of the rind, and pigmented albedo. The flesh color will fade if fruit is on-tree stored (Hodgson, 1967) for too long a time.

Popular Red Marsh budlines in California have been Redblush number 3 nucellar, Redblush (or Ruby or Ruby Red), and Shambar nucellar (Nauer *et al*, 1976). The Shambar nucellar may mature slightly earlier than other Red Marsh budlines and its internal color may be better (Nauer *et al*, 1976; Hodgson, 1967).

Rio Red, Ray Ruby, and Henderson • These are three new Texas ruby red grapefruit cultivars. The Rio Red was released to nurseries by the California Citrus Clonal Protection Program in September 1988 and the Ray Ruby and Henderson were released in September 1989. The new selections were reported to have high quality and the ability to retain their deep ruby color (Anonymous, 1988). There were 220 reported bearing, 1,262 nonbearing, and 185 newly planted acres of Rio Red in California in 1992 (Tippett, 1993a). The Rio Red develops a good pink flesh color even in California coastal valleys.

Rio Red grapefruit

(https://search.aol.com/aol/image;_ylt=AwrEwhE8sodfeO4AkrdpCWVH;_ylu=Y29sbwNiZjEEcG9zAzMEdnRpZAMEc2VjA3Nj?q=rio+red+grapefruit&v=t=loki-tb-sb#id=0&iurl=http%3A%2F%2Flemoncitrustree.com%2Fstore%2Fmedia%2Fcatalog%2Fproduct%2Fcache%2F1%2Fimage%2F1200x1200%2F9df78eab33525d08d6e5fb8d27136e95%2F%2Fi%2Frrio-red-grapefruit_6.jpg&action=close)



Star Ruby. This is a cultivar from Texas that has 0 to 9 seeds and a deeper pink or red flesh color than Red Marsh. It originated in Texas from irradiated seed of the red-fleshed Hudson Foster grapefruit and was first released in Texas in 1970 (Nauer *et al*, 1976; Jackson, 1991). It appears to develop good flesh color even without much heat such as in the intermediate or even cooler California coastal valleys. There have been some plantings made in such areas. A question to be answered in coastal valley areas is whether fruit will be sweet enough to meet minimum standards and consumer acceptance. Production may be adequate in intermediate or coastal valley areas, but both production and growth is variable in hot interior areas and even in Texas where the more consistent-yielding Red Marsh types are preferred. The Star Ruby tree commonly exhibits leaf discoloration or chlorosis because of its sensitivity to herbicides and sunburn (Nauer *et al*, 1976). Fruit is often borne in clusters and, in general, appears to be smaller than that of Red Marsh. There were 250 reported bearing acres and 152 nonbearing acres of Star Ruby in California in 1992 (Tippett, 1993a).

Star Ruby grapefruit

[\(https://www.louiesnursery.com/plants/citrus-trees/grapefruit-trees/star-ruby-grapefruit/\)](https://www.louiesnursery.com/plants/citrus-trees/grapefruit-trees/star-ruby-grapefruit/)



Oroblanco and Melogold • These are two early maturing, seedless, low acid pummelo grapefruit hybrids which have potential for production of very sweet fruit in intermediate and even coastal valley areas of California, if not commercially, at least for backyard production. The author has tasted very sweet fruit of Oroblanco and Melogold grown in the California central coast area of San Luis Obispo. Fruit quality in hot desert areas may be unsatisfactory since acid levels may be too low causing the fruit to be flat and tasteless. Soost and Cameron (1980a, 1980b, 1985, 1986) have stated that both cultivars are best adapted to the inland citrus areas of California where they will mature several months earlier than currently grown cultivars. They also have stated that they may be suitable for intermediate climate zones in other citrus areas, but that fruit quality had not been satisfactory in cool, humid climates nor in hot desert areas in California. Fruit tested at South Coast Field Station (a cool, humid area) had bitterness and lacked flavor. Desertgrown fruit had been/rather/tasteless.

The author feels that these cultivars should be grown commercially only on a trial basis with small plantings to further test both their performance in various climatic areas in California but also their market potential. For backyard production, however, the author recommends them as very sweet fruit, especially for cool California coastal areas where other cultivars do not obtain sweetness, but also for early maturing, very sweet fruit in intermediate and San Joaquin valley areas of California.

Oroblanco: https://c1.staticflickr.com/5/4034/5157073564_28a474c77f_b.jpg



Melogold:

(<https://search.aol.com/aol/image?p=melogold+grapefruit&it=img-ans&v t=loki-tb sb&fr=lokitbsb&imgurl=http%3A%2F%2Fwww.specialtyproduce.com%2Fsppics%2F15526.png#id=0&iurl=http%3A%2F%2Fwww.specialtyproduce.com%2Fsppics%2F5847.png&action=click>)



Both cultivars resulted from crosses between a white grapefruit and an almost acid-free pummelo. Both the Oroblanco and Melogold were patented by the University of California and were released in 1980 and 1985, respectively (Soost and Cameron, 1980a, 1980b, 1985, 1986).

Seasons of harvest and use for Oroblanco and Melogold, respectively, are early December through April and early December through March at Riverside, California, and early November through February for both at Lindcove. Melogold is slightly earlier in maturity than Oroblanco.

University of California taste tests of fruit grown at Riverside and the Lindcove Field Station indicated taster preference for Oroblanco slightly over Melogold but both cultivars were preferred by a wide margin over Marsh grapefruit (Anonymous, 1986; Soost and Cameron, 1985). Melogold tastes more like a pummelo than Oroblanco.

Both cultivars have white flesh and smooth to slightly pebbled yellow peel, are larger than Marsh grapefruit, with Melogold the largest; have thicker peels than Marsh, with Oroblanco the thickest; similar fruit shape to Marsh, greater hollow core than Marsh at maturity, and tender and juicy flesh which separates well from segment membranes. Melogold has the same percent juice as Marsh, but Oroblanco has a lower percent juice because of its thicker rind. Oroblanco lacks the bitterness of grapefruit, but an astringent aftertaste has been noticed by some early in the season or in cooler areas. Melogold may have a slightly bitter taste particularly early or late in the season. Soluble solids to acid ratios of Oroblanco and Melogold fruit are much higher than Marsh particularly because their acidity is much lower than Marsh. Their soluble solid levels are often, but not always, higher than Marsh (Soost and Cameron, 1980a, 1980b, 1985, 1986).

There were 123 bearing acres of Melogold in California in 2020 (Anonymous, 2020). There were 289 bearing acres of Oroblanco.

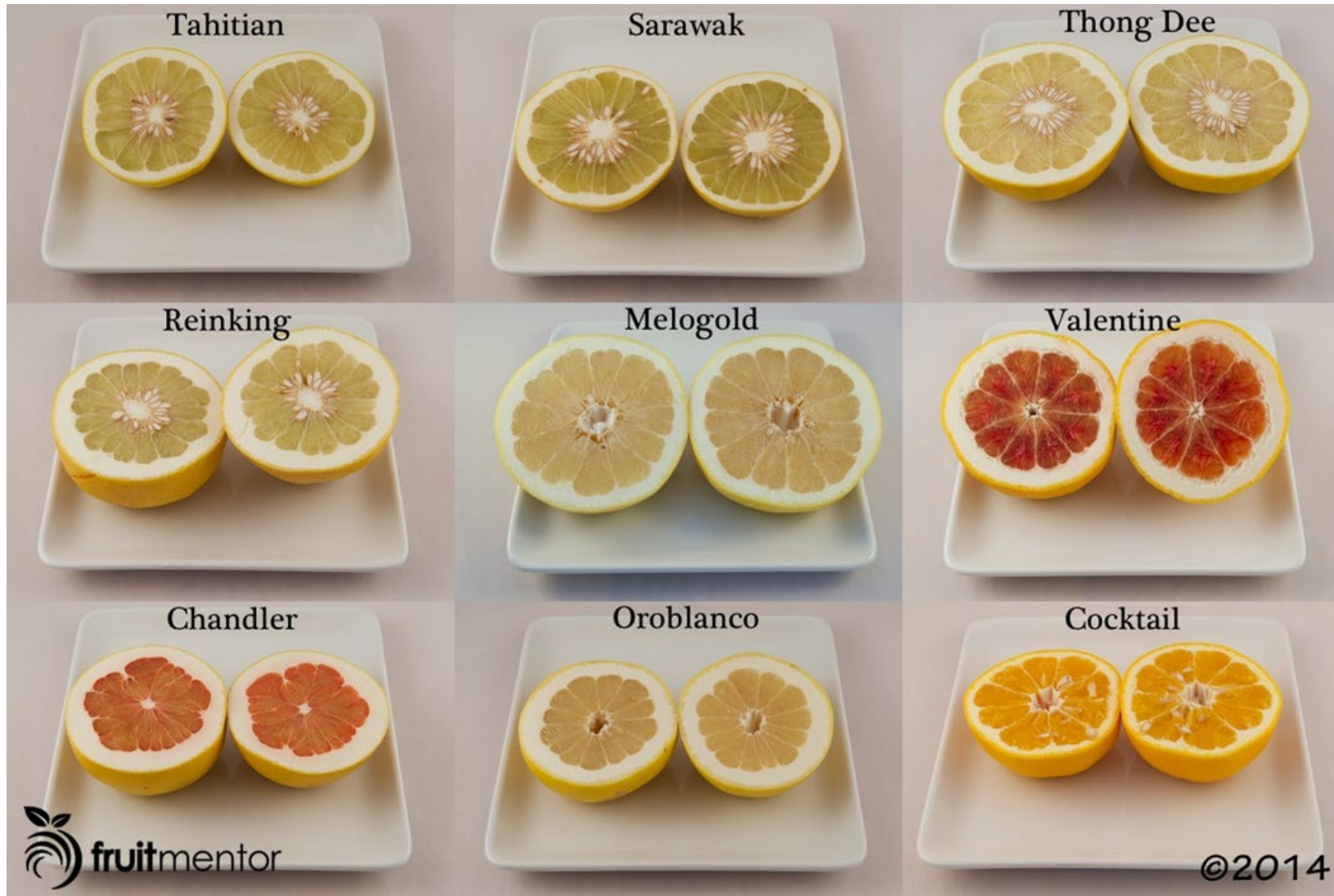
Melogold grapefruit tree.

(<https://www.ebay.com/itm/254735239368>)



Melogold compared to Oroblanco, Chandler, and Reinking pummelo.

(<https://www.fruitmentor.com/wp-content/uploads/20jpg15/07/9-Pummelos>)



CHAPTER VII

***Citrus maxima* (Burm.) Merr. (The Pummelo)**

Hardy from the mid to low 20's F. (Davies and Jackson, 2009)(McNeil, 2001).

The pummelos or shaddocks are the largest of all citrus fruits. They resemble the grapefruit in their tree and external fruit characteristics but have a number of differences for both of these types of characteristics. Hodgson (1967) described the principal differences between pummelos and grapefruit with a list of comparison characteristics that he adapted from Webber (1943). The list of comparisons is as follows (adapted from Hodgson, 1967):

Pummelo Characteristics

Young twigs pubescent

Leaves finely pubescent along midribs beneath

Petioles usually very broadly winged

Wings commonly overlapping the leaf blade

Fruit size usually large to very large

Fruits mainly round, obovate, or pyriform

Rind usually thick or very thick

Segments usually open at suture, core semi-hollow or hollow

Flesh usually firm, sometimes crisp

Flavor highly variable

Capillary membranes readily separable

Seeds monoembryonic

Fruits borne singly

Grapefruit Characteristics

Twigs glabrous

Leaves glabrous

Petioles broadly winged

Wings rarely overlapping the leaf blade

Fruit size medium to large

Fruits mainly oblate. round, or obovate

Rind thin to medium thick

Segments closed at suture, core solid or semi-hollow

Flesh tender and delicate

Flavor distinctive

Capillary membranes difficulty separable

Seeds polyembryonic

Fruits mainly borne in clusters

Very large wings on pummelo leaves:

(http://idtools.org/id/citrus/citrusid/images/features/wavy_margins.jpg)

and very large flowers: (<https://www.pinterest.com/pin/443393525785553729/>)



Pummelo flowers

https://upload.wikimedia.org/wikipedia/commons/thumb/d/d2/Pomelo_flower.jpg/800px-Pomelo_flower.jpg



Pummelo versus grapefruit

(<https://rozmena.files.wordpress.com/2011/02/pomelo-and-grapefruit-halves.jpg>)



Pummelos as a group have a much greater degree of variation in characteristics than do the grapefruit (Hodgson, 1967). Tree size for different cultivars may range from relatively small to very large. Pubescence may be present on new growth of some cultivars but not on that of others. Fruit vary by cultivar as to size, shape, and rind thickness. Fruit flavor may range from insipidly sweet to highly acid, however, there are many good-tasting cultivars.

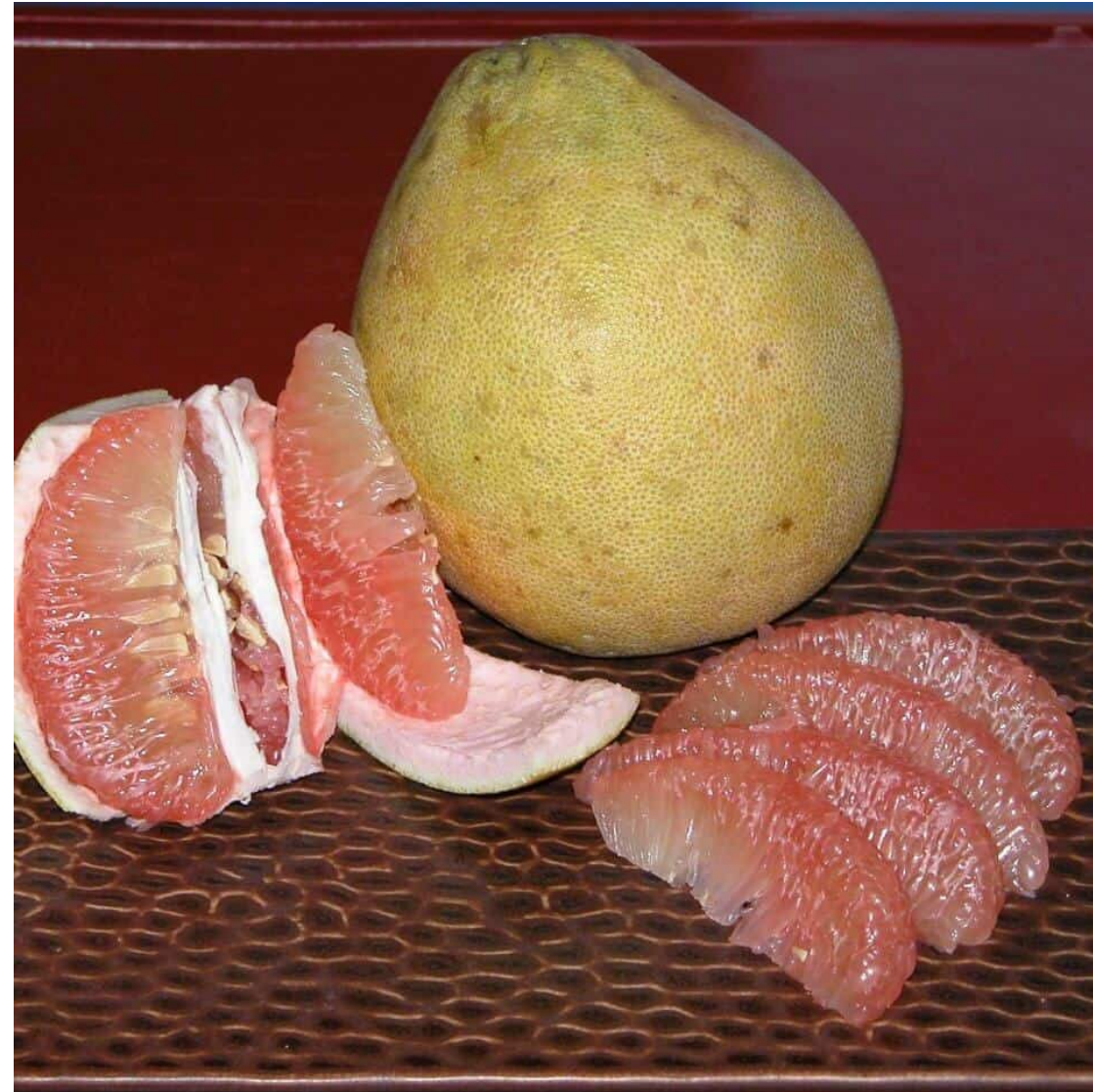
There are three groups of pummelos with respect to their fruit characteristics (adapted after Hodgson, 1967):

- 1. The common or ordinary pummelos. These are all non-pigmented, moderately to highly acid, and usually seedy, but some seedlessness may occur for some self incompatible cultivars in the absence of cross-pollination (Soost, 1964). Most pummelos are in this group.**
- 2. The acidless or non-acid pummelos. These are similar to the common pummelos for most characteristics except they contain very little acid having levels as low as .08 to .10% (Soost and Cameron, 1961).**
- 3. The pigmented pummelos. These are similar in characteristics to the common pummelos except for pink or red flesh pigmentation.**

The commercially important cultivars belong to the common and pigmented groups.

Pummelos are eaten in a quite different manner than are grapefruit (Hodgson, 1967). The flesh cannot easily be cut and spoon eaten nor easily juiced because of the firm flesh texture and low juice content. The fruit is peeled, the segments separated, and the capillary membranes are easily pulled away from the mass of pulp vesicles. The pulp vesicles are then eaten by hand or served with or without sugar in dishes. Grapefruit could not be eaten in this manner as they are too juicy. The pummelo shares with grapefruit the presence of a bitter glucoside, naringin (Swingle and Reece, 1967). The major varieties do not exhibit the slight bitterness as do grapefruit, however, bitter pummelos do exist (Hodgson, 1967). Pummelos are peeled and segmented before eating. Only the vesicles are eaten. They are less juicy than grapefruit. They are sold already peeled as a whole fruit in the Philippines.

<https://www.tastythais.com/how-to-peel-a-pomelo/>



The pummelo is thought to have its origin in the Malayan and East Indian archipelagos from which it spread to South China and India and eventually to Europe and America (Hodgson, 1967). Webber (1943) claims that the pummelo was described in Jamaica in 1696 by the name Shaddock and later in 1707 it was reported that it had been introduced by seeds brought to Barbados by the commander of an East Indian ship, Captain Shaddock (Hodgson, 1967). The name Shaddock has been widely used in the United States and the West Indies ever since. Pummelo, the preferred name, is claimed to be derived from pompeiros or pomplemoose, which it was named by the Dutch in the East Indies (Indonesia) (Hodgson, 1967).

The pummelo is a highly favored fruit in Asian countries especially in China and Thailand and other southeast Asian countries (Davies and Albrigo, 1994; Hodgson, 1967). Principal areas of production have been southern China, Thailand, Vietnam, Malaysia, Indonesia, Taiwan, and Japan (Hodgson, 1967). There has been limited production in other major citrus producing regions. A small amount of pummelos are now produced in California to be marketed to Asian communities in San Francisco and other cities and localities (Ray and Walheim, 1980). They are especially in high demand during the Chinese New Year. Cultivars grown to a limited extent in California are the Chandler and the Reinking, the former being the more popular probably due to its having pink flesh. There were 1029 bearing, 111 nonbearing acres of pummelos (Chandler) in California in 2020 (Anonymous, 2020.) Important varieties in other pummelo-producing countries are Kao Pan, Siamese Pink, and Kao Phaung in Thailand, Mato Butan in Taiwan, Bonpeiyn in Japan, and Moanlua in Tahiti (Ray and Walheim, 1980).

California growing areas for pummelos would likely be the same as those for grapefruit (see grapefruit chapter), especially for optimum sweetness and early maturity. Pummelo trees have about the same or slightly less cold hardiness than grapefruit trees (Ray and Walheim, 1980), tolerating temperatures in the low to mid-twenties degrees F. (McNeil, 2001). In addition, their fruit have less of a heat requirement for adequate fruit maturity than do grapefruit (Ray and Walheim, 1980), probably due to their more moderate acidity. The author has tasted fruit of the Chandler and Reinking varieties with adequate sweetness in the moderately cool central coast area of San Luis Obispo, CA. They may be worth a try, at least for backyard production in such areas.

CALIFORNIA PUMMELO CULTIVARS

Chandler • This is the leading cultivar grown in California. There were 1029 bearing, and 111 nonbearing acres of Chandler in 2020 (Anonymous, 2020). It resulted from breeding programs at the University of California's Citrus Experiment Station in Riverside and was released in 1961 (Cameron and Soost, 1961; Hodgson, 1967; Ray and Walheim, 1980). The pollen parent was Siamese Pink and the seed parent was Siamese Sweet. The Chandler's characteristics are as follows: pink-fleshed (like its pollen parent); intermediate sugar-acid flavor; flesh firm, tender, moderately juicy; rind yellow, medium thick, smooth, sometimes faintly pubescent, moderately adherent; medium-sized fruit, oblate or globose, many seeds; early fruit maturity; fruit holds on tree well with only slight juice loss, stores well, some pre-harvest fruit drop; medium-sized, vigorous tree, open growth habit; large, broadly-winged leaves; large, woody flowers (Hodgson, 1967; Ray and Walheim, 1980).

Reinking • This cultivar was developed at the U.S. Department of Agriculture Citrus and Date Experiment Station in Indio, California (Ray and Walheim, 1980). The Reinking's characteristics are as follows (Ray and Walheim, 1980): pale yellow flesh, intermediate sugar-acid flavor, firm, tender, moderately juicy; rind yellow, smooth, moderately adherent; fruit large, many seeds; early fruit maturity, subject to pre-harvest drop; large, vigorous tree, denser than Chandler, fruit inside tree.

Chandler pummelo fruit. (<https://www.fruitmentor.com/wp-content/uploads/2014/08/Chandler-Pummelo.jpg>)

Fruit on tree. (<https://www.naturehills.com/media/catalog/product/cache/c4218f1997800f206b38e4323d8d1cf4/c/h/chandler-grapefruit-multiple-600x600.jpg>)



Reinking pummelo fruit.

<https://www.specialtyproduce.com/sppics/11859.png>



Pummelo trees

<https://thumbs.dreamstime.com/z/pomelo-fruit-tree-garden-83822209.jpg>



Pummelo Characteristics (adapted from Swingle and Reece, 1967; and Hodgson, 1967)

1. Large, spiny, round-topped tree. Hardy from mid to low 20's F. (Davies and Jackson, 2009)(McNeil, 2001).

2. Twigs angular, often pubescent

3. Large or very large leaves, oval or elliptic oval, blunt-tipped, broadly rounded base, often subcordate or overlapping the winged petiole, midrib and large veins often pubescent

4. Petioles broadly winged, cordate, usually pubescent

5. Flowers very large, single or in clusters or subterminal inflorescences

Large flowers of the pummelo.

(<https://search.aol.com/aol/image; ylt=AwrEk5cvjYhfhxIAQB1pCWVH; ylu=Y29sbwNiZjEEcG9zAzIEdnRpZAMEc2VjA3Nj?q=pomelo+flowers&v t=loki-tb sb#id=24&iurl=http%3A%2F%2Fpics.davesgarden.com%2Fpics%2F2012%2F11%2F22%2FNeLindah%2F654e6f.jpg&action=click>)



Cuban Shaddock fruit (*Citrus maxima* Burm.), a semidwarfing rootstock: (<http://citruspages.free.fr/images/cuban1-gl.jpg>) (<http://edulisgardens.com/inside-of-a-cuban-shaddock-sour/>)
See UCR website for tree photos:
(https://citrusvariety.ucr.edu/citrus/cuban_shaddock.html)



Cuban Shaddock. Hardy between grapefruit and lemon (Davies and Jackson, 2009). Estimated to be hardy from mid to low 20's F. (McNeil, 2001). The fruit mostly looks like a pummelo, however, the foliage characteristics are more like the citron. It was introduced from Cuba. Its only/known/importance/is/as/a/semidwarfing/rootstock/for backyardcitrusinCalifornia.

CHAPTER VIII

***Citrus reticulata* Blanco (The Tangerines)
and *Citrus reticulata* Swingle (The Mandarins) and Their
Hybrids. Hardy from 18-20 degrees F. Satsumas 14-18.
(McNeil, 2001)**

<https://jerrycolebywilliams.files.wordpress.com/2012/08/mandarin-citrus-reticulata-parramatta-sweets-5.jpg>



Tangerine trees are hardy from 18-20 degrees F. Satsumas 14-18. (McNeil, 2001).

The tangerines and mandarins are highly esteemed fresh eating citrus fruits because of their delicate flavors, ease of peeling, and easily separable segments. They are more of a specialty citrus fruit, however, because of their short season which is primarily the late fall and winter months (November through March).

The short season and other limitations such as poor on-tree fruit storage (granulation and puffing), poor shipping storage (soft, loose, thin rinds), and alternate bearing and small fruit size for many varieties has limited the acreage of commercial plantings in California and other areas, although bearing acreage has greatly increased in recent years in California. Yield per acre has ranged from 310 boxes (75 lb) in 2018 to 419 boxes in 2019. (Anonymus, 2020). Fresh was 69.1% in 2019, 77.3% in 2020 (Citrus Fruits Summary, 2020). Percentage processed was 30.9% in 2019, 22.7% in 2020 (Citrus Fruits Summary, 2020).

There were 72,300 bearing acres of tangerines in California in 2020 (Anonymous, 2020). This was an increase of 68,434 bearing acres since 1998 (Tippett et al 1999). As with other citrus fruits, the market emphasis for tangerines, mandarins, and their hybrids is for fresh fruit. Processing grade fruit (for juice, etc.) are not profitable for the grower.

Although tangerines and mandarins have been classified as separate species by some, it is felt by others (including the author) that they are essentially identical in botanical characteristics and, therefore, should be placed in the same species, *Citrus reticulata* Swingle (Ziegler and Wolfe, 1975; Jackson, 1991) or *Citrus reticulata* Blanco. The terms tangerine and mandarin can be used as synonyms for each other.

Various species classifications for different types of tangerines and mandarins have been as follows (Ziegler and Wolfe, 1975; Jackson, 1991): Satsuma mandarins (from Japan): *Citrus unshieu* Marc or *Citrus reticulata* Swingle. King mandarin (from Indo-China): *Citrus nobilis* Lour or *Citrus reticulata* x *Citrus sinensis* of Swingle.

Tangerines (from India, Malaya, China, one from Italy): *Citrus reticulata* Blanco.

Tangerines/mandarins and their hybrids (tangelos and tangors) in general have a quite high heat requirement for early fruit maturity except for the Satsuma mandarin which has a low heat requirement. They are second only to grapefruit in this requirement. Cold hardiness of the tree is very good, about 18-20°F for most cultivars, 14-18 F for the satsuma (McNeil, 2001).

Commercial growing areas in California are limited to warmer inland locations for early and acceptable maturity. The leading area is the southern California desert (Riverside, Imperial, San Bernardino counties). Second is the San Joaquin valley (Tulare, Kern and Fresno counties), and third are southern California intermediate areas (San Diego, western Riverside, and western San Bernardino counties). Tangerine seasons are as follows:

(<https://www.umina.com/wp-content/uploads/2016/10/umina4-1024x354.png>)

Tangerines		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
California	Fairchild												
Arizona	Fairchild												
Florida	Honey												
	Fallglos												
	Sun Burst												
Australia	Honey												
	Fallglos												

CALIFORNIA TANGERINE/MANDARIN CULTIVARS

Fairchild • This was the leading bearing cultivar grown in California and was the most-planted until about 1989. It has since then been surpassed in new plantings by the Clementine mandarin, the Tango, and the W. Murcott Afourer. California acreage of this cultivar was 572 bearing, 0 nonbearing in 2020 (Anonymous, 2020). It is an early variety especially for desert areas where satsuma mandarins do not do well. Fruit maturity and harvest are November to January in the desert. It may be worthy of trial in the San Joaquin valley where soluble solids to acid ratios may be higher than for the satsuma mandarin.

Fruit are medium-sized, but small with heavy crops, reddish-orange, and peel relatively poorly. They section easily, are seedy, and have a good flavor. Cross-pollination is required for good crops.

Fairchild mandarin. Good flavor but seedy.

<https://www.specialtyproduce.com/sppics/15706.png>



Fairchild mandarin fruit and foliage. **Mandarin leaves are thin with small** **wings on the petiole.**

[https://idtools.org/id/citrus/citrusid/images/fs_images/Fairchild
Mandarin_IMG_4581.jpg](https://idtools.org/id/citrus/citrusid/images/fs_images/Fairchild_Mandarin_IMG_4581.jpg)



Satsuma • This is the seventh leading bearing mandarin/tangerine cultivar grown in California. It is the leading citrus type grown in Japan. California acreage of this cultivar was 2190 bearing and 66 nonbearing acres in 2020 (Anonymous, 2020). It is an early cultivar especially for the San Joaquin valley, intermediate areas and even coastal valleys. Harvest is November to February. It is not adapted to desert areas where it will puff and granulate very rapidly. Fruit rapidly puffs and granulates in all growing areas, but can be picked and stored for a month or so at 32°F.

Satsuma mandarins have the lowest heat requirement for fruit maturity of all mandarin/tangerine cultivars, therefore, will mature fruit adequately even in cool areas such as coastal valleys. The fruit are medium to small in size, completely seedless, with a very loose, yellowish-orange rind which is bumpy in warm interior areas but smooth in cooler coastal areas. Flesh is tender and juicy with a mild sweet-acid flavor in cool areas but sweet and low acid in warm areas and has easily separable segments. Fruit matures internally before full rind color, therefore, post-harvest ethylene treatments or color picking may be necessary. Production is consistent with little alternate bearing tendency.

The trees are usually grown on trifoliate orange, citrange, or sweet orange stocks. Trees are small (10 feet or less), thornless, and are very cold hardy tolerating between 14 and 18°F. (McNeil, 2001)(Anderson and Ferguson, 2019). (<https://edis.ifas.ufl.edu/publication/ch116>)

There are several strains of the satsuma mandarin, the most common in California being the Owari. Other strains in California available through the Citrus Clonal Protection Program (Witney, 1993) are the Frost Owari, Dobashi Beni, Okitsu Wase, and Neopolitana. The Owari seems to have the best flavor, Dobashi Beni and Okitsu Wase are acceptable, while Neopolitana is reported to have poor quality. Dobashi Beni and Okitsu Wase mature and color earlier than the Owari (McNeil and Dettling, 2004).

Dobashi Beni has a deeper orange color than Owari and Okitsu Wase. The Owari is usually harvested in December in the San Joaquin valley. There is interest in extending the early satsuma season into October and November by increased plantings of Okitsu Wase and Dobashi Beni satsumas (Ferguson and Chao, 2000).

Okitsu Wase actually may reach legal maturity (6.5/1 Brix/acid ratio) in early to mid-September in the San Joaquin valley but has poor color (<25%) at that time and exhibits zebraskin if degreened at that time. Dobashi Beni reaches legal maturity three weeks later and also with poor color (<25%) and zebraskin if degreened. It is recommended to harvest both strains at a 10.5 Brix/acid ratio and 75% color (without degreening) for best consumer acceptance. Okitsu Wase would most likely be harvested in October and Dobashi Beni in November in the San Joaquin valley.

Okitsu Wase reaches legal maturity in mid to late October in coastal valleys which is about one month earlier than Owari and Dobashi Beni (McNeil and Dettling, 2004).

Owari satsuma mandarin.

https://www.plantingtree.com/products/owari-satsuma-mandarin-tree?msclkid=deff9bcdcab614b24601c4454ec83383&utm_source=bing&utm_medium=cpc&utm_campaign=Shopping%20%7C%20Primary&utm_term=4585032212072462&utm_content=GSAPI%205baaaa063cc88



Dobashi beni satsuma mandarin

(<https://idtools.org/id/citrus/citrusid/>)



Okitsu wase satsuma mandarin

(<https://www.thetreecenter.com/okitsu-satsuma-mandarin-tree/>)



Miho wase mandarin, a new satsuma for California.

(<https://tse1.mm.bing.net/th?id=OIP.3JzJbpcntIAHW2eV8MGEQHaFS&pid=Api&P=0&w=235&h=168>)

(https://search.aol.com/aol/image;_ylt=A0geKeN9vohfldwA16VpCWWH;_ylu=Y29sbwNiZjEEcG9zAzIEdnRpZAMEc2VjA3Nj?q=miho+wase+satsuma&v t=loki-tb sb#id=23&iurl=http%3A%2F%2Fkaragozlergida.com.tr%2Fsites%2Fdefault%2Ffiles%2Fmandalina-yetistiriciligi.jpg&action=click)



Miho wase satsuma

(<http://www.marialuisa.com.pe/en/images/popup.jpg>)

MIHO WASE MANDARIN

Harvest Period: December - January
Availability: December 2018
Seeds: None
Color: Yellowish orange
Brix: 9 - 10 %
Juice %: 35 - 45%
Peeled: Easy
Shape: Flat, oval
Diameter: 70 - 80mm
Weight: 180 - 200g
Cortex width: 2.0 - 2.6mm



JAN					FEB					MAR					APR					MAY					JUN					JUL					AUG					SEP					OCT					NOV					DEC				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52								

New and old satsuma varieties

<http://citruspages.free.fr/mandarins.php>

Early Wase varieties: Miyagawa, Okitsu, Seto, Miho, Kuno

Late Unshû varieties: Owari, Silverhill, Dobashi Beni, Kimbrough, Aoshima

Newer satsuma varieties: Armstrong, Dart North, Dart South, Xie Shan

Kuno wase is no longer commercially available in California.

Miyagawa - Trees are said to be vigorous and productive, fruit to be of high quality, early, and seedless. Miho wase-earlier in maturity than Miyagawa. Similar to Okitsu wase but slower to color. Silverhill-almost identical to Frost Owari. Dobashi beni-fruit of deep orange red color, good quality. Aoshima-a late maturing satsuma. An Owari mutant.

Armstrong-Selected at Louisiana state university. Dart Owari north-not commercially available in California. Dart Owari south-Not commercially available in California.

Xie shan-No longer commercially available in California. Supposedly the earliest maturing satsuma. Mid-September in the San Joaquin valley.

Dancy • It was the leading cultivar for many years and also was important in Florida. California acreage of this cultivar was 500 bearing, 53 nonbearing, and 553 total acres in 1992 (Tippett, 1993a) but very little acreage now. The Dancy does best in desert areas since it has a relatively high total heat requirement for fruit maturity. It may be too acid in cooler areas, however, the author has tasted Dancy fruit of acceptable sweetness in coastal valleys (San Luis Obispo). Fruit mature from December to March depending on location.

Fruit are reddish-orange, medium-sized, with a loose rind, easily to peel. Dancy's limitations are some alternate bearing and small fruit size in the heavy crop year. Fruit store poorly on the tree due to rapid granulation and rind puffing. Refrigerated storage is good. Fruit are frost susceptible. Dancy trees are large, vigorous and productive. Leaves separable segments, and a rich, excellent flavor with moderately high acidity, and a few seeds.

Dancy tangerine fruit:

([https://tse4.mm.bing.net/th?id=OIP.mTD-kt7LxEUJ-SFqCK0paAHaFs&pid=Api&P=0&w=197&h=152](https://search.aol.com/aol/image;_ylt=AwrJ4NZX74hfP9gADV1jCWVH;_ylu=c2VjA3NIYXJjaARzbGsDYnV0dG9u;_ylc=X1MDMTE5NzgwMzg3NQRfcgMyBGFjdG4DY2xrBGNzcmNwdmlkAzU2Lk9pekV3TGpKeHINNnkuQUdibUFIR056TXVNUUFBQUFBMkZEXzQEZNIDBGdwcmIkAwRuX3N1Z2cDMARvcmlnaW4Dc2VhcmNoLmFvbC5jb20EcG9zAzAEcHFzdHIDBHBxc3RybAMEcXN0cmwDMTcEcXVIcnkDZGFuY3kIMjB0YW5nZXJpbmUEdF9zdG1wAzE2MDI4MDk3MzY-?fr2=sb-top-&q=dancy+tangerine&v t=wscreen50-bb&s it=sb top&ei=UTF-8&n=60&x=wrt&s qt=)
(<a href=))



Dancy tangerine fruit on tree:

<https://images-na.ssl-images-amazon.com/images/I/610K0POxLML.AC.jpg>



Clementine selections will perform best in California conditions, especially in the San Joaquin valley. Another research objective is to determine which selections will produce seedless (parthenocarpic) fruit along with adequate yields. Algerian (Clementine)• This is the leading cultivar in California having 25,876 bearing and 100 nonbearing acres in 2020 (Anonymous, 2020). It is a popular commercial cultivar in Mediterranean citrus areas and is probably the most popular mandarin in world markets. Spain has been exporting significant quantities of seedless Clementines into the United States in recent years. California would like to share a portion of this Clementine market by growing more of this mid-season cultivar. Studies are underway by University of California personnel to determine which selections are seedless with good fruit size, and which areas are best for Clementines (Kahn and Bier, 2000). Seedless fruit would be most in demand by consumers. New plantings of various Clementine selections are already underway in California, hopefully on a trial basis until their performance has been determined.

Clementine (*Citrus × clementina*) is believed to be a [tangor](#), a citrus fruit hybrid between a willowleaf [mandarin orange](#) (*C. × deliciosa*) and a [sweet orange](#) (*C. × sinensis*),-named for its late 19th-century discoverer.-The exterior is a deep orange colour with a smooth, glossy appearance. Clementines can be separated into 7 to 14 segments. Similar to [tangerines](#), they tend to be easy to peel. They are typically juicy and sweet, with less [acid](#) than oranges. Their [oils](#), like other citrus fruits, contain mostly [limonene](#) as well as [myrcene](#), [linalool](#), [α-pinene](#) and many complex aromatics (Wikipedia, 2022).

The clementine is a spontaneous citrus **hybrid** that arose in the late 19th century in **Misserghin, Algeria**, in the garden of the orphanage of Brother **Clément Rodier**, for whom it would be formally named in 1902.- Some sources have attributed an earlier origin for the hybrid, pointing to similar fruit native to the provinces of **Guangxi** and **Guangdong** in present-day **China**, but these are likely distinct mandarin hybrids, and genomic analysis of the clementine has shown it to have arisen from a cross between a sweet orange (*Citrus × sinensis*) and the Mediterranean willowleaf mandarin (*Citrus × deliciosa*), consistent with Algerian origin.

(<https://en.wikipedia.org/wiki/Clementine>, 2022)

Fruit mature mid-November to mid-March. Fruit are reddish-orange, smooth, medium-sized, peel easily, have a few seeds, and are of excellent quality flavor. Fruit will store on the tree longer than other cultivars, but will granulate in the desert. The tree is of medium size. Cross-pollination by Dancy, Kinnow, or Valencia is recommended for good crops, however, the effects of cross-pollination on the seediness or seedlessness of the resultant fruit needs to be determined (Kahn and Bier, 2000) since seedless fruit would be more in demand by consumers. Problems in the past have been low yields, alternate bearing, and small fruit size in the heavy crop year.

Varieties: (<https://en.wikipedia.org/wiki/Clementine>) **Also see the UCR website:** (<https://citrusvariety.ucr.edu/varieties.html>)

Algerian is the original Rodier cultivar (Wikipedia, 2022).

Fina, a Spanish cultivar originally grown on a bitter orange rootstock that gave it superb flavor, but due to disease vulnerability is now grown on a broader range of rootstocks, affecting the flavor profile.

Clemenules or Nules is a popular, seedless, easy to peel Clementine with a very pleasing sweet flavor. A mutation of the Fina variety, Nules is the most widely planted Clementine in Spain, where it matures from mid-November to mid to late-January. Also widely planted in California, where it matures from October to December.^[15] It produces seedless fruit that is larger than the Fina, but less sweet.^[14]

Also known as 'Clemenules', 'Nulesina', 'Clementina Reina', 'Clementina Victoria', and 'Reina y Gorda de Nules'. A mutation of 'Fina' was found in Nules, Castellon de Plana, in 1953. Larger and a few days earlier than 'Fina'; seedless and high quality; hangs moderately well but tends to puff if held too long. This is the most widely grown 'Clementine' in Spain (<https://citrusvariety.ucr.edu/varieties.html>). See this UCR website for other Clementines.

Clementine del Golfo di Taranto, a (practically) seedless Italian cultivar given Protected geographical indication (PGI) status by the European Union, produced around the Gulf of Taranto. They have a sweet flavour and an intense aroma.

Clementine di Calabria, another Italian PGI variety, grown in the Calabria region.

Seedless Clementines: Clementine de Nules, Fina Sodea, Monreal,
without cross-pollination. (<https://citrusvariety.ucr.edu/varieties.html>)

Clementine fruit: (<https://en.wikipedia.org/wiki/Clementine>)



Wikipedia, 2022(FAO STAT OF THE UNITED NATIONS)

Production of clementines, tangerines, mandarins and satsumas* in 2016	
Country	(millions of tonnes)
China	17.2
Spain	7.9
Turkey	1.3
Morocco	1.1
Egypt	1.0
Brazil	1.0
World	37.8
*FAOSTAT of the United Nations , which groups these fruits together in their data ¹⁸	

A 2017 study indicated that clementine **phytochemicals** may interact with drugs in a manner similar to those of **grapefruit** (<https://en.wikipedia.org/wiki/Clementine>).

Clementine tree: (<https://media.buzzle.com/media/images-en/photos/botany/plants/1200-71991521-ripe-and-fresh-tangerines-tree.jpg>)



Clementine variety acreage in California (Anonymous, 2020). Bearing/Non-bearing	
Clementines	12,938/50
Algerian/Clementine	835/0
Caffin/Clementine	2,542/31
Clemenules(Nules)	8,305/19
Fina Sodea/Clementine	1,115/0
Oro Grande/Clementine	141/0
Total	25,876/100

“Notes: Caffin Clementine- reported to be earlier, better colored, has slightly thicker rind so ships well. However, it has several drawbacks including more mild taste, small fruit, tends to fruit splitting, slow tree growth, poor parthenocarpic activity requiring GA treatment for fruit setting, sensitivity to soil salinity, mites. (<https://citrusvariety.ucr.edu/citrus/caffin.html>)

Notes: Fina Sodea-Comments in letter from Ray Copeland: "Clementina Fina (Sodea). I took from some young trees near Larache, Morocco, on the Compania Agricola Del Lukus farm because it represented the most widely grown seedless Clementine selection in Morocco. In my opinion, this selection is quite different from the Clementine selection available here in California because of its lack of seeds and early maturity which was about October 20. The Sodea designation is for the governmental organization (<https://citrusvariety.ucr.edu/citrus/finasodea.html>https://www.dpi.nsw.gov.au/data/assets/pdf_file/0005/1206167/Orogrande-clementine) Orogrande. A Spanish selection from Oroval Clementine introduced to Australia by Auscitrus. Large fruit size, lighter crop on young trees, fruit maturity before color development, fruit produced inside the canopy good for hot climates, short harvest window of 4-5 weeks as fruit granulates at the end of maturity period (Australia).



Kinnow • This once was the fifth leading cultivar in California (Tippett, 1993a) but is no longer important. It originated as a cross between King and Willowleaf mandarins. Desert and coastal-interior areas are best for the Kinnow where fruit mature December to February and February to May, respectively.

Fruit are yellow-orange, medium-sized (with average crops), smooth-peeled, difficult to peel, rich and spicy-flavored, and relatively low in acid. Trees are vigorous and upright.

The chief problem with the Kinnow cultivar is a severe alternate bearing tendency with very small fruit in the heavy crop year and very few or no fruit in the light crop year.

Kinnow/mandarin/tree:

https://en.wikipedia.org/wiki/Kinnow#/media/File:Kinnow_tree.JPG

Kinnow mandarin fruit: https://www.fast-growing-trees.com/products/Kinnow-Mandarin-Tree#yotpo-reviews-section_1532789227572



Common Tangerine/Mandarin Characteristics·(adapted from Swingle and Reece, 1967; and Hodgson, 1967)

- 1. Small tree with slender twigs. Very cold resistant. 18-20 F., satsuma 14-18 (McNeil 2001)(Anderson and Ferguson, 2019).**
- 2. Leaves thin and broadly or narrowly lanceolate with very small wings which are line-margined. Blade notch-pointed with main vein prominent above and below.**
- 3. Spines small and few or lacking.**
- 4. Flowers small, single or in small clusters in leaf axils.**
- 5. Fruit very small to medium, oblate to highly compressed (depressed globose to subglobose), with thin, loose peel, rind and sections easily separable, open core, flavor range from bland to rich and fragrant, color range from pale yellow-orange to deep red-orange; seedy, slightly seedy, or seedless; seeds small, pointed at one end, with greenish cotyledons.**

Tango tangerine. This is the second leading tangerine in California with 14,628 bearing acres, 2550 nonbearing acres (Anonymous, 2020).

<https://cdn3.volusion.com/kceqm.mleru/v/vspfiles/photos/337-2T.jpg?v-cache=1597056844>



Tango tangerine. “This is a new hybrid of the Murcott mandarin developed by the University of California at Riverside. Fruit size is moderately large, averaging over 3 oz. per fruit. The variety has a pronounced squatty-round shape with a deep orange, very smooth rind that is easy to peel. The interior fruit is also a very rich orange color, delicately textured and quite juicy with a full-bodied, sweet flavor when mature. Unlike most mandarin varieties, the Tango is completely seedless. Tango Tangerines are great for juicing or simply an out of hand snack. Product of California. Choose a tangerine that feels heavy (juicy) for its size with a soft, but not wrinkled skin that is bright in color. This fruit will stay fresh two weeks under proper refrigeration.”

W. Murcott Afourer.

<http://citruspages.free.fr/images/wmafourer-jr.jpg>



Afourer (a.k.a. W. Murcott Afourer) is a chance seedling of Murcott from Afourer near Beni Mellal, Morocco, from where it came to California and was released in 1993. There were 9152 bearing acres in California in 2020 (Anonymous, 2020) and 449 nonbearing acres making it the third leading variety in California (Aol.com) Its principal advantages over Murcott are fewer seeds, better fruit coloration and the fact that it is easily peelable like a clementine. In Morocco it matures in late February. The fruit is low-seeded in the absence of cross-pollination, but seedy when cross-pollinated. The flesh is orange-colored and juicy, with a rich and sweet flavor. In his book *Citrus Varieties of the World* James Saunt points out that naming new cultivars is seldom straightforward. Afourer is also known in Europe as Nadorcott after Mr. El Bachir Nadori who discovered it in Morocco. In California it is mostly know as W. Murcott but sometimes as W. Murcott Afourer. It is also marketed as Delite.”

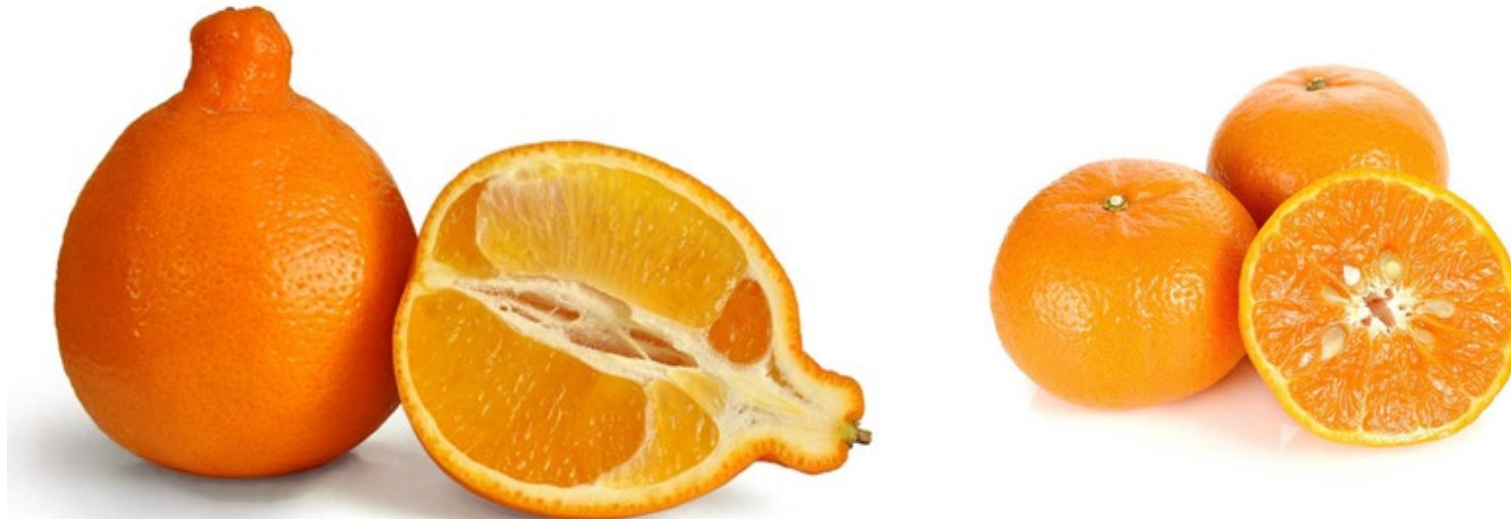
TANGERINE/MANDARIN HYBRIDS

The two common tangerine/mandarin hybrids grown commercially in California are the tangelo and the tangor. They are marketed according to the same packing and maturity standards and during the same seasons as tangerines/mandarins. The leading cultivars are the Minneola tangelo, the Orlando tangelo, and the Temple tangor (also called the Royal Mandarin). Acreage for all California tangelos was 5,644 bearing and 27 nonbearing acres in 2020 (Anonymous, 2020). Their primary advantages over the tangerines/mandarins in general are larger fruit size and better shipping quality (tougher, thicker rinds) while still having some of the ease of peeling and segmentation and delicate flavor attributes of the tangerines.

Minneola tangelo fruit:

(http://upload.wikimedia.org/wikipedia/commons/thumb/a/a4/Minneola_fruit_3.jpg/1200px-Minneola_fruit_3.jpg)

Orlando tangelo fruit: (https://cdn.shopify.com/s/files/1/2077/6015/products/Orlando_Tangelo_Fruit-50_704x704.jpg?v=1545598048)



Orlando tangelo on tree:

(https://cdn.shopify.com/s/files/1/2077/6015/products/Orlando_Tangelo_Tree50504x504.jpg?v=1545598048)



Minneola Tangelo • This is the leading tangelo grown in California but grown only to a limited extent in Florida. California acreage consisted of 5382 bearing, 211 nonbearing, and 3,533 total acres in 1992 (Tippett, 1993a). 1998 acreage was 3,827 bearing and 9 nonbearing acres in 2020 (Anonymous, 2020). The Minneola originated from a cross made by W. T. Swingle in 1911 using Dancy tangerine pollen on a Duncan grapefruit pistil (Jackson, 1991).

The Minneola can be a productive cultivar but may need a pollinator (such as the Dancy, Clementine or Kinnow) to ensure good production. Orlando is incompatible. It is best commercially adapted to the low elevation desert but also may be adequate in the San Joaquin valley and intermediate areas. Maturity and harvest are from December to January in the desert and February to April in intermediate (coastal interior) areas.

Fruit are large with a prominent neck, red-orange rind, dark orange flesh, nearly smooth but often slightly pebbled rind, juicy, and with a rich, tart flavor and only a few seeds. It peels and segments moderately well. The tree is cold hardy, but the fruit are somewhat frost sensitive.

Fruit will puff and granulate if left on the tree but store and ship well off the tree. Fruit are subject to preharvest drop. Gibberellic acid and 2,4-D will lessen puffing and pre-harvest drop, respectively.

Orlando (Lake) Tangelo. This is the second leading tangelo grown in California primarily because of its smaller fruit size than the Minneola. California acreage was most likely only 262 bearing and 18 nonbearing in 2020 (Anonymous, 2020). It is the leading tangelo in Florida, however, with about 10,000 acres in 1985 (Jackson, 1991). It resulted from the same cross as the Minneola made by W. T. Swingle in 1911 (Jackson, 1991).

The Orlando may need a pollinator (such as Dancy, Clementine, Kinnow, or Temple) for good production. It is incompatible with Minneola.

Fruit are orange colored, medium-large, slightly flat and pebbled. Peelability is poor, flavor is mild and sweet, and fruit are seedy. Pre-harvest drop, puffing and granulation may be a problem. Rapid harvest and/or growth regulator application may be necessary to lessen some of these problems as for the Minneola. Fruit maturity and harvest are from November to December in the desert and January to March in intermediate (coastal interior) areas. This is earlier than for the Minneola. It is said to be slightly more cold hardy than the Minneola and especially adapted to hot desert areas, but not recommended for cool coastal areas (Ray and Walheim, 1980).

Temple tangor (Temple orange in Florida, Royal Mandarin in California) fruit: (https://cdn.shopify.com/s/files/1/2077/6015/products/Temple-Orange-Tree-100_500x500.jpg?v=1578543239)



Temple orange (Royal mandarin)

(www.dreamstime.com)



Temple Tangor (Royal Mandarin) • This is the leading tangor grown to a limited extent in California but quite extensively in Florida. This cultivar is marketed as the Temple orange in Florida and as the Royal Mandarin in California. It originated as a seedling in Jamaica late in the nineteenth century (Jackson, 1991). California acreage in 2020 was 117 bearing, 0 nonbearing acres in 2020 (Anonymous, 2020). There were about 10,000 acres of the Temple in Florida in 1988 (Jackson, 1991).

The Temple obtains acceptable sweetness and color mainly in California desert areas and in Florida. Fruit have had rough rinds and coarse and dry flesh in the San Joaquin valley.

Fruit are a highly colored red-orange, large, round to slightly flat, slightly rough and pebbly, peel and segment fairly well, have many seeds, and a tart to sweet flavor. Trees and fruit are somewhat cold sensitive, Fruit maturity and harvest are February to March in the desert and March to April in intermediate areas (coastal interior).

Other Tangor Cultivars • Three other tangors of interest are the **Dweet**, **Ortanique**, and **Ellendale**. The Dweet is primarily a backyard cultivar for both interior and coastal areas of California, but not the desert. The fruit season is March to May inland and April to June in coastal valleys. It has a rich flavor and red-orange color inland but poor color and pebbliness near the coast. Fruit puff and dry out if left on the tree too long. Fruit are subject to sun and wind damage in desert areas since it is borne near the end of branches (Ray and Walheim, 1980). It originated from a cross between a Mediterranean sweet orange and a Dancy tangerine (Lance and Walheim, 1980). Dweet tangor fruit:

(<http://idtools.org/id/citrus/citrusid/factsheet.php?name=Dweet>)

Dweet/tangor/tree.Florida.

(<http://idtools.org/id/citrus/citrusid/factsheet.php?name=Dweet>)



The Ortanique tangor is believed to have originated as a chance seedling in Jamaica in 1920 (Hodgson,1967) where it became important commercially (250,000 field boxes) in the mid-1960's. The fruit are large with a bright yellowish-orange color at maturity. The flesh is orange, juicy, and rich-flavored, with about 10 seeds. Maturity is late mid-season. Mature fruit hold well on the tree.

Ortanique/fruit,Riverside,CA. (<http://idtools.org/id/citrus/citrusid/factsheet.php?name=Ortanique>)

Tree/Riverside,CA. (<http://idtools.org/id/citrus/citrusid/factsheet.php?name=Ortanique>)



EllendaleTangor/fruit,WinterHaven,FL

[http://idtools.org/id/citrus/citrusid/
images/fs_images/Ellendale
IMG_2235.jpg](http://idtools.org/id/citrus/citrusid/images/fs_images/EllendaleIMG_2235.jpg)



The Ellendale originated as a seedling in Queensland, Australia, in 1878. It became the principal cultivar in Queensland and also became important in New South Wales (Hodgson, 1967). Production became limited primarily to the Central Burnett District northwest of Brisbane due to yield and quality problems in coastal and more southerly areas of Australia. Fruit is medium to large, sometimes very large, late-midseason in Queensland. Color develops slowly, but eventually will be deep orange. The pulp is of high color, tender, rich, sweet, and juicy but with high acidity if picked too early. Seed number varies from zero to twenty depending on pollen source. Harvesting may extend over a long period and may be extended further with gibberellic acid. Styler-end splitting occurs with heat and humidity. Puffiness does not develop. Fruit stores and ships well (Witney, 1993).

CHAPTER IX

***Citrus latifolia* Swingle (The Large-Fruited Lime) and *Citrus aurantifolia* Tanaka (The Small-Fruited Lime) and Other Lime-Like Fruit**

The limes are thought to have originated in northeastern India, adjoining parts of Burma, or northern Malaysia. Limes were brought to the Americas in the early sixteenth century by Spanish and Portuguese explorers (Hodgson, 1967).

The acid limes consist of the small-fruited type (*Citrus aurantifolia* Tanaka, the Key, West Indian, or Mexican lime) and large-fruited type (*Citrus latifolia* Swingle, the Persian, Tahitian, or Bearss lime). These two species differ in climatic adaptation and susceptibility to certain diseases. The West Indian lime is more cold-sensitive (28 F.)(McNeil, 2001) and requires more heat to develop good fruit size as compared to the Tahitian lime. The West Indian lime is highly susceptible to the tristeza virus (for which it is used as an indicator plant), citrus canker, and the withertip fungus as compared to the Tahitian lime. It has resistance to the citrus scab fungus (Hodgson, 1967).

West Indian lime fruit have a stronger flavor and odor but smaller fruit than the Tahitian lime. The former is seedy while the latter is seedless (Hodgson, 1967).

The commercial lime industry of the world has consisted primarily of the West Indian lime. The principal areas have been hot semitropical, subtropical and tropical due to the cold sensitivity (28°F)(McNeil, 2001) and high heat requirement for good sized fruit. Fruit is too small to bring good prices in cool subtropical regions such as Southern California(Hodgson,1967).

The main lime producing countries are primarily Mexico, India, Egypt, and the West Indies. Much of the Mexican crop is exported to the United States as a supplement to the Tahitian limes grown in Florida and California. In Egypt a forcing treatment similar to the *verdelli* lemon treatment of Sicily has been utilized to produce summer fruit(Hodgson,1967).

Most of the world commercial lime crop is marketed for fresh consumption used by the consumer similarly as to the lemon. Uses, products,andbyproductsarelimeade, carbonated beverages, in alcoholic drinks, pickling, culinary, and medicinal preparations, lime juice, and lime oil(Hodgson,1967).

The West Indian lime was found planted in the Florida keys (hence called Key lime) as early as 1838 where it became naturalized. Not until the early 1900's did a small commercial industry develop but which later was virtually destroyed by the 1926 hurricane. It was introduced into Southern California by the Spanish missionaries but did not succeed commercially (Hodgson, 1967).

Commercial culture of the Tahitian lime has been much less important world-wide but is important in the United States (Florida and California) because of its greater cold hardiness (26-27°F)(McNeil, 2001), lower heat requirement, and larger fruit size than the West Indian lime. The U.S. industry is concentrated primarily in humid southern Florida where fruit mature during the summer at which time market demand and prices are at their peak. California acreage is limited because of a much later maturing (fall and winter) crop at which time demand and prices are relatively low (Hodgson, 1967).

Florida produces about 95% of the U.S. lime crop, most of it being marketed fresh. Much of the crop (25 to 50%+), however, has been processed into frozen, concentrated limeade. Total production was 1,250 million boxes (1-3/5 bushel) for the 1988-89 season (Jackson, 1991). Fruit handling practices are somewhat similar to lemons. Fruit are picked by size (however green, for longer storage time and so the consumer does not confuse them with lemons). They will turn yellow if left on the tree too long. Yellow limes taste fine, however, and may even have a better flavor than green ones according to a Florida study.

Hurricane Andrew in 1992 destroyed much of the lime acreage in southern Florida. Much acreage was also removed to prevent citrus canker spread into major orange and grapefruit areas. Florida lime acreage has been rebounding in recent years. (<https://www.tampabay.com/news/humaninterest/lime-groves-make-a-return-to-south-florida/2208412/>).

California produced 492 acres of Bearss limes in 2020. Nonbearing acreage was 24 acres. Most of this bearing acreage was in San Diego county, 232 acres, Imperial county, 101 acres, and Riverside county, 79 acres. This acreage consisted primarily of the Tahitian (Bearss, Persian) species. West Indian, Mexican, Key Lime (*Citrus aurantifolia* Tanaka) is the small-fruited commercial acid lime, the most important species worldwide except in the United States. It is called the Mexican lime in California and the West Indian or Key lime in Florida. It has a high degree of polyembryony, thus trueness to type from seed such that seed propagation has been extensively used in countries where it has been widely grown such as Mexico, India, and Egypt. Seedlings are widely used as an indicator plant to detect the tristeza virus (Hodgson, 1967).

It is not much grown commercially in California because of low prices, and it is difficult to harvest because of its thorniness and small fruit. It is also sensitive to frost (28°F) (Opitz and Platt, 1969).

Keylime fruit and tree:

(<http://3.bp.blogspot.com/k89Hk1cKaZY/UAcINyBbpAI/AAAAAAAAA2Y/40IlwhsZVSA/s1600/P1090566.JPG>)

(<https://www.thaiseeds.com/Graphics/fruits/keylime.jpg>)



Common West Indian lime characteristics (adapted from Hodgson, 1967; Swingle and Reece, 1967)

- 1. Small to medium-sized bushy tree with many slender twigs having many short, very sharp, slender spines.**
- 2. Foliage dense with small (5-7.5 cm), broadly lanceolate, pale green, blunt-pointed leaves with winged petioles. New growth faintly purple-tinted but soon fades, especially in warm weather.**
- 3. Flowers and buds small, white, in clusters of 2 to 7, rarely single, 4 to 5 petals, 20 to 25 stamens, stigma deciduous, flowering all year but mainly spring and late summer.**
Flowers and flower buds faintly purple-tinged but color soon fades especially in warm weather.
- 4. Fruit very small, round, obovate or short-elliptical; sometimes with slight neck; base also rounded but usually with a slight nipple. Rind thin, smooth, leathery, tightly adherent, glandular dotted, greenish-yellow at maturity. Segments 9 to 12, flesh color greenish-yellow, tender, juicy, fine-grained, highly acid, moderately seedy, highly polyembryonic.**
- 5. Seeds small, oval, white inside. Fruit mature year-round but mainly in winter, earlier in hot climates. Fruit drops when mature.**
- 6. Tree is very cold sensitive (28°F)(McNeil, 2001).**

Tahiti, Persian, Bearss Lime (*Citrus latifolia* Tanaka) • This is the large-fruited commercial acid lime. It is grown commercially primarily in the United States (Florida and California) because of its greater cold tolerance (26-27 degrees F.)(McNeil, 2001), lower heat requirement, and larger fruit size than the West Indian lime. The origin of this lime is unknown. The Tahiti lime bears its name from its introduction from Tahiti into California sometime between 1850 and 1880 (Hodgson, 1967). It was introduced into Australia as the Persian lime as early as 1824, possibly from Brazil (Bowman, 1955).

The origin of the name Persian is unknown. The fruit has not been found growing in Persia (Iran) (Chapot, 1965), however, similar fruits have been observed growing in Tunisia and Algeria possibly having been grown there for centuries (Hodgson, 1967).

The tree and fruit characteristics of the Bearss lime correspond very closely with that of the Tahiti lime (Hodgson, 1967). It appears to have originated in 1895 as a seedling grown from a seed from a fruit of Tahitian origin (Webber, 1943). This occurred in Porterville, California, on the property of T. J. Bearss, a nurseryman. These three limes (Tahiti, Persian, Bearss) appear to be and are considered by most to be identical, therefore, are presented here as one and the same. Persian is the commonly used name in Florida, Bearss in California, although Tahiti should be the most appropriate name (Jackson, 1991).

Persian/lime/fruit:

(https://www.bing.com/images/search?view=detailV2&ccid=hq%2fjRVy0&id=68F17B8F4653D2FC8D9B8727ACBFBBA76F12044B&thid=OIP.hq_jRVy02y-chpCEMOpUNAHaJQ&mediaurl=https%3a%2f%2fcdn.shopify.com%2fs%2ffiles%2f1%2f2336%2f3219%2fproducts%2fshutterstock_188169533bearsss_1024x1024.jpg%3fv%3d1554664732&exph=1000&expw=800&q=bearss+lime&simid=608010044826845513&ck=A65EA19FF1D3C0B6B5F2E5A80E5C2940&selectedIndex=0&FORM=IRPRST&ajaxhist=0)

Bearss/lime/foilage/and/fruit:

(https://www.bing.com/images/search?view=detailV2&ccid=S3a9tBtj&id=8861ABB305512E4B671A807967F307FA5EA60D02&thid=OIP.S3a9tBtjwz64o95FZcMLhAHaE7&mediaurl=https%3A%2F%2Fi.pinimg.com%2Foriginals%2F78%2F9c%2F0e%2F789c0e08dfdccc752fe13c12df830aa5.jpg&exph=853&expw=1280&q=Lime+Tree+Leaf&simid=608026790815532252&ck=5D52CAA46E3B3FE1BC4790BCFDC4171D&selectedIndex=9&form=IRPRST&ajaxhist=0&vt=2&sim=11&pivotparams=insightsToken%3Dccid_7qjGQb6S*cp_CCE9722F9A6A0FCE9E689D043CA6C461*mid_67ADEAC3FE71A553C0B639A2E5B70E110DCDDE66*simid_608037197556877927*thid_OIP.7qjGQb6Sml39pev8Ox6TwAAAA&iss=VSI)



The Tahiti lime is considered by some (Reece and Childs, 1962; Jackson, 1991) to be of hybrid origin with one parent being the small-fruited West Indian lime and the other being either lemon or citron (Reece and Childs, 1962). The seedlessness of this lime bears from its complete lack of viable pollen and few functional ovules (Hodgson, 1967). A serious defect of this lime is the frequent development of stylar or blossom-end rot (Opitz and Platt, 1969). Photo: (tastylandscape.com).



Common Tahiti lime characteristics (adapted from Hodgson, 1967)

- 1. Vigorous tree, medium to medium-large, spreading, dense green foliage, nearly thornless. Cold sensitive at 26-27°F (McNeil, 2001); almost as cold hardy as the true lemon tree.**
- 2. Medium-sized leaves, broadly lanceolate, winged petioles, new growth faintly purplish.**
- 3. Medium-sized flower buds and flowers; flowers faintly purplish; flowering all year but mainly in spring.**
- 4. Medium-small fruit, oval, obovate, oblong or short elliptical; base rounded sometimes slightly necked; apex rounded and with slight nipple; seedless; thin, smooth, adherent rind; mature color pale lemon yellow; 10 segments; axis small and solid. Flesh color pale greenish-yellow; tender, juicy, very acid. Styler end breakdown of overmature fruit.**
- 5. Everbearing but mainly with summer crop in hot climates (southern Florida), or winter crop in cooler climates (southern California).**

Indian/or/Palestine/Sweet/Lime/(*Citrus limettoides* Tanaka)

Hardy to 30 degrees F (FourWindsGrowers.com)

The Indian sweet lime is the *mitha nimbu* of India, the *limim helou* or *succari* of Egypt, and the Palestine sweet lime (Hodgson, 1967). It is grown commercially in northern India and Egypt. It is widely but not commercially grown around the Mediterranean (Jackson, 1991). It is also a popular garden plant in other areas. It has been an important rootstock in parts of India and a very important stock in Palestine and Israel. It is used as a stock for oranges in Brazil and Israel (Jackson, 1991). It was abandoned after testing as a stock in Florida because of its susceptibility to xyloporosis virus (Jackson, 1991). It has primarily been propagated by cuttings in Egypt while other areas mostly utilize seedlings. Palestine sweet lime fruit:

(https://search.aol.com/aol/image;_ylt=AwrJ6yuCHYtfx7cAlydpCWWH;_ylu=Y29sbwNiZjEEcG9zAzlEdnRpZAMEc2VjA3Nj?q=palestine+sweet+lime&v t=loki-tb sb#id=0&iurl=http%3A%2F%2Fwww.logees.com%2Fmedia%2Fcatalog%2Fproduct%2Fcache%2F1%image%2F600x600%2F9df78eab33525d08d6e5fb8d272F136e95%2FC%2F2%2FC2006-2-large.jpg&action=click) (<https://www.naturehills.com/palestine-lime-tree>)



The flavor of the sweet lime is highly esteemed by people in India, the Near East, Egypt and Latin America but is considered insipid to those in the United States and California. It is thought to have medicinal value in the treatment of fevers and liver problems in those regions where it is favored (Hodgson, 1967).

Columbia has been the most common clonal selection of the sweet lime (Hodgson, 1967).

The Mediterranean or Tunisian limetta has often been classified as a sweet lime, however, Hodgson (1967) believed it should be considered as an acidless member of the limetta group (*C. limetta* Risso). It is similar to the Indian sweet lime only in flavor and cupping of the leaves, the rind oil and all other characteristics are different but typical of the other limettas. The Mediterranean sweet lime of Spain and Italy was the one responsible for eighteenth century British sailors being called "limeys" when they carried lime juice on voyages to prevent scurvy (Jackson, 1991).



Finger Lime *Citrus australasica* F. Muell.

Finger limes are originally from Australia. The fruits are small and long, roughly resembling a finger. The skin is thin and the pulp is made up of small, round beads of tart juice. It has been referred to as the caviar of citrus and is a sought after culinary fruit. The trees are small, with fragrant flowers and numerous thorns and produce copious amounts of fruit throughout the year.

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[HTTPS://EDIS.IFAS.UFL.EDU/IMAGE/14855029/SCREEN](https://edis.ifas.ufl.edu/Image/14855029/SCREEN)

FINGER LIME IN THE UNITED STATES

The United States Department of Agriculture first imported finger lime seeds and cuttings more than a century ago as a research subject, with the crop remaining at the research level into the twenty-first century. The University of California-Riverside (UC-Riverside) developed an interest in the crop and began rootstock trials and hybridization research experiments with finger lime trees in 1965. As part of the UC-Riverside Citrus Variety Collection, UC scientists have released finger lime budwood for California nurseries to use in propagating trees. California is the only US state that grows finger lime on a commercial basis, at around 15,000 finger lime trees (Karp 2009).

Photo: <http://plantsforsaleselangor.blogspot.com/2016/09/grafted-finger-lime-many-variety.html>AustrFingVisalia007_000.jpg

See the UCR website information:

https://citrusvariety.ucr.edu/citrus/microcitrus_australasica_3661.html





**Southern Florida
may have potential
for finger lime
production.**

***Citrus australasica* F. Muell.**

Photo:
www.freshplaza.com

***Citrus australasica* F. Muell., the Australian finger lime** or caviar lime, is a thorny understorey shrub or small tree of lowland subtropical rainforest and rainforest in the coastal border region of Queensland and New South Wales, Australia.

It has edible fruits which are under development as a commercial crop.^{[2][3]}

The finger lime has been recently popularized as a gourmet bushfood. The globular juice vesicles (also known as pearls) have been likened to a "lime caviar",^{[5][6]} which can be used as a garnish or added to various recipes. The fresh vesicles have the effect of a burst of effervescent tangy flavour as they are chewed. The fruit juice is acidic and similar to that of a lime. Marmalade and pickles are also made from finger lime. Finger lime peel can be dried and used as a flavouring spice.^[2]

Commercial use of finger lime fruit started in the mid-1990s with boutique marmalades made from wild harvested fruit. By 2000 the finger lime was being sold in restaurants, and exported fresh.^[2]

The finger lime has been recently grown on a commercial basis in Australia in response to high demand for the fruit. There is an increasing range of genetic selections which are budded onto citrus rootstock. With the sudden high market demand for the fruit the primary source of genetic material for propagation has been selections from wild stock.

https://en.wikipedia.org/wiki/Citrus_australasica

Growing Finger Lime in Florida

<https://blogs.ifas.ufl.edu/stlucieco/2021/06/10/growing-finger-lime-in-florida/>

Citrus growers are beginning to look into alternative crops to diversify and find new markets. Some of these alternative crops might work, while others will not because of lack of adaptability to local climate or lack of market for that specific crop. When selecting any crop, it is necessary to choose a crop that is native to a similar climate or is already adapted to local conditions. Florida tropical fruit industry has some challenges such as more foreign competition, higher domestic labor costs, stringent US environmental regulations, and an increase in invasive alien pests and diseases in the state. It is difficult for Florida's growers to compete in some of the markets for traditional tropical fruit crops. Therefore, they are actively searching for alternative niche-market crops that has the potential of relatively high returns. In this article we will talk about one of the potential alternative niche crop, called finger lime.

There is limited data about production and marketing of the crop in the United States. The Australian finger lime (*Microcitrus australasica* F. Muell.) is native to the rainforests located in the coastal border regions of Queensland and New South Wales (NSW) in Australia. As you probably know, it belongs to citrus family. It tastes like lemon, lime, and grapefruit. There is different color of finger lime such as pink and green. The fruit is about three inches in length consisting of hundreds of tiny, tangy juice vesicles, which some refer to as citrus caviar due to their shape, desirability, and high price.

Finger lime was imported by USDA more than a century ago as research subject. California is the only US state that grows finger lime on a commercial scale.

Climate Requirements

Finger lime is a frost sensitive, meaning it should be planted in south and central Florida. Since finger lime is sensitive to wind, it is highly recommended to establish a windbreak before planting.

Soil Requirements. Finger lime needs a full sun and well-drained soils.

Fertilization. The tree requires less fertilizer compare to other commercial citrus varieties because of smaller leaves and canopy. In general, finger lime can grow from a large shrub to a small tree (up to 18 ft).

Varieties. There are several varieties available to growers include DPI-50-36, DPI-205-1, and DPI-205-4. However, these varieties are the typical non-pigmented type.

Pest and Disease. Finger lime has been reported to be highly resistant to *Phytophthora citrophthora* root disease. Preliminary studies have also indicated that finger lime is tolerant to Huanglongbing (HLB), or citrus greening.

Normal Calamondin, called Calamonsi in the Philippines



<https://www.naturehills.com/media/catalog/product/cache/429326693ee8b1c5f8feef3778eb2ea4/c/a/calamondin-orange-cluster-600x600.jpg>

Other Acid Citrus Fruits Used Like the Lime Calamondin (*Citrus madurensis* Loureiro, *Citrus mitis* Blanco) The calamondin is a dwarf and bushy tree used as an attractive ornamental shrub or potted plant. It also makes an excellent rootstock for the Nagarni kumquat (Hodgson, 1967). The fruit are small and mandarin-like in appearance, however, they are quite acid and used like a lime. The fruit are seedy with a thin, reddish orange rind and can be peeled and segmented similarly as for the mandarin. Most fruit mature in winter. The seeds are true to type, thus will reproduce the tree exactly. The tree is hardier to cold than all except the kumquats and the trifoliolate orange. It is hardy between 10 to 20°F. (McNeil 2020) or 18 degrees F. (Wikipedia, Cold Hardy Citrus)

Peters Variegated Calamondin

The calamondin is believed to have originated in China from which it spread throughout the Orient, especially Indonesia and the Philippines (Hodgson, 1967). It was introduced from Panama into Florida as an "acid orange" in 1899 by Lathrop and Fairchild and was called the "Panama orange" (Jackson, 1991). It had come to Panama from Chile and to Chile from China (Jackson, 1991). Some believe it may be a hybrid of lime and [a sour] mandarin or lime and kumquat (Jackson, 1991). A variegated form is available in California called the Peters (Hodgson, 1967).



http://idtools.org/id/citrus/citrusid/images/fs_images/Variegated_Calamondin_IMG_5327.jpg

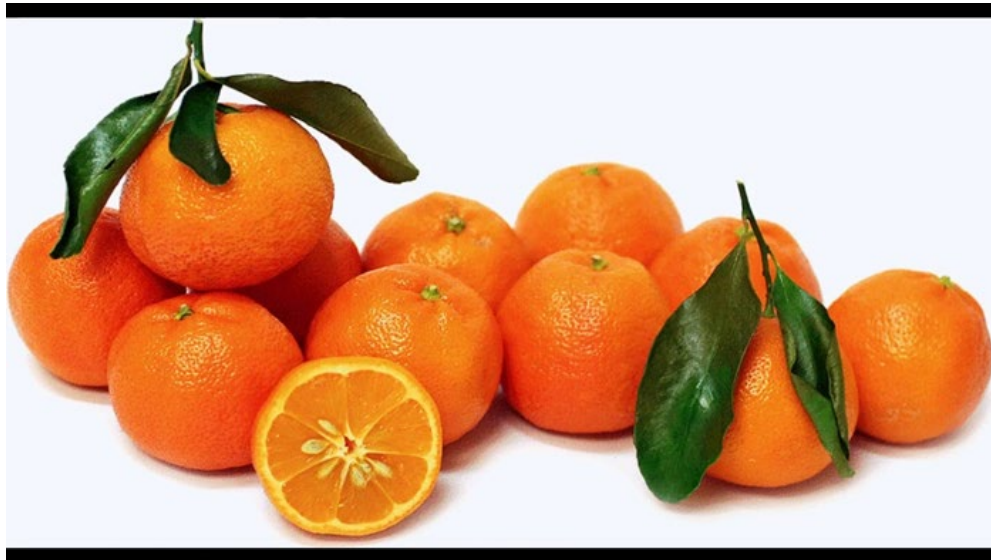
Common Calamondin Characteristics (adapted after Hodgson, 1967):

- 1. Medium-sized tree, upright, columnar, nearly thornless, productive. Hardy between 10 and 20 F. (McNeil, 2001). 18 F. on [Wikipedia, Cold Hardy Citrus](#).**
- 2. Small, broadly oval leaves.**
- 3. Very small fruit, oblate to spherical, apex depressed or flattened. Holds on tree well.**
- 4. Orange to orange-red rind, smooth, very thin, finely pitted, easily separable, sweet and edible.**
- 5. Nine segments, small semi-hollow axis.**
- 6. Orange-colored flesh, juicy, tender, and acid.**
- 7. Few, small, plump seeds, polyembryonic with green cotyledons.**

Rangpur lime (*Citrus limonia* Osbeck) Hardy to 16 degrees F. (**Wikipedia, Cold Hardy Citrus**) The Rangpur is widely used as a dooryard hardy fruit and ornamental in California and as a potted or tubbed plant (Hodgson, 1967). It is easily propagated by cuttings and is readily dwarfed when its roots are confined. The seeds are highly polyembryonic, thus reproduce true from seed. In other countries, such as in the Orient and South America (Brazil), its primary use is as a rootstock because of its resistance to the tristeza virus and soil-borne diseases. It is highly susceptible to the exocortis virus, however. Rangpur lime fruit:

(<https://i.ytimg.com/vi/yQryIMtBi9g/maxresdefault.jpg>)

Rangpur lime tree (Hawaii): (http://www.hawaiiifruit.net/konalime/rangpur_lime.html)



The Rangpur acid fruit are medium-sized (about 2 inches in diameter), mandarin-like, sometimes with a slight neck. Fruit mature in fall and winter. The tree is medium-sized, vigorous and productive and cold hardy to about 16°F. (Wikipedia, Cold hardy Citrus).

The Rangpur is believed to have originated in India and from there spread throughout the Orient and to the East Indies (Hodgson, 1967). Webber (1943) claims it was introduced into Florida in the late 1800's from seeds obtained from northwestern India by the Reasoner Brothers of Oneco. Some believe it may be a hybrid of mandarin with lemon or lime (Jackson, 1991).

Common names for the fruit in India include Rangpur, Sylhet lime, surkh nimboo, Sharbati, and marmalade lime; Canton lemon in South China, hime lemon in Japan, cravo lemon in Brazil, Japanche citroen in Java, and Rangpur lime or mandarin lime in the United States (Hodgson, 1967).

Common Rangpur Lime Characteristics (adapted after Hodgson, 1967):

- 1. Medium-sized, spreading and drooping tree, slender twigs, with few small thorns, vigorous, productive. Hardy to 16 degrees F. ([Wikipedia, Cold Hardy Citrus](#)).**
- 2. Foliage dull-green, mandarin-like, new growth lightly purple-tinted.**
- 3. Flowers small, mandarin-like, buds and petals deeply purple-tinged.**
- 4. Fruit small to medium-sized, depressed globose, round or broadly obovate, sometimes with furrowed collar or low neck, often having slight nipple partially or entirely surrounded by a shallow furrow. Holds on tree well.**
- 5. Yellowish to reddish-orange rind, minutely pitted, smooth to slightly rough, thin, moderately loose.**
- 6. Orange-colored flesh, tender, juicy, strongly acid. 8-10 segments, loosely adherent, axis large and hollow.**
- 7. Seeds numerous [about 14], small, highly polyembryonic, with light green cotyledons.**

Two other forms of the Rangpur are the Kusaie lime and the Otaheite orange.

Kusaie Lime, Kusaie Rangpur • Probably same hardness as Rangpur, 16 degrees F. This is a yellow-colored highly acid fruit. The fruit differs from the Rangpur only in color while the tree is indistinguishable. It is of local/importance/as/an/acid/fruit/in/the/Hawaiian/Islands./It/is/mainly/an/oddity/or collector's/item/elsewhere/in/the/UnitedStates(Hodgson,1967).

Hodgson (1967) claimed the origin of the Kusaie to be India. Webber (1943) said that it was introduced into Hawaii by Henry Swinton in 1885 from Kusaie Island of the Caroline group, and later into the United States by Webber in 1914.

Kusaielimetree.(https://citrusenthusiast.blogspot.com/2016/06/taste-test-kusaie-lime_48.html)

Kusaielimefruit(<https://www.kings.co.nz/catalogsearch/result/?cat=0&q=kusaie+lime>)
(<http://boulevardandboutique.co.nz/product/lime-kusiae>)



The Otaheite acidless Rangpur lime. Same hardiness as Rangpur? 16 Degrees F. Believed to have originated in India, however, the first reference to it was as a small orange from Otaheite (Tahiti) brought to Paris from England in 1813 (Hodgson, 1967). It is not known how or when it reached the United States, but it was described as a potted ornamental in 1882 in the nursery catalog of R. J. Trumble of San Francisco, California (Butterfield, 1963; Hodgson, 1967). It is an acidless or sweet form of the Rangpur. Easily propagated from cuttings, as are all the Rangpur, it is extensively grown in the United States as a hardy potted ornamental, primarily as a winter house plant. Otaheite orange fruit on tree: (<https://www.oscartintori.it/en/prodotto/otaheite-orange/>) Otaheite orange tree: (<https://www.pinterest.com/pin/283023157807550432/>)



Limequats (*Citrus aurantifolia* x *Fortunella* spp.)

Hardy to 20 degrees F. Two of these hybrids, Eustis and Lakeland, were produced by Swingle in 1909 with hope that they would produce a more cold hardy type of lime which would allow lime culture further north in Florida (Jackson, 1991). They are more cold hardy than commercial limes, almost as cold hardy as the sweet orange tree (20° F). They have not achieved commercial production, however, but are popular as home-grown lime substitute fruits on a dwarf plant. They are popular in California as potted or tubbed plants (Hodgson, 1967).

Eustis Limequat (Key Lime x Marumi Kumquat) • Fruit is light yellow, nearly oval, 1¾ by 1¼ inches, with about eight seeds, rind is sweet. Fruit mature year-round, with most in late fall and winter. Tree has small leaves and many small thorns. (adapted after Jackson, 1991)

Lakeland Limequat (Key Lime x Marumi Kumquat) • It has larger fruit (2¼ x 1¾ inches) than the Eustis, a slightly deeper yellow color, similar shape and acidity, fewer (about five) and larger seeds. Twigs are almost thornless. (adapted after Jackson, 1991)

Lakeland Limequat fruit (www.ebay.com)
Eustis limequat tree (www.flickr.com)



CHAPTER X

Citrus aurantium L. (The Sour, Bitter, Seville Orange, or Bigarade)

Hardy to the low 20's F. (McNeil, 2001). The Sour, Bitter, or Seville Orange, Bigarade (*Citrus aurantium* L.) The sour orange has been utilized primarily in four ways: as a rootstock, to make marmalade from its peel, to make perfume from its flowers, leaves and young shoots, and as an ornamental tree.

It is believed to have originated in northeastern India and nearby China and Burma (Hodgson, 1967). It spread northward to Japan and westward to the Mediterranean and Europe. It was the only orange known to Europeans until the fifteenth century when sweet oranges from southeast Asia reached Europe (Swingle and Reece, 1967). It was one of the first citrus to be taken to the New World.

Sour orange has been widely used as a rootstock in many important citrus areas of the world because of its foot rot (brown rot gummosis) tolerance. Its shortcoming, however, has been susceptibility to the tristeza (quick decline) virus. It's use as a rootstock should be discouraged in citrus growing areas where tristeza is prevalent.

The sour orange fruit is unacceptably sour and bitter for fresh eating. Its peel, however, is very suitable for its principal use, marmalade. Bitter orange marmalade, with its distinctive bitter taste, has for centuries been in high demand by European consumers, especially those in Great Britain (Hodgson, 1967; Ray and Walheim, 1980). True marmalade is made from sour orange peel. Sour orange trees are grown commercially to a limited extent in most of the Mediterranean countries to meet the demand for marmalade production especially by Great Britain.

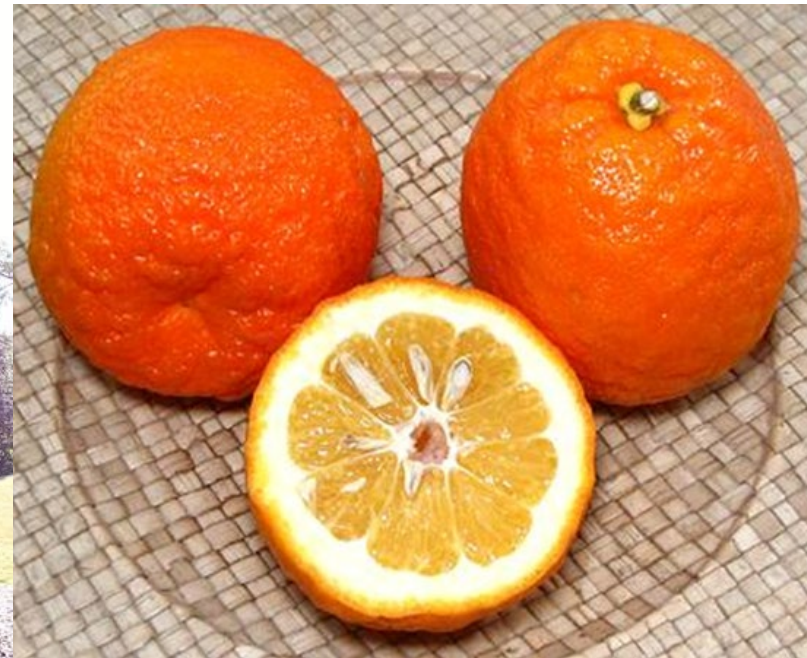
The principal production area has been near Seville in southern Spain (Hodgson, 1967). Other products or uses made from the fruits are rind oil, liqueurs such as Curacao and Cointreau, and to make a refreshing drink (Hodgson, 1967; Ray and Walheim, 1980).

Sour orange products used to make perfume are oil of petit grain distilled from the leaves and young shoots, and oil of neroli from the flowers. Orange flower water, a byproduct of these processes, is used to make perfume, for cake flavoring, and for medicinal use (Hodgson, 1967). Special varieties may be grown for flower and perfume production.

Sour orange trees are also useful as ornamental trees because of the attractiveness of both the dark green tree and the deep orange fruit, and their hardiness and resistance to unfavorable conditions (Hodgson, 1967; Ray and Walheim, 1980). They are useful as hedges, specimen trees, and street trees).

Sour Orange tree: (<https://paradisenuresery.com/product/sour-orange-tree-naranj-shiraz/>)

Bitter orange fruit: (www.clovegarden.com)



SOUR ORANGE CULTIVARS

Hodgson (1967) stated that there are three natural groups of sour oranges: the common bitter orange, the bittersweet orange, and the variant bitter orange (perfume and ornamental cultivars).

Common Bitter or Sour Orange. This is the common sour orange used as a rootstock and for marmalade, oil of neroli, and orange flower water. The Sevillano has been the primary marmalade variety in Spain for which there are several clones selected for vigor, thornlessness, and production (Hodgson, 1967).

Bittersweet Orange. The fruit has lower acidity and better flavor than the sour orange. It is believed to be a mutant of the sour orange. Other differences as compared to the sour orange are slightly smaller, smoother-rinded, and paler-colored fruit; denser, more compact growth habit, broader and less taper-pointed leaves. (Hodgson, 1967)

Two named cultivars are the Bittersweet of Florida and the Paraguay (Apepu). The latter has been extensively grown in Paraguay as a source of oil of petit grain (Hodgson, 1967).

Variant Bitter Oranges• These have many diverse forms or varieties used for perfume and/or ornamental purposes. Differences as compared to the common or bittersweet oranges are: less vigorous trees, broad spreading tops, few or no thorns, smaller and less winged leaves, smaller and flatter fruits with fewer seeds, and profuse flowering (Hodgson, 1967).

Perfume Cultivars

The three most widely grown perfume cultivars are the **Bouquet (Bouquet de Fleurs)**, **Bouquetier a Grandes Fleurs (Boquetier a Peau Epaisse)**, **Bouquetier de Nice a Fleurs Doubles (Bouquetier de Nice a Fruits Plats, Bouquetier de Nice)** (Hodgson, 1967).

The Bouquet is also used as an attractive ornamental in California, especially for hedges. The Bouquetier a Grandes Fleurs is the most important perfume cultivar. The fruit of the latter cultivar is excellent for confections.

Perfume cultivars grown primarily for their profuse flowers have been grown extensively in the French Riviera, the perfumery center of the Mediterranean basin, and in North Africa (Hodgson, 1967). Italy and Paraguay, and to some extent Spain and North Africa, have used flowers of the common bitter orange to make oil of neroli and orange flower water.

Ornamental/Cultivars

The perfume cultivars can also be grown as ornamentals, however, other cultivars of the sour orange that are only grown as ornamentals are the Abers Narrow Leaf, Kabusu, Kikudaidai, Panache, Variegated (Panache Variegated Sour), Willowleaf, and Zadaidai (Hodgson, 1967).

The Abers Narrow Leaf is believed to have originated and is grown in Florida. The Variegated originated and is grown in California, as is the Willowleaf. The Kabusu and Zadaidai are grown in Japan and the fruit are used formarmaladeandvinegar.

Common Sour Orange Characteristics (adapted after Swingle and Reece, 1967):

- 1. Medium-sized tree, rounded top. Hardy to low 20's F. (McNeil, 2001).**
- 2. Angular twigs, single, short, slender thorns, or stout, long thorns on vigorous shoots.**
- 3. Medium-sized leaves, ovate, blunt-pointed, broadly rounded to cuneate at the base, petioles rather broadly winged, sometimes narrower, narrowing rapidly to the wingless base.**
- 4. Large flowers, very fragrant with oil of neroli, 5-12 per cent male.**
- 5. Medium-sized fruits (usually), subglobose, slightly depressed at both ends (usually), thick peel, somewhat rough surface, brilliant orange with reddish tint. Fruit color in November and December and will hang on the tree for nine or ten months (Ray and Walheim, 1980).**
- 6. Ten to twelve segments, acid pulp, the core becoming hollow as fruit matures. Numerous seeds.**

FRUITS RESEMBLING THE SOUR ORANGE

Natural Hybrids of the Sour Orange • There are several natural hybrids of the sour orange, some of which may be commercially important in some countries (Hodgson, 1967). The primary ones are the kitchli, grown commercially in southern India; the Nanshodaikai, from Taiwan but not commercially important except as a possible substitute for sour orange rootstock; Naruto (Narutomikan), grown on Awaji Island, Hyogo Prefecture, Japan; and Sanbo (Sanbokan), grown in Wakayama Prefecture, Japan.

Myrtle-leaf Orange (*Citrus myrtifolia* Rafinesque) • Hardy to 18 degrees F. ([Wikipedia, Cold Hardy Citrus](#)). This is the chinotto of Italy and the chinois of France (Hodgson, 1967). It may be considered to be a botanical variety of the sour orange because of their similarities. It is thought to be a mutation of the sour orange, however, is given species standing due to its differences from the sour orange.

It is believed to have been introduced centuries ago into the Mediterranean from China (Hodgson, 1967). Its use has been primarily as an ornamental, however, the fruits of certain types have been highly claimed for candying or crystallizing whole. Commercial culture has been limited mainly to the Italian province of Liguria.

Myrtle Leaf Orange fruit on tree: *Citrus aurantium* var. *myrtifolia*
Ker-Gawl (davesgarden.com) Also called the **Chinotto**. Hardy
to 18 degrees F. ([Wikipedia, Cold Hardy Citrus](http://en.wikipedia.com))
Chinotto tree at the Botanical Garden of the Brissago Islands:
(en.wikipedia.com)



All forms or cultivars of the myrtle-leaf orange consist of small trees of low vigor and slow growth, thornlessness, dense and compact growth habit, and crowded leaves due to short internodes. Leaves are usually lanceolate and pointed, very small, and dark green. The fruit are small, oblate to round, orange to deep orange, with a somewhat rough rind. Seed number varies from zero, to few, to many. (Hodgson, 1967) These characteristics make for an attractive, compact, ornamental tree.

There are four forms or cultivars of the myrtle-leaf orange according to Hodgson (1967): the Boxwood Leaf Chinotto, a less dwarfed variety with larger, oval-shaped, round pointed leaves like the boxwood, an unfruitful clone in California; the Crispifolia Chinotto (Crinkle leaf Chinotto), known only in the Mediterranean, less dwarfed and more upright, with crinkled or twisted leaves; the Large Chinotto, less dwarfed and less compact, broader and larger leaves, flowers less showy, highly productive with larger fruit that hang well on the tree and preserve and candy well, some clones are seedless; Small or Dwarf Chinotto, highly dwarfed tree or shrub, thornless, very small, clustered, myrtle-like leaves; compact, symmetrical, round or broadly conical form, profuse blossoms, varies in fruitfulness, fruit hangs well until picked.

Bergamot (*Citrus bergamia* Risso) • Cold hardy to 28 degrees F.

(<https://foodgardening.mequoda.com/plant-profile/bergamot-orange-tree/>) The bergamot appears to be a hybrid or botanical variety of the sour orange, however, it has been given species standing since its differences from the sour orange are numerous (Hodgson, 1967). It is believed to have originated as a seedling in southern Italy with sour orange as one parent and possibly an acid lime or lemon as the other. It has been known in the Mediterranean for several centuries.

Bergamot, *Citrus bergamia* Risso ([istockphoto.com](https://blog.thermasol.com/))
(<https://blog.thermasol.com/>)



Bergamot (*Citrus bergamia* Risso). The bergamot appears to be a hybrid or botanical variety of the sour orange, however, it has been given species standing since its differences from the sour orange are numerous (Hodgson, 1967). It is believed to have originated as a seedling in southern Italy with sour orange as one parent and possibly an acid lime or lemon as the other. It has been known in the Mediterranean for several centuries.

The commercial production of the bergamot fruit has been chiefly in the province of Calabria in southern Italy (Hodgson, 1967). It is grown primarily for the rind oil, bergamot oil, which is commercially important as the base for cologne water (eau de cologne). Another product, bergamot petit grain oil, is distilled from the leaves and young growth, an important byproduct of which is citric acid. The desirable characteristics of its oil were recognized as early as 1750.

There has been some recent interest in growing bergamot in California, at least on a trial basis.

Common Bergamot Characteristics (adapted after Hodgson, 1967):

- 1. Moderately vigorous, upright to spreading tree, thornless, medium-small to medium. Cold hardy to 28 degrees F.**
[\(https://foodgardening.mequoda.com/plant-profile/bergamot-orange-tree/\)](https://foodgardening.mequoda.com/plant-profile/bergamot-orange-tree/)
- 2. Large lemon-like leaves, but sharper-pointed, with longer and more broadly winged petioles.**
- 3. Medium-large, white flower buds and flowers with one bloom period.**
- 4. Small to medium-large lemon-yellow-colored fruits, oblate, round obovate, or broadly pyriform, frequently with a small navel, and usually with a persistent style.**
- 5. Numerous segments, solid core, moderately firm, pale greenish-yellow flesh, highly acid with a faint bitter aftertaste.**
- 6. Medium-thin rind, smooth to moderately rough, ridges, and adherent.**
- 7. Few or no seeds, highly monoembryonic, often not well-developed, cotyledons white or faintly green.**
- 8. Strongly pungent and agreeable aromatic oil in both foliage and fruits, similar to that of the sour orange leaf but not the fruit.**

BERGAMOT CULTIVARS

There are several cultivars of bergamot which include the Femminello and Castagnaro clones of the common Bergamot, the Melarosa, the Torulosa (Striata), and the Piccola (Petite) (Hodgson, 1967). Femminello and Castagnaro have been the preferred commercial cultivars of bergamot, with Femminello having the better productivity and rind oil quality (more aromatic).

CHAPTER/XI

***Citrus medica* L. (The Citron) and Citron Hybrids**

The Citron (*Citrus media* L.) Hardy to 31 degrees F. (McNeil, 2001). The citron is believed to be the first citrus to be cultivated, the first to reach the Mediterranean, and the first to become known in Europe (Tolkowsky, 1938).

Citron fruit (en.wikipedia.com)

Etrog Citron on tree (backyardcitrustrees.com)



The pulp and juice of the thick-rinded citron fruit are useless, but the rind is highly valued after candying for use in cakes and confections. One should be cautioned not to confuse this citrus fruit with a watermelon used for candied rind (Jackson, 1991), nor the French word for lemon (Hodgson, 1967), both having the same name citron.

Hodgson (1967) believes its origin to have been in northeastern India and adjacent areas. It is believed to have been introduced to the eastern Mediterranean following the invasion of Persia by Alexander the Great about 325 B.C. (Swingle and Reece, 1967). It spread to Media and Persia becoming known to the Greeks and later the Romans. The Romans then called it the Persian or Median apple which became the basis for its species name, *medica*.

Its main use by the ancient Greeks and Romans seems to have been as a perfumant and moth repellent because of its delicate and lasting fragrance. It is believed to have reached the Holy Land soon thereafter. Its earliest possible reference in the Holy Land was the thirteenth century B.C. as the hadar or goodly fruit of the Bible (Lev. 23:40) according to Jewish scholars (Hodgson, 1967). This ancient use was and still is as part of the Jewish Feast of Tabernacles (Succoth). The Etrog (Ethrog) citron is required in the ceremony.

Theophrastus (a Greek botanist, biologist, physicist, ethics, metaphysics) called the citron the Median or Persian apple in some of his writings in 310 B.C. He cited its inedibility, but praised its use as a remedy for rheumatism and sore mouth, and as a moth repellent. The citron fruit had the same uses as the wood of the Sandarak tree, *Callitris quadrivalvis*, therefore, the ancient name of this wood 'Citrus' was transferred to the citron fruit as *Mala citrea*. "This renaming of the Median apple as the citrus apple led to the transfer of the name 'Citrus' first to the citron and later to other citrus fruits." (Swingle and Reece, 1967)

Cultivation in Italy is believed to have begun in the first century. It was brought to the West Indies and Brazil soon after the discovery of the New World. The Spanish missionaries brought it from Mexico to California (Butterfield, 1963).

The more recent usage of the citron has been candying of the peel for use in cakes and confections. The rind is commonly exported in a brine to markets where it is to be candied, especially to Great Britain, France, and the United States (Hodgson, 1967).

Commercial production of citron should be and is limited to areas where there are mild freezing-free winters and mild (not hot) summers since it is prone to freezing (31°F) and heat injury. Wind-induced scarring should also be avoided since premium prices are paid for unblemished fruits (Hodgson, 1967).

Citron rind (<https://www.sanpellegrinofruitbeverages.com/us/>)
Fingered Citron, Buddha's Hand, An ornamental variety.
(<https://www.thetreecenter.com/buddhas-hand-citron-tree/>)



***Citrus medica* var. *sarcodactylis*, or the fingered citron, is an unusually shaped citron variety whose fruit is segmented into finger-like sections, resembling those seen on representations of Buddha. It is called Buddha's hand in Chinese, Japanese, and Korean. "The different cultivars and variations of this citron variety form a gradient from "open-hand" types with outward-splayed segments to "closed-hand" types, in which the fingers are kept together. There are also half-fingered fruits, in which the basal side is united and the apical side fingered. The origin of this kind of citron is commonly traced back to South or East Asia, probably northeastern India or China, where most domesticated citrus fruits originate.**

(https://en.wikipedia.org/wiki/Buddha%27s_hand).

The principal commercial citron-producing countries have been France (Corsica), southern Italy (Calabria, Sicily and Sardinia), and southern Greece (Crete and other islands/in the Cyclades) (Hodgson, 1967; Jackson, 1991).

The citron had been grown and processed to a limited extent in southern California, but this was not a commercial success because of competition from the Mediterranean countries (Hodgson, 1967).

Common Citron Characteristics (adapted after Hodgson, 1967):

- 1. Shrub or small tree, thorny, light gray bark, soft wood, thick-stemmed, straggly growing, short-lived, injury (31°F) and recovers slowly or not at all.**
- 2. Highly sensitive to freezing , rumpled blades, serrated margins; short, wingless petioles.**
- 3. Large, oval to oblong leaves.**
- 4. Large flowers, purple-tinged or not; variable, but often high proportion male (by pistil abortion), produced year-round.**
- 5. Large to very large fruits, usually oblong and blunt-pointed, with pronounced mammilla, and often a persistent style.**
- 6. Very thick, yellow rind, fleshy, tightly adherent; smooth, but often bumpy surface, rind oil pleasantly aromatic.**
- 7. Flesh is minute, not juicy, and firm.**
- 8. Juice is either acid or sweet.**
- 9. Numerous seeds, monoembryonic, with a pronounced beak and white cotyledons.**

Acid citrons:

- a. Purple flower buds and purple-tinged flowers.**
- b. Pink-colored new shoot growth.**
- c. Acid pulp.**
- d. Seeds have dark-colored inner seed coat and chalazal spot.**

Sweet citrons:

- a. No purple or pink coloration of flower buds, flowers, or new growth.**
- b. Sweet pulp (lacks acid).**
- c. Inner seed coat colorless, chalazal spot light yellow.**

CITRON CULTIVARS

Acid Citron Cultivars. The **Diamonte (Cedro Liscio)** and the **Etrog (Ethrog, Atrog)** are the two most important acid citron cultivars. Diamonte has been the principal variety of Italy. It was introduced into the United States in 1898. California introductions similar to the Diamonte are the **Sicilian** and the **Italian**. **Jericho Ethrog** has been the most widely planted citron cultivar in Israel. (Hodgson, 1967) **Buddha's Hand (fingered)** citron has been prized for centuries in Indo-China, China, and Japan (Hodgson, 1967). The fruit is split into a number of finger-like projections resembling a human hand. It is an oddity primarily found in collections or as an ornamental conversation-piece. There are two Buddha's Hand clones, one with deep fingers for all fruits, no flesh, nor seeds; the other with only partial fingers (not deep) for only some fruits, the others corrugated, no flesh, and with seeds. Other acid citron cultivars are **Poncire (from France)**, **Saigon (from Indo-China to Algeria and Morocco)**, **Earle (from Cuba)**, and **China (Chinese or China lemon, from China to California)** (Hodgson, 1967).

Sweet Citron Cultivars. The most widely grown sweet citron cultivar has been the **Corsican**, the main cultivar in France. It was introduced to the United States in 1891. The **Citron of Commerce** cultivar in California is identical. Other sweet citron cultivars are **Assads (from Morocco)**, **M'Guergueb (from Morocco)**, and **Dulcia (a California introduction)**. (Hodgson, 1967)

CITRONHYBRIDS

**The/most/important/fruits/with/some/citron/like/
characteristics/are/the/Cuban/Shaddock/and/the/
Ponderosa/lemon.**

**Cuban Shaddock. Hardy between grapefruit and lemon
(Davies and Jackson, 2009). Estimated to be hardy to low
to mid 20's F. (McNeil, 2001). The fruit mostly looks like a
pummelo, however, the foliage characteristics are more
like the citron. It was introduced from Cuba. Its/only
known/importance/is/as/a/semidwarfing/rootstock/for/back
yard/citrus/in/California.**

Cuban Shaddock fruit (*Citrus maxima* Burm.):

(<http://citruspages.free.fr/images/cuban1-gl.jpg>)

(<http://edulisgardens.com/inside-of-a-cuban-shaddock-sour/>)

See UCR website for tree photos:

(https://citrusvariety.ucr.edu/citrus/cuban_shaddock.html)



PonderosaLemon(WonderLemon,AmericanWonderLemon)

See/ChapterV/for/a/discussion/of/this/fruit.

Hardy/to/mid20's/F.(McNeil,2001)

Ponderosa/lemon/fruit/and/tree:

(<https://images-na.ssl-images-amazon.com/images/I/417jYbKf19L.AC.jpg>)



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APPENDIX: California, Florida, Texas, Arizona, Georgia, Alabama, Mississippi, Louisiana, South Carolina, Hawaii, New Mexico, and Nevada citrus and/or websites; and US Citrus Production Map. US production. Citrus greening. And Citrus ID slides.

California Citrus Varieties are at

<https://citrusvariety.ucr.edu/varieties.html>

Florida Citrus Varieties are at

UltimateCitrus.com: and

<https://gardeningolutions.ifas.ufl.edu/plants/edibles/fruits/citrus.html>

Growing Citrus in Florida

<https://gardeningsolutions.ifas.ufl.edu/plants/edibles/fruits/citrus.html>

Nearly all homeowners in Florida have the opportunity to pick citrus from their own trees. Of course, what you can grow depends on where in Florida you live. Citrus is a subtropical fruit and is limited to parts of Florida that don't regularly experience freezing temperatures.

Careful consideration should be given to site selection, choice of variety, nutrition, and cold protection. And just like any other plant in the landscape, your citrus tree will thrive with the proper amount of water and fertilizer, weed control, and sensible pest management.

Oranges

Second only to Brazil in global orange juice production, Florida's citrus is a \$9 billion industry annually. While Valencia oranges are famous for their juice, Florida also produces Navel, Hamlin, Pineapple, and Ambersweet varieties as well.

Navel oranges are the most popular, because they can be eaten fresh or juiced. Hamlin trees produce the most oranges for juicing. Valencias provide sweet, bright-orange juice, and are considered the “king” of juice oranges in Florida. The Temple orange and the Honey tangerine, which is also called the Murcott, are delicious hybrids of tangerine and sweet orange.

Tangelos

Tangelos are a juicy result of a cross between a tangerine and a grapefruit. Two varieties generally available are Orlando and Minneola (also called "Honeybells"). Tangelos are fairly cold-hardy, which makes them suitable for many parts of Florida. The tree can grow quite large, so be sure for the sweet leave plenty of room. Tangelos aren't very self-fertile, so it helps to have a compatible citrus tree nearby, like Temple, Sunburst, or Fallglo, to ensure good pollination and high fruit yields.

Click on the highlighted terms below on each page for more information when in powerpoint mode.

[Florida Plant ID: Tangelo \(*Citrus x tangelo*\)](#)

[Minneola Tangelo](#)

[Nova Tangelo](#)

[Orlando Tangelo](#)

Lemons and Limes

Lemons and limes are in the acid citrus group (while all citrus juice is acidic, juice from these fruits have the lowest pH). Acid fruits tend to be very cold-sensitive and are usually best suited for warmer locations in Central and South Florida.

One exception is the mellow 'Meyer' lemon, which is relatively cold-hardy and can be grown through the state. It has large fruit that ripens from November to March. The Meyer has a bushy growth habit and can even be grown in containers.

Click on the highlighted terms below for more information when in powerpoint mode.

[Read more about the Meyer lemon.](#)

[Florida Plant ID: Lemon](#)

[Florida Plant ID: Tahiti \(or Persian\) Lime](#)

[Growing Tahiti Limes in the Home Landscape](#)

Key Lime

Another notable acid citrus is the Key lime, famous for the delicious pie it flavors. However, the Key lime tree should be grown in the warmer parts of the state, where the fruit is harvested year-round.

Key limes are tarter, smaller and more round in shape than the limes more likely to be found in grocery stores, the Tahitian lime. While key limes are no longer grown commercially in Florida, many South Florida homeowners are lucky enough to have a key lime tree of their own.

Click on the highlighted term below when in powerpoint mode for more information.

[Florida Plant ID: Key Lime](#)

Kumquat

Kumquats are small, orange fruit with a unique "sweet-tart" flavor. Generally considered part of the citrus family, this is the only citrus that is meant to be eaten whole, including the peel, like a grape. Kumquats are cold hardy and can be grown throughout Florida. The two most popular varieties are 'Nagami' and 'Meiwa.'

Click on the highlighted terms below when in powerpoint mode for more information.

Florida Plant ID: Kumquat

Meiwa Kumquat *Fortunella crassifolia* -- UF/IFAS Extension Nassau County

Planting and Care. See the following website:

<https://gardeningolutions.ifas.ufl.edu/plants/edibles/fruits/citrus.html>

Florida Citrus Varieties (Ultimatecitrus.com)



Ambersweet Orange

Tastes like a mild tangerine; easy to peel and section. Excellent source of Vitamin C and fiber, containing more fiber than an English muffin.



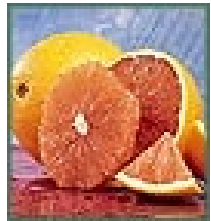
Hamlin Orange

Medium size, round to oval, deep yellow to orange color with a smooth, thin peel. Usually seedless. An excellent juice orange.



Navel Orange

Large to extra large, round to oval, deep yellow to orange color. Pebbly, medium thick peel. Usually seedless. Peels and section very easily.



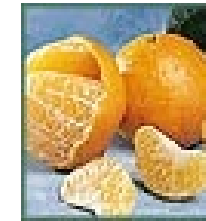
Red Navel Orange

Very sweet; easy to peel and section. Flesh is red-orange and usually seedless. Has more fiber than a serving of raisins.



Pineapple Orange

Medium to large size, round to oval, orange color, pebbly peel. Has some seeds. The Pineapple is acclaimed for its juicy sweetness.



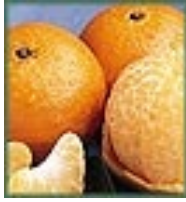
Temple Orange

Medium size, oval shape, deep orange color, sometimes pebbly peel. Few seeds; peels and sections easily. Has a rich flavor and fragrance all its own. Generally regarded as Florida's finest eating orange.



Valencia Orange

Medium to large size, round to oval shape, yellow to orange color (sometimes tinged with green) with a smooth, thin peel. Usually seedless or with only a few seeds. Valencias have orange colored flesh, which is loaded with golden juice of fine rich flavor and aroma.



Orlando Tangelo

Oval to round and medium to large in size. Light to deep orange color. Peel usually pebbly and of medium thickness. A tangerine-grapefruit hybrid, which peels easily and is very juicy.



Minneola Tangelo

Sometimes called a "Honeybell" Tangelo. Medium to very large, round to somewhat bell shaped. Deep orange to red-orange color with smooth to pebbly peel. Few seeds in this tangerine-grapefruit hybrid.



Fallglo Tangerine

Mild taste, sweet and juicy. Easy to peel and section.



Dancy Tangerine

Small to medium size, flat, deep orange or red colored fruit with a smooth, but loose peel. A few seeds. Often called the "zipper skin fruit". Has a rich, sweet flavor with a spicy aroma.



Honey Tangerine

(Murcott) Small to medium size; flat, yellow-orange in color (may be tinged with green or russet). Smooth, easy to peel. Has some seeds. Its rich red flesh is honey sweet and juicy, with a lovely fragrance.



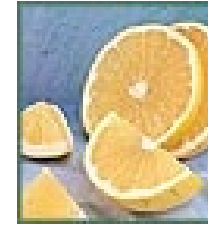
Robinson Tangerine

Medium to large, flat, orange fruit with smooth to pebbly peel. Few seeds. Peels easily and has a rich, sweet flavor.



Sunburst Tangerine

Delightful sweet, rich flavor. Tight skin, easy to peel and section. Skin has a bright, deep orange color.



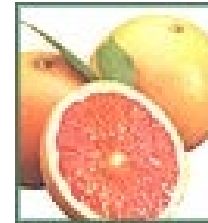
White Seedless Grapefruit

Medium to large size, usually flattened at both ends. Peel is yellow, smooth and thin. White to amber colored flesh and almost seedless. Easy to section. Excellent flavor and plenty of juice.



Flame Grapefruit

Flavorful, sweet and juicy. Flesh is red in color and usually seedless. Half a Florida grapefruit has more fiber than one cup of popcorn!



Ruby Red Grapefruit

Medium to large size, usually flattened at each end. Smooth yellow peel with areas of pink to red blush. Segments have characteristic pink to reddish tinge. Few seeds.

Texas Rootstock and Scion Varieties (<https://aggie-horticulture.tamu.edu>).

The choice of a rootstock and scion variety is still a fairly easy proposition in Texas citrus, primarily because of the traditional nature of the Texas industry--ours is a fresh fruit industry based on high quality, red-fleshed grapefruit, complemented with a very few orange varieties. At present, grapefruit accounts for about 72 percent of the estimated 34,000 acres of Texas citrus, of which about 75 percent is the deep red Rio Star grapefruit. Because of the long-term nature of citrus orchards, changes in the varietal makeup of an industry normally occur slowly until a major disaster forces extensive orchard removal and replanting. Historically, severe freezes have periodically crippled the Texas citrus industry, which afforded growers the opportunity to replant with newer, redder grapefruit varieties which were developed in Texas. So it was that Ruby Red supplanted white and pink varieties of grapefruit during the 1950's and 1960's. In turn, Ruby red gave way to other, redder varieties following two major freezes of the 1980's.

The dominance of sour orange rootstock and its susceptibility to citrus tristeza virus have always been a minor concern to Texas growers. However, the arrival of the brown citrus aphid into Florida and its ability to transmit severe strains of the tristeza virus have spurred the development of a budwood certification program to provide disease-free budwood for the future. Initiated in the mid-1990's, the program has advanced to the point of planting a foundation block and the establishment of nursery increase blocks of all major varieties and a large number of non-commercial varieties of citrus. Limited numbers of certified buds were provided for the propagation of rootstock trials in 1999; general availability of certified budwood of major commercial varieties for Texas citrus nurseries is expected in 2000. (Sauls, 2008)

Texas Scion Varieties—Grapefruit (<https://aggie-horticulture.tamu.edu/citrus/cultivars/L2304.htm>)

The Rio Grand Valley's reputation for high quality grapefruit is unsurpassed by other citrus-producing areas, a reputation that is based upon seedless, red-fleshed fruit high in sugars and low in acids. The principal varieties grown in Texas are commercially seedless, have red flesh, normally achieve legal maturity in October-November and hold well on the tree into April-May.

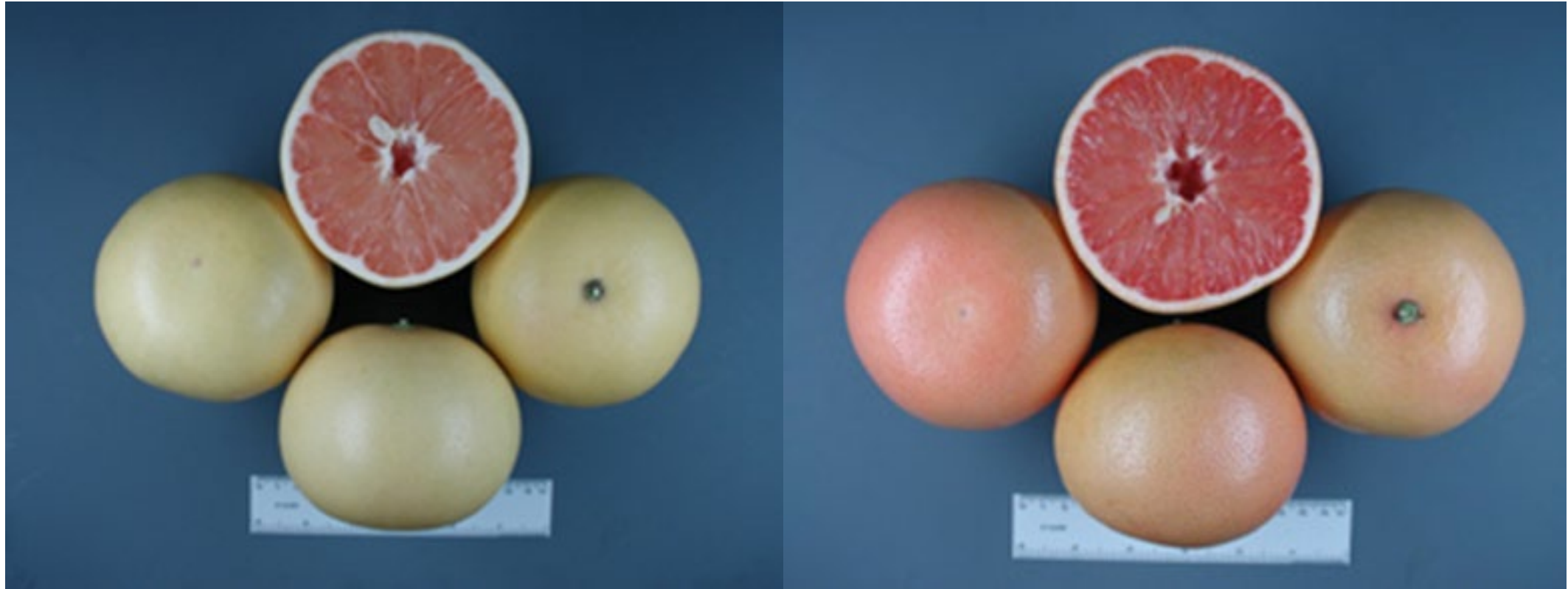
Ruby-Sweet Grapefruit

The Ruby-Sweet varieties include Ruby Red and similar selections as well as the redder Henderson and Ray Ruby varieties. Together, they account for no more than about 25 percent of Texas grapefruit acreage. Several hundred acres have been removed in the last couple of years, with no new plantings.

Ruby Red or Redblush was the leading red grapefruit in Texas for nearly four decades and it is the variety on which Texas' reputation for quality is based. It is commercially seedless, may have a red blush on the rind and has excellent quality. The early redness of the flesh gradually fades to pink by midseason and buff by spring. Ruby Red is well-suited for gift fruit, fresh market and processing.

Henderson and Ray Ruby apparently are indistinguishable cultivars discovered in the early 1970s, Henderson as a limb sport of an Everhard strain red grapefruit tree originally planted in 1945 and Ray as four separate young trees planted in a Ruby Red orchard. Both are commercially seedless, of excellent quality and acceptable for gift, fresh and processed markets. Both have more rind blush and two to four times redder flesh color than Ruby Red, with flesh color holding well into late season.

Texas Ruby Red and Henderson grapefruit photos:



Rio Star Grapefruit

Rio Star grapefruit are the super-red or deep-red fleshed grapefruit of Star Ruby and Rio Red varieties, which comprise about 75 percent of Texas grapefruit acreage. Very few, if any, Star Ruby orchards exist, however, so virtually all of the Rio Star grapefruit is Rio Red. Star Ruby was released by Texas A&I University in 1970, having originated from irradiated seed of Hudson grapefruit. Its primary attributes are intensely red flesh, good color retention even in late season and a fairly uniform red blush on the rind. Star Ruby commanded good market acceptance and premium prices, but it is sensitive to some herbicides, frequently exhibits winter chlorosis and apparently is more susceptible to *Phytophthora* and cold damage than other cultivars. Star Ruby is also noted for erratic bearing. Because of its inherent production problems, the freezes of 1983 and 1989 and the introduction of Rio Red in 1984, Star Ruby has essentially disappeared from the Texas industry.

Rio Red was released by Texas A&I University in 1984 as a natural mutation on a tree produced from irradiated budwood which came from Ruby Red seedlings. Tested by Texas A&I University as A&I-1-48S, it produces fruit with a rind color similar to Henderson and Ray and flesh color almost as red as Star Ruby. Other fruit and tree characteristics are similar to Ruby Red except that its deep red flesh color persists throughout the season and it has a strong tendency to sheeponing. It is a heavy bearer, with a slight tendency to alternation, i.e., exceptionally large crops are often followed by what would normally be considered an average crop. Rio Red is suitable for gift, fresh and processed markets.

Texas Rio Red Grapefruit



Texas Scion Varieties-Oranges

Most oranges grown in the Valley are characterized by low acidity, thin peel, good yellow peel color, but generally light juice color. Fruit maturity is considered as early and mid-season, navels (October-February) and late season (February-May). Total orange acreage is estimated at about 10,000, which is about 29 percent of total citrus acreage.

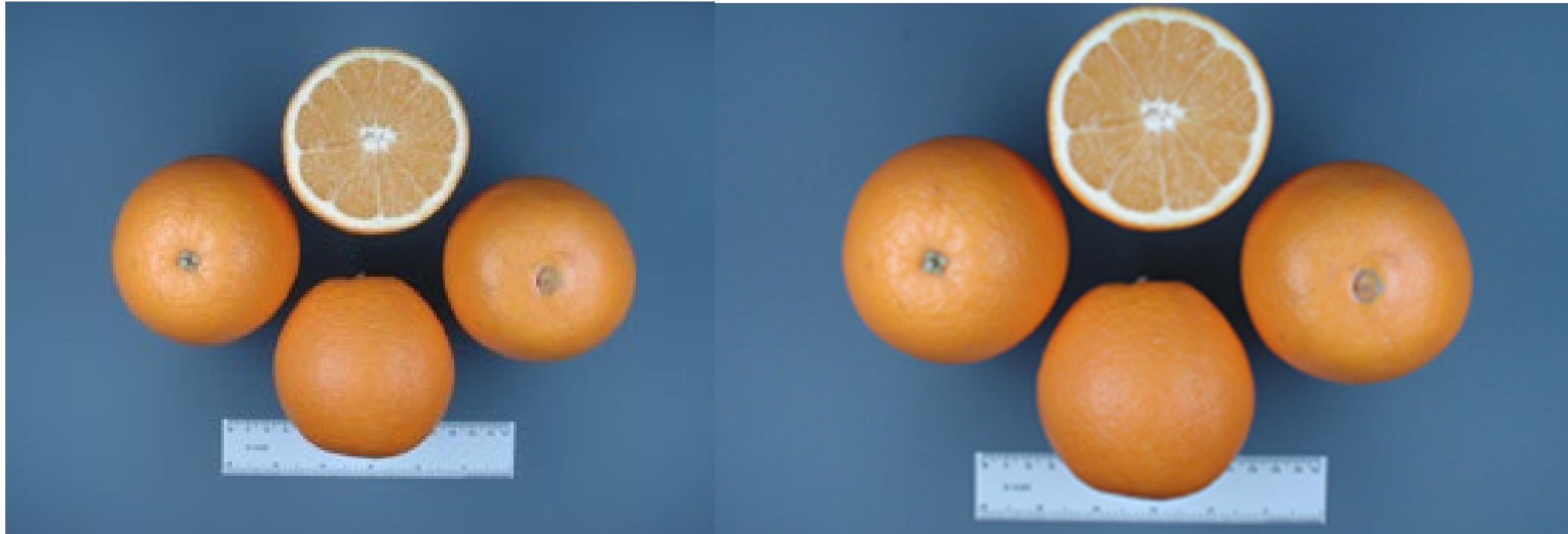
Navels and Early Oranges

Navel oranges comprise several selections and varieties, all commercially seedless and with a small, secondary fruit (the navel) embedded in the apex of the primary fruit. Navels normally mature in October and are shipped through January. Most produce comparatively low yields. The primary use is for gift pack and fresh market.

Everhard is a smaller fruit characterized by a very small or no navel; it is a consistent producer. N33E is a local navel selection that accounts for the majority of the estimated 2800 acres of navels in Texas. It is characterized as a large fruit with a prominent navel. N33E consistently suffers severe fruit splitting in late summer, yet production is still better than most other navel oranges.

Marrs is a navel orange budsport relatively unknown outside Texas. It is commercially seedless, but seedy fruit can occur because of adjacent pollinizers. Marrs attains legal maturity in early October, sometimes in late September, primarily because of its low acidity. It bears heavy crops of medium fruit size but it exhibits a tendency to alternate bearing. It is grown for the fresh market, usually being shipped through January. Marrs comprises the vast majority of the estimated 6,000 acres of early and mid-season oranges.

Texas N33E navel orange and Marrs Orange



Parson Brown is a very early, seedy orange that usually matures in early September. Its fruit are of medium size, containing 10 to 20 seeds, and have a pebbly-textured peel. Fruit quality is about as good as Marrs. Parson Brown is sometimes designated as Pineapple, which is inaccurate. Only a few acres of Parson Brown exist.

Hamlin is a seedless, early orange that matures in October. Fruit size is smaller than Marrs and its quality is not so good as Marrs. Very few acres exist.

Texas Parson Brown and Hamlin Oranges



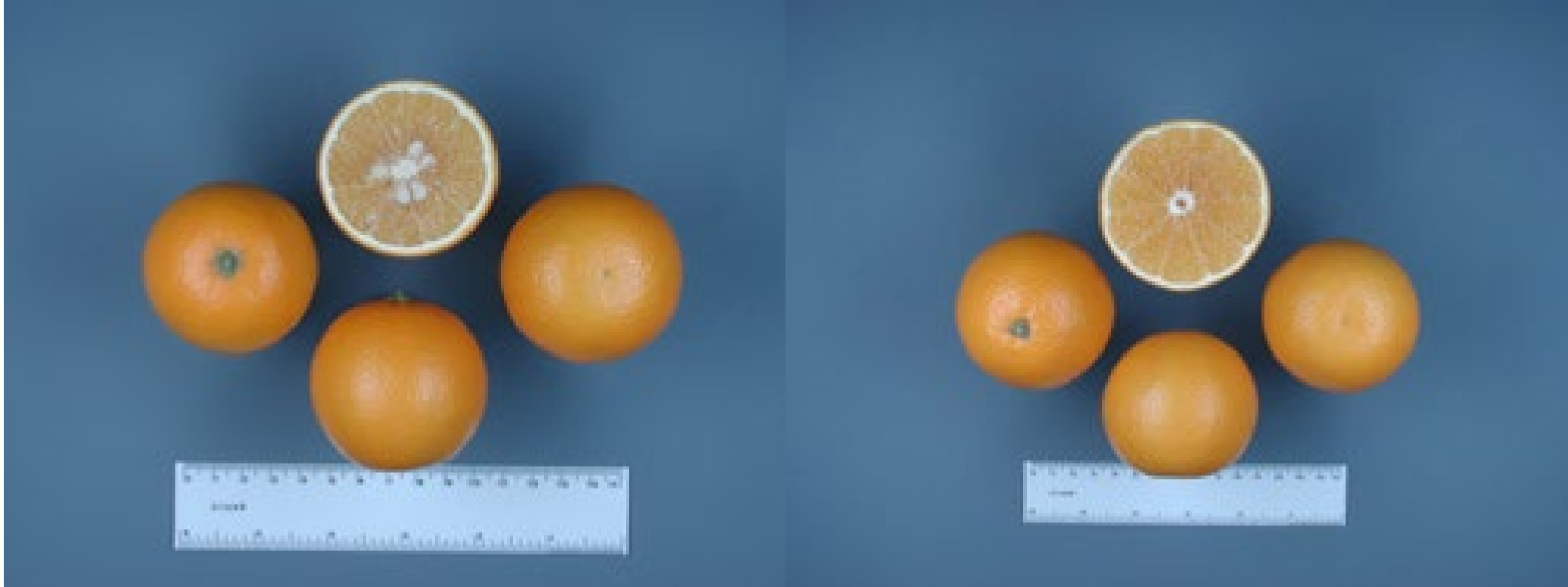
Mid-season Oranges

Pineapple matures in late November and holds into February. Fruit size, fruit quality and yields are a little better than Marrs. The fruit is seedy, having 15 to 20 seeds. It has a strong tendency to alternate bearing. Although other varieties are often designated as Pineapple, the true Pineapple orange can be distinguished by its seediness and time of maturity. Not many acres of Pineapple exist.

Jaffa and Joppa are mid-season, seedless oranges that are commonly confused with each other and the Shamouti or Palestine Jaffa from which they apparently originated.

Generally, Joppa has a smaller fruit that is also rounder than that of Jaffa, with somewhat richer color and flavor. Jaffa reportedly does not store well on-tree and tends to alternate bearing. Occasional blood orange flecking has been noted in a couple of smaller plantings in some seasons, although such flecking is not reported in the literature for either variety. Acreage is very limited.

Texas Pineapple and Jaffa Oranges



Late Season Oranges

Valencia, probably the premier orange variety in the world, is grown in every commercial citrus-producing area. It is a late-season orange that normally achieves maturity in late January, with shipments continuing into May. It is commercially seedless, of average size and has excellent juice quality, although yields generally are lower than early oranges. Valencia is excellent for fresh market and for processing to upgrade the quality of juice from early oranges.

Although various selections of Valencia exist, all but Olinda are simply referred to as Valencias. Olinda is more productive than other selections in Texas, and limited new Olinda Valencia orange plantings, possibly about 200 acres, have been made recently in orchards which were previously planted to Ruby-Sweet grapefruit varieties. Only about 1400 acres of Valencia oranges are grown in Texas, including the recent new plantings, primarily because of lower yields and late maturity, the latter of which puts the crop at greater freeze risk than other orange varieties.

Texas Olinda Valencia Orange



Other Texas Citrus Varieties

Very limited acres of Clementine (Algerian) tangerine, Dancy tangerine and Orlando and Minneola tangelos provide fruit for gift and specialty markets. Most are more cold hardy than oranges or grapefruit, are easy to peel and have orange peel color and rich flavor.

True lemons and limes are too cold sensitive for commercial plantings in the Valley, but a few acres of Meyer lemon are grown for local use.

Texas Rootstocks. A wide variety of citrus rootstocks are available, each having desirable attributes. The success of a rootstock is determined by its tolerance to prevailing conditions of soil, climate and disease, while still producing high yields of good quality fruit. A rootstock for Valley citrus must be adapted to alkalinity, salinity and calcareous soils, should be resistant to *Phytophthora* and virus diseases, provide some measure of cold tolerance and produce good yields of high-quality fruit.

Sour orange is the standard rootstock in Texas, being generally well adapted to the different citrus soils in the Valley. It is somewhat tolerant to salinity, alkalinity and less than optimal drainage, and is relatively tolerant to cold, cotton root rot and *Phytophthora*. It is susceptible to citrus nematode and citrus tristeza virus. Grapefruit and orange yields on sour orange are moderate, with average fruit size and good quality. Sour orange accounts for at least 95 percent of Valley orchards.

Cleopatra mandarin, or Cleo, is generally adapted to Valley conditions. It is more cold tolerant than sour orange and tolerant to tristeza, but is less tolerant to alkalinity. Trees on Cleo are slower to bear and yields, fruit size and quality are all poorer than those obtained on sour orange. Cleo is not being propagated currently.

Swingle citrumelo is a trifoliate hybrid that reportedly equals or exceeds sour orange in most characteristics. It is resistant to nematodes and *Phytophthora*, tolerant to tristeza and produces a vigorous tree with excellent yields and excellent fruit size. It is reported as tolerant to xyloporosis and exocortis, but some stunting has been observed with old-line budwood having those viruses. Swingle citrumelo is intolerant of poor drainage and exhibits severe chlorosis in heavy soils, so it should be limited to well-drained, very deep sandy soils. An estimated 15 percent of Valley citrus soils are suitable for Swingle citrumelo but very few orchards are planted on this rootstock.

Carrizo and Troyer citranges are sibling trifoliate hybrids that are intermediate between sour orange and Swingle citrumelo in terms of vigor, fruit size, total yield and soil adaptability. The citranges are tolerant to tristeza but susceptible to exocortis, citrus nematode and soil alkalinity and exhibit less cold hardiness. Perhaps a third of Valley citrus soils are suitable for the citranges, but their use has been very limited.

Numerous rootstocks were tested in Texas in years past, but none proved superior to sour orange. The better rootstocks from those tests, plus some newer ones, are being re-evaluated on a range of citrus soils. Until a better rootstock than sour orange emerges or until the dual threat of citrus tristeza virus and the brown citrus aphid appears eminent in Texas, there is not likely to be any significant change in rootstocks in Texas citrus.

Arizona Citrus Varieties are at

(<https://cals.arizona.edu/extension/ornamentalhort/landscapemgmt/plantmaterial/citrusvar.pdf>)

(<https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1850-2020.pdf>)

LOW DESERT CITRUS VARIETIES Issued April 1998 by: Michael Maurer, Agent Fruits Crops Lucy Bradley, Agent Urban Horticulture Cooperative Extension College of Agriculture <http://ag.arizona.edu/extension/> When choosing a variety of citrus to plant in your yard consider: what you like to eat; when you want to harvest; and how cold it gets in your yard. &Each of us has individual taste and the variety that you prefer may not be what someone else prefers. Do you want a seedless fruit? Is it important that the skin be easy to peel, or that the fruit be low in acid? These are all personal preferences. Evaluate the fruit characteristics that are important to you and choose a fruit to meet your needs. &Harvest time can have a significant impact on fruit flavor. Citrus fruit will not ripen once removed from the tree. However, if the fruit is left on the tree it will continue to sweeten as the season progresses. For example, grapefruit is palatable in September, but most people prefer them in March or April when they are sweeter and have less acid. If you are only here in the winter, you will want to choose a variety that is sweet while you are here. &Some fruit trees are more frost sensitive than others. Kumquats and Mandarins tend to be the most cold hardy, followed by grapefruit, orange, lemon and lime. If you live in some of the colder parts of the Valley you may want to select cold tolerant varieties. (While trees may be somewhat cold hardy, the fruit is not) When purchasing citrus be sure to select a tree that is clearly identified. It is not enough to simply be identified as an orange, grapefruit or mandarin.²⁷⁸

There are many varieties of each species of citrus, each with its own characteristics. Be sure the tree has a tag which identifies both the variety and the rootstock, i.e., ‘Fukumoto’ navel orange on a ‘Carrizo’ citrange rootstock. Listed below are some of the most popular varieties of citrus available in Maricopa County. This is not an all-inclusive list, but includes varieties that are often available at your local nursery. Navel Oranges Navel oranges are the premium fresh-eating orange, because they are seedless and moderately easy to peel. Navels can also be juiced, but the juice can not be stored, as navel oranges have a compound called limonin which produces a bitter taste. At a Glance: Select varieties that: meet your needs regarding flavor, ease of peeling, number of seeds, acidity, and color & ripen at a convenient time & have adequate cold hardiness & are clearly identified as to variety and rootstock. Pigmented navel ‘Cara Cara’ or red navel is the only pigmented navel orange with a crimson flesh similar to red grapefruit. The flavor and peel color of the ‘Cara Cara’ is similar to other navel orange varieties. Fruit segments are attractive in salads due to its crimson color. ‘Fukumoto’ an early-season, medium-sized navel which should be harvested by the end of October or early November. Currently being evaluated for Arizona, this variety has performed well in California trials. Due to its early maturity it may not have full orange peel color at the time of harvest although it is ready to eat. ‘Beck Early’ should be harvested about the same time as the ‘Fukumoto’. Depending on climatic conditions, this navel tends to be more oblong in shape than most navels. This variety also is being evaluated for Arizona. ‘Lane Late’ is one of many new Australian late season navels.

These are often called summer navels; however, here in Arizona they can be harvested beginning in January. There are over 13 different varieties of late navels with the 'Lane Late' being one of the most promising. It is currently being evaluated for Arizona conditions. Other varieties include 'Autumn Gold', 'Barnsfield', 'Chislett', 'Powell', and 'Summer Gold'. 'Parent Washington' is probably the most popular navel grown in the Salt River Valley. This mid-season navel variety produces a large fruit which has good quality. Harvest beginning around Thanksgiving or the first of December. Other mid-season navels include 'Atwood', 'Fisher', 'Newhall', 'Robertson', 'Spring', and 'Thompson Improved.'

Sweet Oranges "Arizona Sweets," refers to any one of a number of sweet orange varieties. The sweet oranges are good for both juice and eating fresh. 'Diller' originated in Arizona and is a small-to-medium-size sweet orange with comparatively few seeds. This variety has been popular here in the Salt River Valley due to its productivity. This variety produces the largest yield and is excellent for home use if juice is the main interest. 'Hamlin' is an early-season sweet orange which has done well here in Arizona. The fruit is medium in size with 0-6 seeds per fruit. " Marrs is another early-season, semi-dwarf tree, sweet orange. The fruit is medium to large in size and is moderately seedy with 7-10 seeds per fruit. It reaches maturity early in the season, and is best when it fully ripens in November. 'Pineapple' produces fruit which is medium in size and seedy with 15-25 seeds per fruit. It is very productive; however, it tends to alternate bear. The name 'Pineapple' came about as some people thought the tree had the flavor or smell of a pineapple.

It is an excellent sweet orange and produces well here in Arizona. The fruit is medium-to-large in size with 6-10 seeds per fruit. Valencia oranges. Valencia Oranges are known for their high-quality juice, which has a deep orange color and high sugar content. However, the fruit does not reach maturity until about March. The fruit is medium in size with few seeds (0-6). Two popular varieties which have performed well in the Salt River Valley are the 'Campbell' and 'Olinda. Two newer varieties which are seedless are the 'Delta' and 'Midknight'. Pigmented or Blood Oranges. In cool climates blood oranges are characterized by the dark red internal color they develop, hence the name "blood oranges." The red color may even be observed on the peel of some varieties. However, in the warm climate of Arizona many of the blood oranges fail to develop the typical deep red internal color. In the Salt River Valley, the 'Salustiana' variety produces the most consistent dark red internal color. Other varieties of blood oranges which may or may not develop dark red internal color, depending on the climate, are 'Moro', 'Ruby', 'Sanguinelli', and 'Tarroco'. Mandarins (Tangerines) Mandarins are popular because most of the varieties are easy to peel and section well. The fruit has a thin peel which when ripe may "plug" (a section of the peel where the stem was attached is removed if the fruit is pulled from the tree). If you are going to store mandarins it may be necessary to "clip" the stem of the fruit from the tree to prevent "plugging" that otherwise may lead to desiccation or decay. 'Algerian' ('Clementine') is an early-season mandarin ripening in November. Fruit size is small to medium.

If the tree is self-pollinated it will produce fewer seeds, but also fewer fruits. Cross-pollination will increase fruit production, but will also result in fruit with more seeds. 'Dancy' is an excellent early season, very sweet, red/orange mandarin. Fruit size is medium to large. 0- 5 seeds. 'Dancy' is harvested beginning in December. Fruit is medium in size with 6-20 seeds. Like many mandarins 'Dancy' tends to be alternate bearing. 'Fairchild' is a popular early-season commercial variety in the Salt River Valley. The fruit is medium in size and ripens in November about the same time as the 'Algerian'. The trees tend to produce more fruit with cross-pollination, but this makes the fruit seedy. Alternate bearing is a problem with this variety. 'Kinnow' is a popular late-season mandarin maturing in January here in the Salt River Valley. The fruit is medium in size and has numerous seeds depending on cross-pollination. Like other mandarins, but even more pronounced, they tend to be alternate bearing. This variety is very sweet when ripe and has the flavor characteristic of many mandarin beverages. Tangelos. Tangelos are hybrids resulting from the cross of mandarin and grapefruit or mandarin and pummelo. 'Minneola' is a hybrid of 'Duncan' grapefruit and 'Dancy' mandarin. Fruit is mature beginning in January. The bright, orange red fruit is large and pearshaped and typically have a fairly prominent neck; however, not all fruit exhibits this characteristic. The fruit has 7-12 seeds. Cross-pollination is recommended for regular production. 'Dancy', 'Algerian' and 'Kinnow' mandarins provide satisfactory pollen. 'Orlando' is the result of the same cross as the 'Minneola' but is distinctly different. The fruit is medium in size but without the neck.

It is harvested in November. Seediness depends on cross-pollination (0-35). Cross-pollination is recommended with 'Algerian', 'Dancy' or 'Kinnow' for regular and good production. This is one of the best juicing fruits available. Grapefruit varieties can be divided into two natural categories: white or red. There is a common misconception that the red grapefruit is sweeter than the white; however, this is not true. Although the demand is greater for red grapefruit, the white grapefruit are just as sweet if allowed to fully ripen. 'Duncan' is one of the oldest grapefruit varieties and, according to many, the best-tasting grapefruit. However, it is very seedy (30-70) and lost popularity as a fresh fruit when the Marsh was introduced. 'Marsh' is the most common and widely planted white grapefruit in the Salt River Valley. Although the fruit is ready to harvest in December, if left on the tree the fruit will continue to mature and become sweeter with time. Fruit is typically best from March through May after acid levels in the fruit have declined. The fruit is large in size with only a few seeds (0-6). The following is a list of red grapefruit varieties, progressing from lightest-to-darkest-colored flesh. 'Redblush' ('Ruby Red'), popular here in the Salt River Valley, was one of the first pigmented grapefruit varieties. It has large fruit with few seeds (0-6). The internal color is a light pink. The fruit is picked beginning in December, but becomes better the longer it remains on the tree. Interior fruit color becomes golden in spring. 'Flame' is a new release from Florida which produces large fruit with few seeds (0-6). The fruit is mature beginning in December. 'Flame' is still being evaluated for the low desert. 'Rio Red' produces a large fruit with few seeds (0-6). The flesh is one of the darkest and the peel can develop a red tint as well. Fruit is picked beginning in December, however, fruit will stay on trees as late as July. 'Texas Star Ruby' produces the darkest flesh color of any variety.

However, it is not recommended for this area. The trees are sensitive to our hot summers and leaves will sunburn more readily than other citrus trees. High temperatures above 115 degrees may kill 'Star Ruby' trees. **Low Desert Citrus Varieties: Grapefruit x Pummelo Hybrids** 'Troyer' or 'Carizzo' rootstocks should be used for these hybrids. 'Melogold' has retained more of the pummelo characteristics. The fruit is large and has a distinctive taste with a high sugar content. It is less acidic than grapefruit. The peel is thick. 'Oro Blanco' has retained more of the grapefruit characteristics. The fruit is about the size of a grapefruit with a slightly thicker peel. The fruit is lower in acid and higher in sugar than grapefruit and has more of the pummelo flavor. **Lemons.** Lemons are typically treated with ethylene gas by commercial growers to develop the yellow color early in the season. They can be harvested when green and used well before the rind turns yellow at maturity. 'Eureka' is generally more ridged, usually with a rougher rind surface and a smaller or less pronounced nipple. The tree is thornless and more frost sensitive. 'Lisbon' fruit is medium in size and characterized by a prominent nipple. The rind is generally smoother than the 'Eureka'. 'Meyer' is illegal (and therefore not available) in the State of Arizona. This variety is known to harbor the Citrus Tristeza Virus (CTV), which is a devastating disease of citrus. Meyer is not a true lemon, but likely a hybrid of a sweet orange and lemon. 'Ponderosa' is most likely the hybrid of a lemon and citron. The 'Ponderosa' is more characteristic of the citron than a lemon and is often grown as a garden ornamental. The fruit is the size of grapefruit and has a thick peel. Limes are extremely frost sensitive

and need to be planted in warm areas or protected from frost. 'Mexican Lime' ('Key Lime') ripens in September and the fruit is small. The fruit is prized for the flavor, used in pies and for other culinary purposes. 'Tahiti' ('Bearss', 'Persian') is believed to be a hybrid between the small acid lime and possibly the citron. The fruit ripens in June and is larger than the 'Key Lime'. Kumquats. 'Fukushu' has small bright orange entirely edible fruit. Small symmetrical tree with attractive dark, green leaves. Beautiful landscape or container specimen 'Meiwa' has round fruit with spicy sweet peel and pulp. The fruit is used for preserves and candied fruit. Similar to the Nagami, the trees are used in home and commercial landscaping and are cold hardy (14 F.). 'Nagami' is more oblong than the 'Meiwa', more acid in taste, and a brighter orange color. The 'Nagami' trees are used in home and commercial landscaping and are quite cold hardy (10-20 F., 14 for Meiwa, McNeil, 2001). Limequats. 'Tavares' is a hybrid (East Indian lime x oblong kumquat). The fruit is characteristic of the kumquat but has a small neck. The trees are popular in home landscaping, and the fruit may substitute for lime as a condiment. The limequat is not as cold hardy (20 F., McNeil, 2001) as the kumquat. Currently under evaluation for growing in the Salt River Valley. **URL:** <http://ag.arizona.edu/extension/pubs/garden/az1001.pdf> Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, James A. Christenson, Director, Cooperative Extension, College of Agriculture, The University of Arizona. The University of Arizona College of Agriculture is an Equal Opportunity employer.

Oranges for southern Arizona (Parent navel, Cara Cara navel, Fukumoto navel, Hamlin orange, Pineapple orange, Delta Valencia, Midnight Valencia, Moro blood orange (Wright, 2020))



Sanguinelli blood orange, Smith Red blood orange, Tarocco blood orange, Seville sour orange, 'Vainiglia Sanguigno' acidless orange, Bergamot sour orange hybrid, Chinotto orange, Bouquet de Fleurs Sour Orange (Wright, 2020)



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Arizona Citrus:**

<https://agriculture.az.gov/plantsproduce/what-we-grow/citrus>
<https://summerwindsnursery.com/az/plant-list/citrus/citrus-varieties-more>
<https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1850-2020.pdf>

Louisiana Citrus:

https://www.lsuagcenter.com/portals/our_offices/parishes/livingston/features/anr/news_articles/growing-citrus-in-louisiana
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www.LouisianaCitrus.org
<https://louisianacitrus.files.wordpress.com/2020/05/la-home-citrus-production-guide-updated.pdf>

Louisiana Areas of Citrus Production **(www.LouisianaCitrus.org)**

Because of potential freezes, citrus can be produced in only a limited area of our state. Louisiana can be divided into three general climatic zones. Only two of these zones are suitable for citrus production. Zone I, the coastal area, is the primary area of commercial citrus production. Generally, all citrus types can be grown in this zone. Zone II is a marginal area where only the cold-hardy satsuma (14-18 F., McNeil, 2001) and kumquats (10-20 F., Meiwa 14 F., McNeil, 2001) should be grown. Certainly any plantings of citrus in Zone II should be undertaken only after realizing the risk of freeze-outs. Success with citrus planted in Zone II can be enhanced with the use of trifoliata rootstocks and cold-protection practices. Citrus in Zone III, the northern area, would freeze-out regularly. Homeowners may risk planting satsumas and kumquats in Zone III. Citrus in Zone III should be grafted on a trifoliata rootstock and be protected in winter.

Recommended Varieties of Citrus (www.LouisianaCitrus.org)

Satsuma

The satsuma is the traditional citrus grown by Louisiana homeowners. Hardy from 14-18 F. (McNeil, 2001).

The fruit is easy to peel, has few seeds and separates easily into segments. The fruit turns from green to yellow as it ripens and to orange at full maturity. The fruit is edible when it shows some yellow color. This allows homeowners to harvest and eat the fruit for a long period.

Owari Satsuma

Owari is the most widely grown satsuma. The fruit is medium to small, seedless, has excellent quality and matures from early to mid-November, but can be harvested through early December. The trees are vigorous and have a willowy growth habit. An Owari satsuma is recommended for home orchards in Zones I, II and the southern part of Zone III.

Armstrong Early Satsuma

Fruit reaches maturity in late September and October. The fruit is large but has only fair quality. It becomes puffy quickly and will split badly during heavy rainfall. Armstrong satsumas should be harvested by early November for best quality. The trees are dwarfed and have an upright growth habit. Armstrong Early is recommended for home orchards in Zones I and II.

Brown's Select Satsuma

This variety produces medium to large fruit. The fruit matures mid-October to early November, several weeks ahead of Owari satsuma. The fruit keeps well on the trees without becoming puffy. The trees are large and have an open spreading branching pattern. Brown's Select is recommended for home orchards in Zones I and II.

Kimbrough Satsuma

Kimbrough was released as a cold-hardy Satsuma. Unfortunately, its cold hardiness is no better than that of Owari. The trees of Kimbrough are large, strong, spreading and very productive. The fruit is generally larger than Owari and matures in early to mid-November. The fruit stores well on the tree after maturity. Kimbrough may be hard to find in the nursery trade. This variety is recommended for Zones I and II.

Louisiana Early and Early St. Ann Satsuma. Louisiana Early and Early St. Ann are two recently released satsuma varieties from the LSU AgCenter. They produce medium to large fruit that mature in early September through mid-October. The overall quality and productivity are better than Early Armstrong. Fruit puffiness ranges from none to slight on both varieties. The fruit does not hold well on the tree for an extended period. The medium-size trees have a spreading growth pattern. The availability of both of these varieties may be limited in the nursery trade. Louisiana Early and Early St. Ann are recommended for trials in home orchards in Zones I and II.

Sweet Oranges. Hardy to 20 F.

Louisiana Sweet. Louisiana Sweet is the traditional round orange grown in South Louisiana. It is a medium to large fruit with a rich flavor and lots of seeds. The fruit matures in December. After reaching maturity, the fruit splits badly and drops. It is the most cold hardy of the sweet oranges. The trees are very vigorous and have thorns. This variety is recommended for home orchards in Zone I and the southern part of Zone II.

Washington Navels. The most distinctive feature of this orange is the presence of a navel, a small rudimentary, secondary fruit embedded in the end of the fruit. The fruit is large, has excellent quality and matures in late November and December. Distinctive characteristics of navel oranges include deep orange color, thin skin, ease of peeling, separation of the segments, high sugars, abundance of juice and seedlessness. The fruit will drop after full maturity, so it's best to harvest navels by end of January. The juice often becomes bitter when stored and should be consumed shortly after squeezing. Navel orange trees are usually less productive than other sweet oranges. The navel orange should be included in home orchards in Zone I and the southern part of Zone II.

Hamlin Sweet. This is the most widely grown of the early round oranges. It matures in early December, but it can hold on the tree through February. The fruit is medium to small and has few or no seeds. Trees are medium large, moderately vigorous and fairly cold tolerant. Hamlin is recommended for home orchards in Zone I.

Pineapple Sweet. Pineapple Sweet is a medium orange that matures in early December and has a pineapple flavor. The fruit is very seedy. The trees are vigorous good annual producers. Pineapple Sweets are recommended for home planting in Zone I.

Plaquemines. Plaquemines is a seedless, low-acid, round orange. It is a bud sport of Pineapple found at Magnolia Orange Grove, Port Sulphur, La., and released as a variety by LSU in 1948. The fruit of Plaquemines is medium, seedless and matures in January. The trees are vigorous good annual producers. Plaquemines is recommended for home orchards in Zone I.

Valencia. Valencia is the most widely planted orange in the world. The fruit is medium-large with few or no seeds. It ripens in April and has excellent quality through June. Juice is abundant and flavor is excellent. Trees are vigorous, upright and prolific. It is subject to heavy fruit drop after a freeze. This variety is recommended for home plantings only in the southernmost parts of Zone I.

Ambersweet. Ambersweet is a sweet orange hybrid released in 1989 by the USDA Horticultural Research Station in Orlando. It is a hybrid of Clementine tangerine by Orlando tangelo crossed with a seedling mid-season sweet orange. Moderately cold tolerant, this early-season orange is of peak harvesting quality from October through December. Ambersweet fruit are medium-size, slightly pear-shaped, low in acid with good juice and flesh quality. Fruit in a home planting can have up to 30 more seeds in mixed plantings. Homeowners are encouraged to ask local nursery and garden centers to obtain trees of Ambersweet. It is recommended for trial in home planting in Zone I.

Moro Blood Oranges. This is a medium to medium-large, round, sweet orange with very few seeds. It is characterized by red coloration in the flesh and peel. It reaches maturity in late December and holds on the tree very well. The riper the fruit, the redder the fruit's pigment. The trees are of medium vigor and size with a spreading round topped shape. Homeowners are encouraged to ask local nurseries and garden centers to obtain trees of Moro Blood oranges. Moro Blood oranges are recommended for trial in home orchards in Zone I.

Grapefruit. (Cold hardy to low 20's F., McNeil, 2001)

Ruby Red. Ruby Red is the most widely planted grapefruit variety in Louisiana. It matures in December and holds wells on the tree through May. The fruit is medium to large and has only a few seeds, light yellow skin at maturity with a red blush, especially where fruit touch one another. It is recommended for home orchards in Zone I and southern part of Zone II.

Rio Red. Rio Red produces larger fruit than Ruby Red. The fruit is yellow at maturity with a red blush. This variety is earlier than Ruby Red and can be harvested from early November through May. It is recommended for trials in home orchards in Zone I and southern part of Zone II

Kumquats.

Nagami Kumquats The Nagami kumquat produces oblong fruit with a smooth rind, deep orange color and acid juice. It ripens from mid-October to February. The fruit contains seeds. The Nagami trees are vigorous with a round, bushy top. Its growth pattern makes it adaptable to hedge and corner plantings.

All kumquats are cold-hardy (10-20 F., Meiwa 14 F., (McNeil, 2001) and recommended for home orchards in Zones I, II and the southern part of Zone III.

Meiwa Kumquats The Meiwa kumquats produce round fruit with sweet pulp. The trees are less vigorous than Nagami. Meiwa kumquats are cold-hardy and recommended for home orchards in Zones I, II and the southern part of Zone III

Lemons. Meyer Lemons. Meyer is the only lemon recommended for Louisiana since it does possess a small degree of cold hardiness (20 F., McNeil, 2001). It ripens in mid-October and holds on the tree until December. It is better when grown from a rooted cutting. It has a strong tendency to bloom and set fruit throughout the year. This makes it an excellent tree for a protected area near a window or door. It is recommended for homeowners in Zone I and in protected areas in the southern part of Zone II.

Other Citrus. Tangerines hardy to 18-20 F.

Ponkan Mandarin. The fruit of Ponkan mandarin is medium to large and develops a deep orange color when mature. It matures in mid-December and should be harvested by mid-January. It has few seeds and a honey-type mandarin flavor. If left on the tree too long, it tends to become puffy. The tree is moderately vigorous and has a very upright growth habit and weak crotches. It has a tendency to bear alternately and suffers from limb breakage in heavy crop years. Ponkan mandarin is recommended for home orchards in Zone I.

Orlando Tangelo. Orlando tangelo is a hybrid between a Duncan grapefruit and Dancy tangerine. The fruit is medium in size and has high juice content. Fruit has deep orange color in late December with good quality until mid-January. Orlando tangelo is recommended for home orchards in Zone I.

Dancy Tangerine. The most extensively planted tangerine variety; the fruit ripens in mid-December to February. Fruit is medium in size and has a slightly flattened shape. The fruit color is deep orange-red at maturity. The fruit dries out when left on the tree for a long time after becoming ripe. Dancy tends to overbear and has brittle wood, resulting in frequent limb breakage. This variety is recommended for planting only in Zone I.

Robinson Tangerine. Robinson tangerine is a cross between Clementine mandarin and Orlando tangelo. This variety produces medium to large fruit with deep orange-red flesh of excellent quality. It peels easily. It matures in midOctober. It produces best when planted with Orlando tangelo or Sunburst tangerine since it will not set fruit with its own pollen. It has brittle wood and a tendency to set fruit near the end of its limbs, resulting in limb breakage with large crops. This variety is recommended for home planting in Zone I.

Sunburst Tangerine. Sunburst tangerine is a cross between Robinson and Osceola tangerine. The fruit ripens in late November and December and holds well on the tree. Fruit are reddish-orange and are high-quality with good flavor. It requires cross pollination with Orlando tangelo for good fruit set. It is very susceptible to rust mite injury. Sunburst tangerine is recommended for trial plantings in home orchards in Zone I.

Rootstocks

The best citrus rootstock for the Louisiana home citrus orchard is trifoliata (*Poncirus trifoliata* Rubidoux). It is the most-cold hardy of the citrus rootstocks, resistant to rots and tolerant of wet soils. Homeowners should ask nurseries to obtain trees on trifoliata, but they are at the mercy of the nurseries on the rootstocks of the citrus trees they buy.

One of the major rootstocks used in the Louisiana citrus nursery trade is Swingle citrumelo. This very vigorous rootstock produces a large budded tree in one year. Trees budded on Swingle rootstocks are vigorous and produce good crops of high quality citrus. The main drawback of using Swingle rootstock is that it is not as cold hardy as trifoliata.

In the last several years, several nurseries have been grafting citrus trees on a dwarf rootstock known as Flying Dragon Trifoliata. Dwarf trees are ideal for homeowners with limited space. Good crops of oranges and satsuma can be made in a circle only 10 feet in diameter. Ask your local garden centers and nurseries to obtain trees budded on the dwarf Flying Dragon Trifoliata rootstocks.

Pollination

Citrus flowers have both male and female parts in the same flower (complete perfect flowers) and will pollinate themselves and produce fruit (self-compatible and self-fruitful). Pollination is seldom a problem in citrus.

There are, however, a few special cases with tangelo and tangerines (Orlando, Minneola, and Clementine) where a pollinator is required for good fruit set.

Citrus trees produce an abundance of flowers. Citrus has a natural tendency to drop its fruit, and most of the fruit set at bloom will not hold on until maturity. A good crop may be borne if only 3 percent to 7 percent of the flowers that are set turn in to mature fruits. The Washington navel and satsuma do not have viable pollen. They set fruit without pollination and have no seeds. The few seeds in a satsuma are from viable pollen from another variety.

Growing Citrus In Louisiana

Patricia M. Arledge, Sharpe, Kenneth W. **LSU AgCenter**, **All Like**

News Article for November 2, 2015:

If you have been munching on some fresh satsumas and think you might like your own supply, November is great time to plant trees.

Citrus likes to grow in a warmer winter environment that we have here. They do better along the coast and even further south in Florida, but the citrus that is grown here is of high quality and tasty. If you are not willing to occasionally lose a plant or have it burnt back by cold and lose a year's production then citrus in southeast Louisiana is not for you.

The two most cold hardy and therefore reliable citrus producers for our area would be kumquats (10-20 F., Meiwa 14 F., McNeil, 2001), and satsumas (14-18 F., McNeil, 2001).

There are two kumquat choices, sweet and tart. The Nagami kumquat produces a tart fruit that is oblong. The fruit will get ripe from mid-October to February and in an attractive evergreen tree with lots of smooth orange fruit. The Meiwa kumquat produces round fruit that has sweet pulp.

Satsuma choices are based on when you want production and then the taste that you like best. For early production consider Louisiana Early or St. Ann. Both varieties were developed in Louisiana and they will be ready for harvest from early September through to mid-October. Brown Select is another Louisiana variety that will have fruit ready for a later harvest in mid-October to November.

The most widely planted satsuma variety is Owari. It produces high quality medium to small sized seedless fruit. The fruit will get ripe about 2 weeks after Brown Select, usually maturing in early to mid-November but can be held on the tree to be harvested into December. Owari has the most cold tolerance (14-18 F., McNeil, 2001) of the satsumas which makes it an excellent choice for planting here in the northern most growing range for citrus.

Satsumas can be harvested once the color starts to change from green to yellow, they do not have to be orange. Some people like satsumas more tart and others like them sweeter. Growers use a meter to determine sweetness and harvest satsuma based on sugar content. You have such an instrument also and it is right on the tip of your tongue. It is hard to pin point the harvest date on a calendar because every year is different and the harvest date can be 2 weeks either way. Just use the old taste test to determine when your satsumas fill your sweet tooth and are ready for harvest.

We do have some people who have been somewhat successful with growing navel oranges but orange trees are more prone to freezing (20 F., McNeil, 2001). If you want to give it a try plant the Washington Navel. It will be ripe when it turns a deep orange color in late November and December before freezing temperatures that freeze fruit at 26-28 F.

Lemons (25 F.) and limes (Mexican 28 F., Tahitian 26-27 F.), McNeil, 2001) cannot take our cold. The Meyer Lemon (20 F., McNeil, 2001) is the only exception. It is really a mandarin orange crossed with a lemon and has lemon like physical characteristics but gets some cold protection from the mandarin. Meyer lemons are ripe when they turn yellow in mid-October and can stay on the tree into December. Be patient with citrus, the quality of the fruit you get the first three years is not that good but year four they get much better and then at year five you will really be pleased.

The best cold protection for citrus is to plant on a southern exposure and keep the grass cleaned out from underneath the canopy. Bare ground under the tree will allow heat to radiate up from the earth to warm the tree on cold nights. Just one or two degrees can make the difference.

Mississippi citrus: <https://mudandmagnolias.com/citrus-trees/>:

Planting and Caring for Citrus Trees in Mississippi:

There aren't many citrus trees that can be grown in Mississippi, but according to Gary Bachman, an extension and research professor of horticulture at Mississippi State University and host of Southern Gardening Radio and Television, there are three types that do quite well in Northeast Mississippi's climate: Satsuma oranges, kumquats and Meyer lemons. We got the details from Bachman on how to grow and care for these beautiful fruit trees.

MEYER LEMONS Meyer lemons are actually a cross between a mandarin orange and a lemon. That's what gives them their slightly sweet flavor. Unlike a regular lemon, Meyer lemons have a much thinner skin. When grown indoors, it may take up to a year for Meyer lemons to ripen. In the meantime, they are beautiful and fairly low-maintenance. Hardy to 20 F (McNeil, 2001).



Kumquats may look like tiny oranges, but unlike their citrus relatives, you can eat them whole — skin and all. Their sweet rind and tart flesh make them popular for adding a sour zing to various dishes and desserts. They're in season from November to March, and you'll know they're ready to harvest when they turn completely orange and are slightly soft to the touch. Hardy between 10-20 F., Meiwa 14 F. (McNeil, 2001) Nagami kumquat:



SATSUMA ORANGES (Mandarins)

Also known as mandarin oranges, satsumas are the most cold-tolerant (14-18 F., McNeil, 2001) of oranges [mandarins] you can grow at home. Plant them in the spring, after the last frost, and you can expect to have fruit ready for harvest by mid-fall, before freezing temperatures, depending on conditions. They're juicy, sweet, seedless and easy to peel.



Container vs. Ground

Bachman strongly encourages growing any of these three citrus trees in containers. “They work quite well in containers, in fact, I only grow citrus in containers,” Bachman said. In North Mississippi, Bachman said, the trees tend to do better in containers no matter the time of year. It’s also easier and more effective to simply bring the trees inside when temperatures drop too low, rather than trying to cover and protect them while planted in the ground. When planting in containers, be sure to use container or potting mix soil. Bachman suggests selecting a container size for your tree based on how large you’d like it to get. In a 25 gallon container, citrus trees can grow to be up to six feet tall. The best size to give the tree adequate room to grow is anywhere from 16 to 25 gallons, though when they’re younger they can be started in smaller containers. Just be sure to monitor their growth and repot them when necessary.

General Care

As with all plants, citrus trees require regular sun, water and fertilization. Citrus trees like bright, full sun, whether that's light from a window or direct sunlight outdoors. According to Bachman, Meyer lemons do particularly well indoors. "A lot of people grow Meyer lemons inside," Bachman said. "If you have a bright window to put them in, they can live there year-round." If kept outdoors, try to select a spot that gets at least eight hours of sun per day and isn't very windy. "They're perfectly happy outside like that," Bachman said. The amount of water needed for these trees depends on where they're located, but generally Bachman said the soil needs to be kept slightly moist. Outside in the Mississippi heat, they may need to be watered every day, if not twice per day. If kept indoors, trees can often be watered just once per month. A simple soil check using your finger can help you determine whether or not the tree needs watering.

Cold-Weather Care

When temperatures drop into the 20s, citrus trees need to be brought inside. “Those three are the most cold-tolerant of the citrus, but that doesn’t mean that they’re going to take hard freezes,” Bachman said. “If you have extended periods where it’s going to be below that, they really need to come in.” They don’t necessarily need to come into your house, though. Bachman said they’ll do fine being brought into the garage or a storage building during the winter, even if it’s unheated. When you bring them in they typically go into a dormant state, but that doesn’t mean they’ve died. They’ll resume growing once they’re placed back outside. When brought in, Bachman says there’s no need to set up lights. Just keep them watered. “Just let them be,” Bachman said. “The whole thing is just keeping them alive.” Bringing the trees in during freezing weather is a must, but there’s never any point during the summer that would be too hot that you would need to bring them indoors.

Citrus Fruits for Southern and Coastal Georgia

Go to the following website for more details:

<https://extension.uga.edu/publications/detail.html?number=B804&title=Citrus%20Fruit%20for%20Southern%20and%20Coastal%20Georgia>

The Thomasville citrangequat and the Glen citrangedin (citrange X calamondin) have been utilized to a limited extent as lime substitutes in areas such as Georgia where it may be too cold for other cold hardy lime-like fruits such as the calamondin (10-20 F.),¹⁸, (Wikipedia, Cold Hardy Citrus**). (Jackson, 1991). The citrangequat is hardy to 5 degrees F (**Wikipedia, Cold Hardy Citrus**).**

See the kumquat chapter for more details.

Citrus fruit plants for Southern and Coastal Georgia are very versatile around the home and may be used as individual specimens, hedges or container plants. Their natural beauty and ripe fruits make them attractive additions to the South Georgia home scene. Cold-hardy varieties that receive recommended care may grow successfully in the coastal and extreme southern areas of the state (and to a lesser degree in more northern locations). The most significant limiting factor to citrus culture is damage from severe winter temperature. The following brief history of citrus culture in the United States vividly illustrates the devastating effect of winter freezes.

Historical Background of Citrus in the U.S. Citrus was first introduced into the continental United States by early Spanish explorers at Saint Augustine, Florida, in 1565. Considerable time elapsed before citrus was introduced into Arizona (1707) and California (1769). History indicates that citrus plants have been grown for many years in gardens near the Gulf of Mexico and even as far north as Charleston, South Carolina. Small satsuma plantings were developed in the Gulf states as early as the 1890s but were destroyed by the freezes of 1894-95 and 1899. Plantings resumed until the freeze of 1916-17 struck, killing thousands of acres. By the early 1940s the hardy satsuma had again made a comeback, with some 12,000 acres growing in the Gulf states of Louisiana, Alabama and northern Florida. But freezes in the two decades following World War II mostly eliminated these plantings. Currently the main commercial areas are on the Gulf Coast of Louisiana and Florida.

Selecting Varieties The three general classes of citrus that produce sweet fruits are mandarins, sweet oranges and grapefruit. All of these citrus types develop into attractive, medium- to large-size trees. However, some are better adapted to South Georgia conditions than others. Mandarins. This citrus class includes a large group of loose-skinned, deeply-colored, highly-flavored fruits. They are sometimes referred to as the kid-glove (easily peeled) fruits. Within this group are the mandarins, satsumas, tangerines and tangerine hybrids. The terms mandarin and tangerine are used interchangeably for a number of loose-skinned fruits, depending upon where they are grown. For example Dancy is called a tangerine in Florida and a mandarin in California. Unlike other types of citrus, cross pollination is required for optimum fruiting of some tangerine varieties and hybrids [such as the Clementine, Minneola, and Orlando].

Satsuma - The highest degree of success and greatest satisfaction in growing citrus in Georgia will be realized with the satsuma. It will withstand colder temperatures (14-18 F., McNeil, 2001), produce more consistent crops over a longer period of time and requires less cold protection than other types of sweet citrus. The satsuma is distinctly different from the mandarin. It is self-fruitful, has excellent cold hardiness and ripens its fruit well ahead of any freeze problems (September to November). Owari is the most popular variety, and is generally available at retail outlets. Fruits retain their peak quality for about two weeks, after which they may become puffy, rough in appearance and lose flavor and juice content. Silverhill is another good variety. Changsha is seed-propagated. Some have good flavor, but most are very seedy. An important fact to remember when growing satsumas is that fruits become fully ripened for eating while the peel color is still rather green. Certain fruits will ripen ahead of others, but by beginning to harvest when the first few fruits become ripe, at least one to two weeks may be added to the length of the harvesting period.

Tangerines (Mandarin) - The next best type of citrus to plant from the standpoint of cropping and cold hardiness (18-20 F., McNeil, 2001) is the tangerine. Satsumas and tangerines will escape damage from many freezes that will severely damage grapefruit and sweet oranges. Dancy and Ponkan are exceptionally good tangerine varieties that produce quality fruits. However, their fruits may not develop good flavor before early- to mid-December, so they may be exposed to freezing temperatures before attaining optimum ripeness. The Ponkan reportedly is less cold-resistant than most mandarins. Its fruits lose quality and the rind puffs if it is not picked when ripe. Earlier-ripening selections such as the Clementine (Algerian) tangerine should be planted where possible. Dancy and Ponkan are self-fruitful, but Clementine requires cross-pollination from another tangerine or tangerine hybrid. The tangerine hybrids described below provide some exceptionally good early-maturing varieties that should be of interest to the homeowner. Tangerine Hybrids - Tangelos are tangerine-grapefruit hybrids that produce loose-skinned, tangerine-like fruits. Orlando is an ideal selection for homeowner use. It is cold hardy and produces excellent quality fruits that ripen early (October to December). Dancy, Clementine or some other variety should be planted with Orlando for cross-pollination. Other early-season (October to November) tangerine hybrids that could be grown include Lee, Robinson, Osceola, Nova and Page. All of these hybrids require cross-pollination for best fruiting.

Sweet Oranges. Hardy to 20 F. Sweet oranges may be grown along the lower coastal area with a fair degree of success if adequate cold protection is provided each year. Hamlin is suggested if fruits are desired primarily for juice. Its cold-hardiness is equal or superior to other sweet orange varieties; however, hard freezes (20 degrees F and lower) will severely damage them. Fruits are commercially seedless (six seeds or fewer per fruit) and ripen early (October to November). Ambersweet is another sweet orange suggested for trial. The Navel orange is recommended for growing seedless fruit that will be eaten fresh. Navel oranges often produce light crops and aren't usually as fruitful as sweet orange varieties (non-navel types) such as Hamlin. Suggested varieties include Washington, Dream and Summerfield. All ripen their fruits relatively early (October to December).

Grapefruit. Because of a lack of outstanding cold hardiness (low 20's F., McNeil, 2001), grapefruit should be grown along the same lower coastal area as sweet oranges. Although numerous selections are available, the Marsh (white seedless) and Redblush or Ruby (red seedless) varieties are the most frequently planted. Both produce excellent quality fruit and have few to no seeds. (For those homeowners who prefer exceptionally high fruit quality, the white seedy varieties Royal and Triumph are suggested.) Marsh and Ruby fruits may be harvested as early as late September and October, but their quality significantly improves if they remain on trees until November and December. The Star Ruby, released by Texas A&I University, is an outstanding red, seedless grapefruit.

Acid Types of Citrus. There are a number of hardy acid-type fruits available for homeowner use. These plants make attractive ornamental specimens and provide delightful fruits. All are self-fruitful and do not require cross-pollination.

Kumquats. Kumquats are the most cold hardy of the commonly grown acid citrus fruits, tolerating temperatures as low as 10-20 degrees F., Meiwa 14 F. (McNeil, 2001). They possess a delayed resumption of growth in the spring, which helps avoid late freeze damage. The kumquat is one of the most widely used citrus plants around the home and develops into an attractive shrub-like tree that bears small orange-like fruit about one inch in diameter. Fruits may be eaten fresh, peel and all, or used in making jellies, marmalade and candies. Several varieties are available, but only three are commonly propagated: **Nagami, Marumi and Meiwa.** Nagami fruit are oblong to pear-shaped and have acid pulp; the others are sweeter and rounder. Meiwa, which produces nearly-round, sweet fruit, has become one of the most popular for home planting.

Calamondins. This small, round fruit looks somewhat like a tangerine and has very acid pulp. It is attractive as an indoor or container plant. Fruits are yellow to orange colored, and are readily used as a substitute for limes and lemons. Calamondins have good cold hardiness. It is hardy between 10 to 20°F. (McNeil 2001). 18 degrees F. says (Wikipedia, Cold Hardy Citrus)

Lemons. Meyer, one of the most cold-hardy lemon selections, is recommended for home planting because it produces good crops of large, practically seedless, juicy lemons. The fruit ripening period usually lasts for several months, beginning in late summer. Plants developed from cuttings are often used around the home. Inherent cold hardiness approximates that of the sweet orange (20 degrees F., McNeil, 2001).

Lime Hybrids. The Eustis limequat is a very cold-hardy lime-kumquat hybrid and makes a very attractive small plant. It is popular as a container plant. Limequats produce fruit resembling the lime in appearance and quality and may serve as an excellent lime substitute. Cold hardiness is about equivalent to the sweet orange (20 degrees F., McNeil, 2001). Lakeland and Tavares are two less popular varieties occasionally found in retail outlets.

Rootstock Selection Proper rootstock selection is crucial. Trifoliata orange (*Poncirus trifoliata*) is a superior rootstock for satsumas, oranges, kumquats and tangerines and is strongly recommended. It induces good cold hardiness in the scion variety and results in favorable yields and high fruit quality. About the only other rootstocks of value are sour orange, Cleopatra mandarin and certain citranges (a cross of sweet orange and trifoliata orange) such as Rusk and Carrizo. Cleopatra mandarin is an outstanding rootstock for mandarins-tangerines. Sour orange is incompatible as a rootstock for kumquats.

Pollination is not needed with the exception of Clementine tangerine and certain tangerine hybrids such as Orlando tangelo. Citrus trees are self-fruitful and usually do not require cross-pollination. Self-fruitful types of citrus may be grown as single trees.

See the rest of this website for planting and care.

<https://extension.uga.edu/publications/detail.html?number=B804&title=Citrus%20Fruit%20for%20Southern%20and%20Coastal%20Georgia>

Meiwa kumquat (www.pinterest.com)

Nules Clementine fruit (www.etsy.com)



Tango mandarin (www.georgiacitrus.com)
Fukushi kumquat (Kumquat 'Fukushu' (*Fortunella obovata*))



**Gold Nugget mandarins,
Franklins Citrus Farm
(Georgiacitrus.com)**



Citrus for Southern and Coastal Alabama. Read details here on this website:

<https://ssl.acesag.auburn.edu/pubs/docs/A/ANR-0603/ANR-0603-archive.pdf>

Choosing a Citrus Tree for the Backyard in Alabama

<https://www.aces.edu/blog/topics/lawn-garden/choosing-a-citrus-tree-for-the-backyard/>

AUBURN UNIVERSITY, Ala.— The recent introduction of new diseases and lack of cold hardiness can make citrus a challenging fruit to grow in some parts of Alabama. However, many homeowners in the southern portion of the state have a backyard citrus tree that can survive cold snaps with proper care and maintenance.



Citrus a Popular Backyard Tree

Alabama Cooperative Extension System Horticulture Specialist, Jeremy Pickens, said as a garden plant, citrus provides a unique texture, season-long dark green foliage, a unique fragrance when in bloom and colorful edible fruit.

“Learning how to properly care for citrus in the home garden will keep trees productive for years to come,” Pickens said. “Healthy plants are more resistant to diseases and insects. Proper installation and maintenance are important to produce healthy plants.”

Tree Selection

Homeowners should purchase trees from a certified nursery. Inspected nurseries will pass examinations by state or federal inspectors to confirm the nursery is producing clean, disease-free plant material.

“Citrus trees grown in a certified nursery will have a tag stating the name of the nursery, registration number, the tree variety and rootstock,” Pickens said.

The following are some tips for homeowners to keep in mind when choosing citrus trees:

Examine trees for symptoms of pest damage or disease.

Trees should have dark-colored leaves and a smooth trunk.

Consider choosing varieties based on cold tolerance—the best-suited rootstock for Alabama is trifoliate orange.

Choose plants 5/8 to 1 inch in diameter and 2 to 4 feet tall.

Look for trees with three to four upward-growing side branches.

Avoid trees with sharp angles that will break under pressure with a heavy crop load.

Container-Grown Citrus

Central and north Alabama gardeners can consider patio citrus, grown in containers.

“Dwarfing citrus varieties tolerate container confinement quite well,” Pickens said. “Container-grown citrus allow gardeners to move the plant indoors in case of an imminent freeze.

It is important to remember, however, container citrus do not have the added insulation of ground temperatures. Therefore, container citrus are more susceptible to mild freezes.

Selecting Varieties in Alabama

<https://ssl.acesag.auburn.edu/pubs/docs/A/ANR-0603/ANR-0603-archive.pdf>

By Arlie Powell, Extension Horticulturist and Dave Williams, Extension Horticulturist, Auburn University. 1998.

The three general classes of citrus that produce sweet fruits are mandarins, sweet oranges, and grapefruit. All of these citrus types develop into attractive medium- to large-size trees. However, some are better adapted to coastal Alabama conditions than others.

If the producer grows citrus “outside” in South Alabama and wishes to harvest the fruit, varieties should be selected that can be harvested early (September through November). Beginning in December (sometimes late November), freezing temperatures (26-28 F.) are often severe enough to freeze fruits while not damaging the trees. Freeze protection methods available to producers may be inadequate to keep fruit from freezing during December.

Mandarins

The mandarin class includes a large group of loose-skinned, deeply colored, highly flavored fruits. They are sometimes referred to as the kid-glove (easily peeled) fruits. Within this group are the mandarins, satsumas, tangerines, and tangerine hybrids. The terms mandarin and tangerine are used interchangeably for a number of loose-skinned fruits, depending on where they are grown. For example, the Dancy variety is called a tangerine in Florida and a mandarin in California. Unlike other types of citrus, cross-pollination is required for optimum fruiting for a number of mandarin (tangerine) varieties and hybrids [such as the Clementine and Orlando].

Satsuma

The highest degree of success and greatest satisfaction in growing citrus in Alabama will be realized with satsumas. They withstand colder temperatures than the other forms of edible sweet citrus, produce more consistent crops over a longer period of time, and require less cold protection.

Satsuma is a mandarin. It has excellent cold hardiness (14-18 F., McNeil, 2001) and ripens its fruit well ahead of most freeze problems (September to November). Owari is the most popular variety and is generally available at retail outlets. Kimbrough is a recent release from Louisiana, but it does not seem to be superior to Owari. Brown's Select is a very recent introduction from Louisiana that is somewhat similar to Owari in tree and fruit characteristics but ripens its fruit at least 2 to 3 weeks earlier. Overall, Brown's Select shows real promise and is being planted extensively in Louisiana and Alabama. Armstrong Early (also called Early Armstrong) is an old variety that has been grown for many years and is planted to a small degree. Fruit of this variety ripen extremely early (beginning in September), but the quality is not as good as later ripening selections such as Owari. Port Neches, a recent variety introduced from Texas, ripens at the same time as and has general characteristics similar to Brown's Select.

It provides yet another promising variety that ripens before Owari.

When grown under warmer climatic conditions (such as Florida), fruit often retain their peak quality for not much longer than 2 to 4 weeks, after which they may become puffy and rough in appearance and lose flavor and juice content.

However, under the cooler climatic conditions of the South Alabama area, fruits tend to remain in good condition on the tree, retaining their juice and flavor for 1 to 2 months or longer after reaching full maturity.

Satsumas may become fully ripened for eating while peel color is still rather green. And certain fruits will ripen ahead of others. By beginning to harvest when the first few fruits become ripe, growers can lengthen the harvesting period by at least 1 to 2 weeks.

For commercial purposes, however, it is usually desirable to wait until at least a prominent orange color has developed on the greenish peel (rind).

Tangerines (Mandarin)

The next best type of citrus to plant from the standpoint of cropping and cold hardiness (18-20F., McNeil, 2001) is the tangerine. Because of their earlier ripening, satsuma and some tangerine fruit will escape damage from many freezes that will severely damage midseason varieties of grapefruit and sweet oranges. Dancy and Ponkan are exceptionally good tangerine varieties that produce quality fruits.

However, their fruits may not develop good flavor before early to mid-December, which means fruits may be exposed to freezing temperatures before attaining optimum ripeness. The Ponkan variety reportedly is less cold resistant than most mandarins; fruits lose quality and the rind puffs if not picked when ripe.

Earlier ripening selections such as Clementine (Algerian) tangerine should be planted where possible. Sunburst was recently introduced by the USDA and is being grown extensively in Florida. It ripens very early and has reasonably good quality. Dancy, Ponkan, and Sunburst are self-fruitful, but Clementine requires cross-pollination from another tangerine or tangerine hybrid. The tangerine hybrids described below provide some exceptionally good early maturing varieties that should be of interest to the homeowner.

The Dancy variety is susceptible to a new disease (alternaria) and is being replaced in Florida. Its best flavor is in January, which means fruit are likely to be injured by cold. Ponkan is not good until December, and then for only a short period.

Tangerine Hybrids

Tangelos are tangerine-grapefruit hybrids that produce loose-skinned, tangerine like fruits.

The Orlando variety is an ideal selection for homeowner use. It is cold hardy and produces excellent quality fruits that ripen early (October to December).

Dancy, Clementine, or some other variety should be planted with Orlando for cross-pollination. If a second variety is not planted with Orlando tangelo, fruiting can be enhanced by scoring (girdling) the trunk with a knife during full bloom (cut a single cut through bark to the wood but do not remove any bark) or by spraying the tree with 10 to 20 parts per million (ppm) of gibberellic acid during flowering.

Other early season (October to November) tangerine hybrids that could be grown include Lee, Robinson, Osceola, Nova, and Page. These will not cross-pollinate each other. All of these hybrids (except Lee), require cross-pollination for best fruiting. Lee does not require cross-pollination as earlier reported but may not be cold hardy enough for Alabama. Fruiting these cross-incompatible varieties can be a problem.

Sweet Oranges

Hardy to 20 F. This citrus can be grown along the lower coastal area with a fair degree of success if adequate cold protection is provided each year. However, hard freezes (20°F and lower) will severely damage trees (fruit is damaged at 26° to 28°F or colder).

Hamlin may well be the best orange variety for Alabama (for fresh fruit and for juice). Fruits are commercially seedless (6 or fewer seeds per fruit) and ripen early (October to November). The cold hardiness of Hamlin is equal to or superior to other sweet orange varieties. All non-navel sweet oranges are self-fruitful.

Ambersweet is the latest (1990) in a number of citrus hybrids released by USDA in Florida. This variety (tangerine x sweet orange cross) has been classified as an orange for marketing purposes. It is currently one of the most sought-after varieties in Florida. It possesses good cold hardiness (somewhat better than most sweet oranges but is still vulnerable to freezes) and ripens in early season (with Hamlin). Ambersweet is suggested as a new variety for those interested in trying to grow sweet oranges.

The navel orange is recommended to the homeowner who wants to raise seedless fruit for eating fresh. However, navel oranges often produce light crops and are generally not as fruitful as regular sweet orange varieties (non-navel types) such as Hamlin. The Washington navel variety is recommended.

Another variety of navel orange of interest to some is Cara Cara. It is similar to the Washington variety but has red flesh. Dream and Summerfield should not be used because of virus problems. Navels make a mediocre dooryard tree, even in Florida. Fruits sometimes begin drying out internally before reaching full maturity. All ripen their fruits relatively early (October to December).

Grapefruit

Because of a lack of outstanding cold hardiness (low 20's F. McNeil, 2001), grapefruit will need cold protection more than oranges. Although numerous selections are available, the Marsh (white seedless) and Redblush or Ruby (red seedless) varieties are the most frequently planted. Both produce excellent-quality fruit and have few or no seeds.

Royal and Triumph are lower in acidity, although not necessarily of better quality. Marsh and Redblush are quite acid because of Alabama's colder winters. Fruits of Marsh or Ruby can be harvested as early as late September and October, but, if allowed to remain on trees until November and December, eating quality significantly improves. The Star variety lacks cold hardiness. All of these varieties are self-fruitful.

Several grapefruit varieties have been introduced during the past 20 years from Texas. Among these are the Star Ruby, Ray Ruby, and, most recently, the Rio Red (discovered as a limb sport on Ruby Red). Producers who wish to try some of the newer grapefruit selections may want to plant one or more of these varieties (all self-fruitful). However, these varieties are probably not very cold hardy.

Acid-Type Citrus Fruits

There are a number of hardy acid-type fruits available for homeowner use. These plants make attractive ornamental specimens and provide delightful fruits as well. All are self-fruitful, requiring no cross-pollination.

Kumquats. The kumquat tree (not the fruit) is the most cold hardy of the commonly grown acid citrus fruits (It withstands temperatures of 10-20 °F. (McNeil, 2001). 14 F. for Meiwa says [Wikipedia, Cold Hardy Citrus](#).

It resumes growth late in the spring, which helps prevent late freeze damage. The kumquat is one of the most widely used citrus plants around the home; it develops into an attractive shrublike tree that bears small orangelike fruit about 1 inch in diameter. Fruits can be eaten fresh, peel and all, or used in making jellies, marmalade, or candies.

Several varieties are available, but only three are commonly propagated: Nagami, Marumi, and Meiwa. Nagami fruit are oblong to date-shaped and have acid pulp; the others are sweeter and rounder. Meiwa, which produces nearly round, sweet fruit, has become one of the most popular for home plantings.

Calamondin

The small, round fruit called calamondin look somewhat like a tangerine and have very acid pulp. It makes an attractive plant for use around the home as well as an indoor or container plant. Fruits are beautifully yellow to orange in color and are readily used as a substitute for limes and lemons. The tree has good cold hardiness. It is hardy between 10 to 20°F. (McNeil 2001) 18 degrees F. says Wikipedia, Cold Hardy Citrus.

Lemons

Meyer is the most cold hardy (20 F.) variety of lemon. The fruit ripening period usually lasts for several months beginning in late summer. Good crops of large, practically seedless, juicy lemons are produced. Plants developed from cuttings are often used around the home. Inherent cold hardiness of the tree approximates that of the sweet orange (20 degrees F., McNeil, 2001), except that the tree grows low to the ground where temperatures are colder.

Lisbon, Villafranca, and Eureka, the commercial varieties of lemon commonly produced in California, can be satisfactorily grown in containers. Hardy to 25 F. (McNeil, 2001).

Ponderosa lemon, a minor variety grown in Florida that produces exceedingly large fruits, can also be grown as a container plant. Hardy to mid 20's F. (McNeil, 2001)

Lime Hybrids

The Eustis limequat is a cold hardy lime-kumquat hybrid that makes a very attractive small plant. It is popular as a container plant. Limequats produce fruit resembling the lime in appearance and quality and may serve as an excellent lime substitute. Cold hardiness is about equivalent to the sweet orange (20 F.)(McNeil, 2001).

Lakeland and Tavares are two less-popular varieties occasionally found in retail outlets. Fruits tend to be especially sensitive to cold injury.

Limes

Limes are among the most cold-sensitive of the common citrus fruits grown. However, the Mexican (also called Key or West Indian) lime, famous for the Key lime pie, can be grown as a container plant when provided with inside protection during the winter (hardy to 28 F., McNeil, 2001). The Persian lime commonly grown in Florida can also be used as a container plant (hardy to 26-27 F., McNeil, 2001).

Kaffir lime (*Citrus hystrix* DC) is a rather unusual selection that Asians think has medicinal properties. The leaves are used in preparing foods. Fruits are small and green, with a rough, wrinkled appearance. They have a slightly off-bitter flavor but may be used in tea. This selection makes a very attractive and satisfactory container plant. [It is adapted to plant hardiness zones 9 and 10. Cold hardiness is 28 degrees F. (vanzyverden.com)]

Kaffir lime (*Citrus hystrix* DC)

(https://en.wikipedia.org/wiki/Kaffir_lime)

(<https://www.ebay.com/itm/403268326014?hash=item5de4aa527e:g:CQEAAOSwpjBhfs4n>)

Citrus hystrix, called the kaffir lime or makrut lime, is a citrus fruit native to tropical Southeast Asia and southern China. Hardy to 28 F. Its fruit and leaves are used in Southeast Asian cuisine and its essential oil is used in perfumery. Its rind and crushed leaves emit an intense citrus fragrance.



Kaffir Lime photos.

(Specialtyproduce.com)

(Healthbenefitstimes.com)



Rootstock Selection

Selection of rootstock is another factor to be considered. Scions must be free of exocortis virus. Trifoliate orange (*Poncirus trifoliata*) is a superior rootstock for satsumas and tangerines and is strongly recommended. It induces good cold hardiness in the scion variety and results in favorable yields and high fruit quality.

About the only other rootstocks that are of value are sour orange, Cleopatra mandarin, and certain of the citranges (cross of sweet orange and trifoliate orange). Avoid the Rusk citrange. This stock has a weak root system, and the tree is more susceptible to cold injury. The Carrizo citrange does not impart enough cold hardiness to the scion and is not recommended.

Flying Dragon is a dwarf selection of trifoliate orange that has been evaluated as a rootstock in California, Louisiana, and Florida since the late 1970s. When sweet oranges or other types of citrus are budded onto this rootstock, the trees produced are about 1/5 to 1/3 normal size. Trees can be planted every 6 to 8 feet in rows, with rows 7 to 15 feet apart. This rootstock has not been evaluated in Alabama. Researchers are concerned that tree size and yields may be too small for commercial use, but limited grower trials look promising. However, Flying Dragon is suggested to home producers who would like to grow citrus trees that may never become taller than 6 to 7 feet. It would also add variety to the landscape.

The Cleopatra mandarin is a good rootstock for mandarins/tangerines. It is outstanding in central Florida but probably not as good as *P. trifoliata* in Alabama. Sour orange is not recommended as a rootstock for kumquats because of incompatibility problems.

Pollination

With the exception of Clementine tangerine and certain tangerine hybrids such as Orlando and Minneola tangelo, citrus trees are self-fruitful and do not require cross-pollination. Thus, self-fruitful types of citrus can be grown as single trees. Cross-pollination requires that two or more varieties bloom at the same time. Some varieties will not cross-pollinate each other.

Satsuma and navel do not produce viable pollen and thus cannot be used for that purpose.

See the balance of this website for additional citrus cultural information for Alabama.

<https://ssl.acesag.auburn.edu/pubs/docs/A/ANR-0603/ANR-0603-archive.pdf>

South Carolina Citrus (<https://hgic.clemson.edu/factsheet/citrus/>)

***Citrus* cannot be sold in or shipped outside of Charleston, Beaufort, or Colleton counties in South Carolina due the Citrus Greening Quarantine.**

Species & Cultivars. *C. aurantifolia* – There are two main commercial cultivars of limes, ‘Tahiti’ and ‘Key’. ‘Key’ lime fruits are smaller in size and slightly more acidic. ‘Tahiti’ or Persian lime trees grow larger and produce less, but larger fruit. Home gardeners tend to have more of a sure crop with ‘Key’ limes, which actually have yellow skin when fully ripened. Key hardy to 28 degrees F., Tahiti to 26-27 (McNeil, 2001). *Citrus latifolia*.

C. limon – Several different cultivars of lemons are available. The most common ones are ‘Eureka’ and ‘Lisbon’. These are the commercial varieties found in grocery stores and are true lemons. ‘Meyer’ is a hybrid variety that is slightly sweeter and easier to grow for the home gardener. Lemon hardy to 25 degrees F., Meyer 20 F. (McNeil, 2001).

C. paradisi – Two main cultivars of grapefruit are available, ‘Ruby Red’ and ‘Rio Red’. Both varieties are seedless and tolerate cold well. Grapefruit is typically harvested in the fall. Hardy to low 20’s F. (McNeil, 2001).

C. reticulata – ‘Mandarin’ oranges are more acidic than their sweeter relatives. Though all *Citrus* flowers are fragrant, ‘Mandarin’ is noted for its extremely fragrant flowers. Tangerines are in this species. They tend to have a sweeter taste than other oranges, and may require two different varieties for pollination such as the Clementine and Orlando. Hardy to 18-20 F., satsuma to 14-18 (McNeil, 2001).

C. sinensis – ‘Navel’ and ‘Valencia’ are two well known sweet orange varieties. Both are sweet and good for juice or fresh eating. [Navel juice turns bitter if stored.] ‘Navel’ is famous for its winter ripening in California. Among these two varieties, ‘Valencia’ is the more patio friendly and tends to be more readily available to home gardeners. Hardy to 20 degrees F. (McNeil, 2001).

Growing Citrus in South Carolina

(<https://wingardsmarket.com/growing-citrus-in-south-carolina/>)

Because of frost and freezing temperatures in the winter, it is necessary to protect vulnerable subtropical plants, by moving them into a greenhouse, garage or sunroom. In order to move it, your lemon or lime tree should be planted in a pot, rather than in the ground. When that first frost or freeze is upon us, go ahead and move it in. And, don't forget watering and direct light are still necessary!

Place it near a sunny window or use an indoor grow light (6 hours minimum needed), but NOT near an HVAC vent. Protect it from any draft.

Be sure not to over water. Let the soil dry out in between waterings.

Move citrus plant(s) outdoors, once there is no danger of frost or freezing temperatures. Place in a spot that receives direct sun all day, or at least 6 hours.

Growing Citrus in Hawaii

Websites:

Citrus for Hawaii's Yards and Gardens 2008.

https://www.ctahr.hawaii.edu/oc/freepubs/pdf/F_N-14.pdf

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<https://www.plantithawaii.com/citru>

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Citrus for Hawaii's Yards and Gardens 2008.

https://www.ctahr.hawaii.edu/oc/freepubs/pdf/F_N-14.pdf

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Citrus trees are among the favorite fruit trees grown around Hawai'i's homes. They are relatively small and widely adapted. The main types grown are lemon, lime, orange, mandarin (tangerine), tangelo, grapefruit, and pummelo. Some culinary and ornamental citrus species are also grown.

Citruses of various kinds can be grown in Hawai'i from near sea level to 2000 feet elevation and above. Most grow best in sunny locations where temperatures range between 65° and 90°F. Citruses in general are better adapted to dry than to wet climates, and earlier publications recommended leeward rather than windward areas for citrus production.

The citruses in which sweet fruit is desirable (such as orange, tangerine, tangelo, grapefruit, and pummelo) are generally best grown at lower elevations, from sea level to 500 ft. When they are grown in or above the 500–1000-ft elevation range, where cooler temperatures are common, the fruit may fail to develop high levels of sugar and instead remain acid, which results in sourness.

At 500–1000 ft, navel orange and tangerine produce fruit of adequate quality. Higher elevations (above 1000 ft) are generally best suited to growing lemons and limes.

Fruit of citruses such as orange and tangerine usually fail to develop color when grown at Hawai‘i’s lower elevations, and a green or green-yellow skin coloration is normal in ripe fruit.

In areas with cooler nights, the fruits turn bright orange upon ripening.

**Navels in Hawaii with
good color at 500-1000 ft,
intermediate elevations.
Fruit at lower elevations
would have a green color.**



Climatic conditions vary widely in Hawaii from place to place over fairly short distances. This variation and the wide variation in the genetic diversity of citrus means that confident statements about which types or varieties grow best in a particular location are difficult to make. Although citrus has been a crop of minor significance at various times since its post-Cook importation to Hawai'i, there has not been much experimentation on citrus horticulture at the University of Hawai'i. Only a few studies on variety suitability or crop management under Hawai'i conditions have been reported. The recommendation of varieties in this publication incorporates the practical experience of CTAHR horticulturists. The advice on cultural practices given here draws on the general knowledge of practices suitable for fruit trees and incorporate recommendations on citrus production from other citrus-growing areas.

Citrus types and varieties

Citrus originated in subtropical South and Southeast Asia, and its diversity of types probably was developed largely in China and India.

Representatives of citrus gradually spread westward, reaching Spain by the late Middle Ages, and were taken to the New World by Columbus and other explorers.

The citrus group crossbreeds freely, which is why its members so rarely produce true to type from seed.

About a dozen primary species of the genus *Citrus* are recognized, but the group's genetic scope, represented by its many species and possible possible hybrids, is of vast complexity and offers great promise for development of improved varieties. While a very few citrus varieties (“nucellar” types), such as the rootstock ‘Heen Naran’) produce true to type when grown from seed, most do not. The citrus trees available from nurseries and garden centers are clonally propagated by grafting a piece of the desired “scion” variety onto a seedling rootstock. Often the rootstock variety has been selected for its influence on producing high-quality fruit or its tolerance of certain citrus diseases. Some rootstocks are claimed to have a “dwarfing” effect, resulting in smaller tree size.

Navel orange is probably the most popular citrus for Hawai'i conditions. grown in home gardens in Hawai'i. The fruit is relatively easy to peel, contains few or no seeds, is juicy and sweet, and provides a nutritious snack. 'Washington' navel which ripens from October to January, is widely grown throughout the state. 'Pera', 'Raratonga Seedless', 'Rico, No. 2' (a nucellar type), and 'Tabata Navel' are recommended for Hawai'i. 'Valencia', 'Shuekhan', and 'Texas and Joppa' are other varieties that are grown here.

Mandarin is also common in home gardens.

The fruit is flavorful and easy to peel.

'Fairchild', 'Fremont', 'Lee', and 'Nova' are recommended for Hawai'i.

Okinawan', 'Honey', 'King', and 'Dancy' are also grown.

Grapefruit produces tart, juicy fruits. Grapefruit varieties that grow well here include ‘Marsh Seedless, ‘Puma’ (a grapefruit-pummelo cross), ‘Ruby Red’ (also particularly recommended for new planting sites. ‘Glenred’ or ‘Ruby’), and ‘Star Ruby.’

Pummelo (also called zabon or jabon) is a close relative of the grapefruit, but its fruit is less tart. Pummelo trees require slightly more growing space because of their large fruit. Favored varieties produce excellent quality fruit with flesh that is sweet and firm, which makes it easier to eat with the fingers. ‘Chandler’, ‘Haiku B’, ‘Kao Pan’. ‘Leslie’, and ‘Scudder’ are recommended for Hawai‘i. ‘Diamond Head’, ‘Pauthel’, ‘Sakata’, ‘Tahitian,’ ‘Thong Dee’ are also grown.

Citrus types grown for juice for flavoring include 'Meyer' lemon, 'Bearss' lime (a.k.a. 'Persian' or 'Tahitian' lime), and 'Key Lime' (a.k.a. 'Mexican,' 'West Indian', or 'Chinese' lime); these may produce fruit throughout the year.

Tangelo, a cross between mandarin and grapefruit, is liked for its ease of peeling and abundant juice. 'Minneola' and 'Orlando' grow well here.

Recommended varieties of tangor, a mandarin-orange cross known for its sweetness, are 'Murcott' and 'Ortanique.'

Citrus types grown for juice for flavoring with leaves are used as a flavoring in Thai cooking are the Kaffir lime.

Some citruses are grown for ornamental purposes. development of improved varieties. Calamondin is often planted as a bonsai or container. Its juice is used as a condiment in Philippine cooking. Kumquat, in a genus related to citrus, can be eaten with its rind or used in marmalade and as an ornamental. Adapted kumquat varieties for Hawai'i include 'Nagami', 'Meiwa', and 'Marumi'. The availability of citrus varieties in Hawai'i's shops and plant nurseries is unpredictable, and not all of those mentioned here are always readily available. Nurseries often bring in varieties that are favored elsewhere, and these introductions may well be worth a try under Hawai'i conditions. See the following website for more Hawaii citrus cultural practices:

https://www.ctahr.hawaii.edu/oc/freepubs/pdf/F_N-14.pdf



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<https://www.plantithawaii.com/citru>

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Citrus — Orange, Lemon, Lime, Tangerine, Grapefruit (see slides)

Citrus is such a vast subject that volumes have been devoted to this genus. It is rich in history, with varieties being cultivated as far back as 2000 BC in China and is now a billion dollar industry worldwide. Citrus can be grown from sea level to the upper slopes, each variety having its ideal growing area. In Hawaii with our tropical climate, expect oranges and tangerines to have a greenish tint to the skin and a tighter adherence of the peel to the fruit, making oranges and other citrus more difficult to peel than citrus grown in more temperate areas such as California. Citrus must be planted in a well-drained soil and requires regular fertilization with minor nutrients for maximum production. Please see our [tree care guide](#) for growing tips and fertilizer suggestions. Click on tree care guide above when in powerpoint mode.

Washington Navel

Washington Navel Oranges are the most widely planted and prolific oranges grown in Hawaii. The tree is medium size with a round crown of dense, dark green leaves. The fruit is large and distributed throughout the tree. The seedless fruit has a delicious, rich juicy flavor.

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Cara Cara Navel

Cara Cara Navel

Oranges have a slightly pink skin that is easy to peel, and flesh ranging from rich orange to dark pink. The interior is sweet with relatively low acid content and few to no seeds. We also grow a variegated Cara Cara with the same characteristics.

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Fisher Navel Orange

Fisher Navel Oranges are a California selection that bear the same high quality fruit as the 'Washington Navel' but ripens earlier in the Fall season. The fruit is delicious, juicy and seedless.

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Lane Late Navel Orange
Lane Late Navel
Oranges are a bud sport
from a Washington Navel
tree in Australia. The
fruit has the same high
quality as the
Washington Navel but
ripens later in the
season, during our
Spring months. The fruit
is delicious, juicy and
seedless.

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Moro Blood Orange

Moro Blood Oranges are the best of the pigmented oranges for our climate. The pigments of the fruit flesh is more subtle when grown in Hawaii because there is less variation between our day and night temperatures. They are a very prolific producer of juicy sweet seedless fruit.

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Valencia Orange

Valencia Oranges are the standard “juice” oranges, and is also delicious eaten freshly out of hand. They are also called ‘Kona Oranges’, as they were the first oranges to be planted by seed in Kona in the late 1700s. They are the most widely grown orange in the world, and are very productive. The fruit is delicious, seedless and make wonderful juice that will keep for several days.

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Minneola Tangelo

Minneola tangelos are a cross of a Dancy tangerine and Duncan grapefruit. The fabulous fruits are favorites among the Plant it Hawaii staff. The flavor is excellent, sweet-tart, aromatic and rich. It makes excellent juice, as the fruits are extremely juicy, but quite difficult to peel in our climate. The large orange fruit is ripe in the fall and winter months and tends to be a heavy and regular bearer.

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Clementine Tangerine

Is easy to peel, usually seedless, and ripens in the winter and spring months. The fruit is rich and very sweet and juicy. Trees prefers a coastal lowland climate for best fruit quality and production. It is a vigorous grower and comes into bearing early. The fruit achieves good color here.

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Daisy Tangerine

Daisy tangerines are a cross between two mandarins, Fortune and Fremont. The trees bear fruit in the winter months, and tend to produce large crops every other year. The skin is smooth and thin, and the flesh is seedless.

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Photo: [Specialtyproduce.com](https://specialtyproduce.com)



Dancy Tangerine

Dancy tangerines are a popular variety and are the most widely planted tangerine in the state. The bright orange fruit is juicy and sweet and is ripe in our winter months. The canopy shaped tree is a vigorous, upright grower tending to bear heavily every other year. Trees are nearly thornless and the fruit must be picked when ripe. The fruit is easy to peel.

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Fairchild Tangerine

Fairchild tangerines are a cross produced from Clementines and Orlando tangelos. The trees bear fruit earlier in the Fall months, tend to produce large crops every other year, and produce more, high quality fruits when planted with other tangerine varieties. The fruit is juicy and rich, and the trees are thornless and spreading.

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Photo: [idtools.org](https://www.idtools.org)



Gold Nugget Tangerine

Gold Nugget tangerines are late season producers, and are usually harvested in the Spring months. The fruits are medium sized with a somewhat lumpy, thin skin with great rich flavor and no seeds. The trees grow upright and benefit from regular pruning to encourage a round canopy.

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Photo: Georgiacitrus.com



Honey Tangerine

Honey tangerines have a sweet, delicious, somewhat spicy flavor and are very juicy. The fruits have few seeds and the fruit holds on the tree very well when fully ripe. The trees are vigorous, upright and productive growers with the fruit being held on the outermost ends of the branches. The fruit is medium sized and can be small if there is a heavy crop. The fruit is generally ripe in mid-winter through spring, although it is known to bear fruit most of the year in many Hawaii locations.

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Satsuma Tangerine [Mandarin]

Satsuma tangerines are a seedless variety that is more cold hardy than other varieties. The reddish-orange fruit is medium sized and somewhat flattened at the stem end, and extremely easy to peel. The sweet, juicy fruits are usually ripe in the winter months. It is a small spreading tree with an open canopy and dark green foliage that loves the higher elevations in Hawaii, but does equally well in the windward lowlands.

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Calamondin Lime

Calamondins are a hybrid of a lime and a kumquat. The tree is small, upright and bushy with many attractive, bright orange small fruits all through the year. The flesh is orange, tart and very juicy. It can be used just as you would use any lime, for garnish, zest or juice, and has a distinct delicious flavor. The tree is easy to prune to keep as a bush and can be containerized for many years in a large pot on the lanai. It is enjoyed for its fragrant blossoms and fruit that cover the tree several times a year. We also grow a variegated Calamondin with the same characteristics.



Finger Lime

Finger limes are originally from Australia. The fruits are small and long, roughly resembling a finger. The skin is thin and the pulp is made up of small, round beads of tart juice. It has been referred to as the caviar of citrus and is a sought after culinary fruit. The trees are small, with fragrant flowers and numerous thorns and produce copious amounts of fruit throughout the year.

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2020**



Kaffir Lime

Kaffir limes are mainly grown for their aromatic leaves which are used in Thai and other Asian dishes such as soups, stews and curries. Kaffir trees are small with compound leaves. The new growth flushes are purple and soft which then mature into glossy, firm, dark green leaves. Kaffir lime makes an excellent patio plant, beautiful with fragrant flowers. Kaffir produces a small, bumpy, wrinkled and seedy fruit with a thick rind that contains pungent oil. The rind can be grated and used with the leaves.

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Tahitian Lime

Tahitian Lime', also known as 'Bearss Lime' is a medium sized, vigorous tree that bears fruit about ten months of the year. The fruit is seedless, juicy and the trees are prolific, dependable bearers. The skin of the fully ripe fruit will turn slightly yellow, but the juicy flesh inside is pale green, and has a true acid lime flavor. The consistent fruiting, dark green leaves and almost constant flowering make the Tahitian lime an excellent orchard tree or container plant for the landscape.

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Eureka Lemon

Eureka lemons are one of the most widely planted lemons in the world. The seedless fruit is borne in clusters at the ends of the branches. The rind is thin, smooth (has the look of the 'Sunkist' lemon) and is rich in aromatic oils. Fruit quality is excellent, juicy and acidic and the skin is used as 'zest' in cooking. It is moderately vigorous and grows into a spreading tree, preferring the sunny lowlands, but can be grown successfully in upland Hawaii. The tree has a long fruiting season.

© Plant it Hawaii 2020



Improved Meyer Lemon

Meyer lemons are popular for having a unique mild, juicy flavor and almost year round fruit production. The small spreading trees have almost constant flowers and fruit, making it an excellent dooryard tree or potted fruiting tree for a sunny lanai. The Meyer Lemon is very adaptable and can be grown in nearly every location in Hawaii. Fruits are large and round with smooth thin skin. It is such a heavy producer that tree does not grow large.

© Plant it Hawaii 2020





Variegated Pink Eureka Lemon

Variegated Pink Eureka lemons are sometimes sold under the name 'Pink Lemonade' and are a bud sport of the conventional Eureka lemon. The leaves are an attractive creamy-white and green variegation with a pinkish tinge on the new growth, making the tree beautifully ornamental. The rind is striped green and cream which yellow as it ripens. The flesh is light pink at full maturity, seedless, acidic, and juicy. Trees produce an abundance of lemons year-round.

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Sudachi

Sudachi, a Japanese citrus, is a hybrid of a mandarin and papeda, a citrus relative. The fruit has a distinct acidic flavor and is used in savory dishes as well as beverages and vinegars. The small fruits are usually ripe in the fall months. Trees are small and spreading with short thorns. The fruit is seedless and can be harvested while the skin is green.

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Yuzu

Yuzu is a hybrid papeda-citron citrus with uses ranging from culinary to medicinal. Both the skin and juice are widely used in Japanese and Korean cooking. The trees have a long fruiting season and can be harvested green in the summer or when the skin turns yellow in the fall. The pungent fruits have a distinct and delicious flavor and triple the amount of vitamin C as a traditional lemon.

© Plant it Hawaii 2020



Buddha's Hand Citron

Buddha's hands are the most unusual looking citrus, as the fruit is indented down the length into several sections, closely resembling fingers. It is very popular in China and Japan, mainly used for religious ceremonies. It is also used in candies, fruit cakes, and as an air freshener. It makes an attractive container plant, offering fragrant flowers and unusual and exotic fruit throughout the year. The trees are vigorous growers and require pruning to keep in a pot as a lanai plant.

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Ben Hu Pummelo

Ben Hu Pummelos are a Hilo selection from Dr. Ben Hu, formerly of the U.S.D.A. It is a sweet, white fleshed variety that grows well in the wet, overcast weather common in the Hilo area. The trees also grow well on the leeward sides, with best fruit quality grown below 1,000 feet.

© Plant it Hawaii 2020



Chandler Pummelo

Chandler Pummelos are a hybrid selection released in 1961 with a sweet, pleasant flavor. The skin is yellow with a slight blush. The flesh is pink or red, and sweet. The fruits are ripe in the winter months and produce best in the sunny lowlands.

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Tahitian Pommelmousse

Tahitian Pommelmousse is a wonderfully juicy, sweet, and tender fleshed pummelo with greenish-white flesh and skin. The fruits are large with slightly flattened sides and grow best in the dry, hot and sunny lowlands of Hawaii.

© Plant it Hawaii 2020



Flame Grapefruit

Flame grapefruits are reliable, heavy producers of high quality pink blushed fruit. The flesh is juicy, seedless, and delicious. The trees produce best in the hotter lowlands of Hawaii and grow into a large, spreading trees with abundant fruit.

© Plant it Hawaii 2020



Oro Blanco Grapefruit

Oro Blanco grapefruits are a California cross between a grapefruit and a pomelo. The flavor is almost as sweet as a navel orange, but with a rich grapefruit flavor. The fruit is a seedless, juicy, and tender. Oro Blanco does well in most Hawaii gardens and is the first variety to ripen in the winter months.

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Star Ruby Supreme Grapefruit

Its the best all around pink grapefruit for Hawaii. The fruit is seedless, thin skinned, and delicious with no bitter aftertaste. The color is excellent and the high quality fruit lives up to its name. The trees will grow into a large, dark green canopy, so it is best to prune the tree regularly for ease of harvest.

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2020**



Meiwa Kumquat

Meiwa kumquats are small, sweet round orange fruit. The fruit is eaten fresh with the sweet skin on . The trees are small and grow upright and bushy, making them ideal container plants. The prized fruit is ripe throughout the year, and is great candied, made into marmalade or used in savory cooking.

**© Plant it Hawaii
2020**



Nagami Kumquat

Nagami kumquats are small acidic oval shaped fruits. The skin is more tart than the Meiwa, so the fruits are commonly used for cooking and makes a marvelous marmalade. The tree bears the abundant orange fruits throughout the year. Even when the tree isn't in full bloom, it still smells incredible. If you keep it potted on your lanai, the tree can fill the area with sweet fragrances.

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New Mexico Citrus

<https://www.abqjournal.com/1345597/citrus-trees-certainly-can-grow-in-new-mexico.html>

By Tracy Fitzgibbon “The good news for you is yes, you can grow citrus trees here, just not planted in the garden like I think you want to. Several nurseries in the area often carry Dwarf Citrus Trees in their greenhouses for the homeowner. But that’s the clue. You will want to think of the trees as houseplants or patio dwellers that would need to come in for the winter months. I know of no successful attempt trying to keep a citrus tree growing outdoors all year long in this climate. So, you’d need to be able to accommodate a potted container with a “tree” that could be upwards to and maybe more than five feet tall, indoors for months every year. With that you should be able to find a variety of citrus to ease your homesickness. Trees like Meyer lemon, Key or Persian Lime, Tangerines and Kumquats have dwarf varieties you can grow successfully in containers.”

Plant cold hardy citrus species such as those recommended for the other gulf coast or southern states. Such as Meyer lemon (20 F.), Limequat (20 F.), Calamondin (10-20 F. or 18), Kumquat (10-20 F., 14 for Meiwa), sweet orange (20 F.), citrangequat (5 F.), satsuma mandarin (14-18 F.), tangerine (18-20 F.), orangequat (16 F.), Rangpur lime (16 F.), Chinotto (18 F.), lemon (25 F.) citrangedin (14 F.), grapefruit (low 20’s F.), Key lime (28 F.), Tahiti lime (26-27 F.). Plant where minimum temperatures do not get lower than their plant hardiness temperature listed. Sweet fruit freeze at a higher temperature, 26-28 F., green fruit at 29-30 F. Pick fruit before winter freezing temperatures. Or bring plants inside before winter. Dr. Robert J McNeil

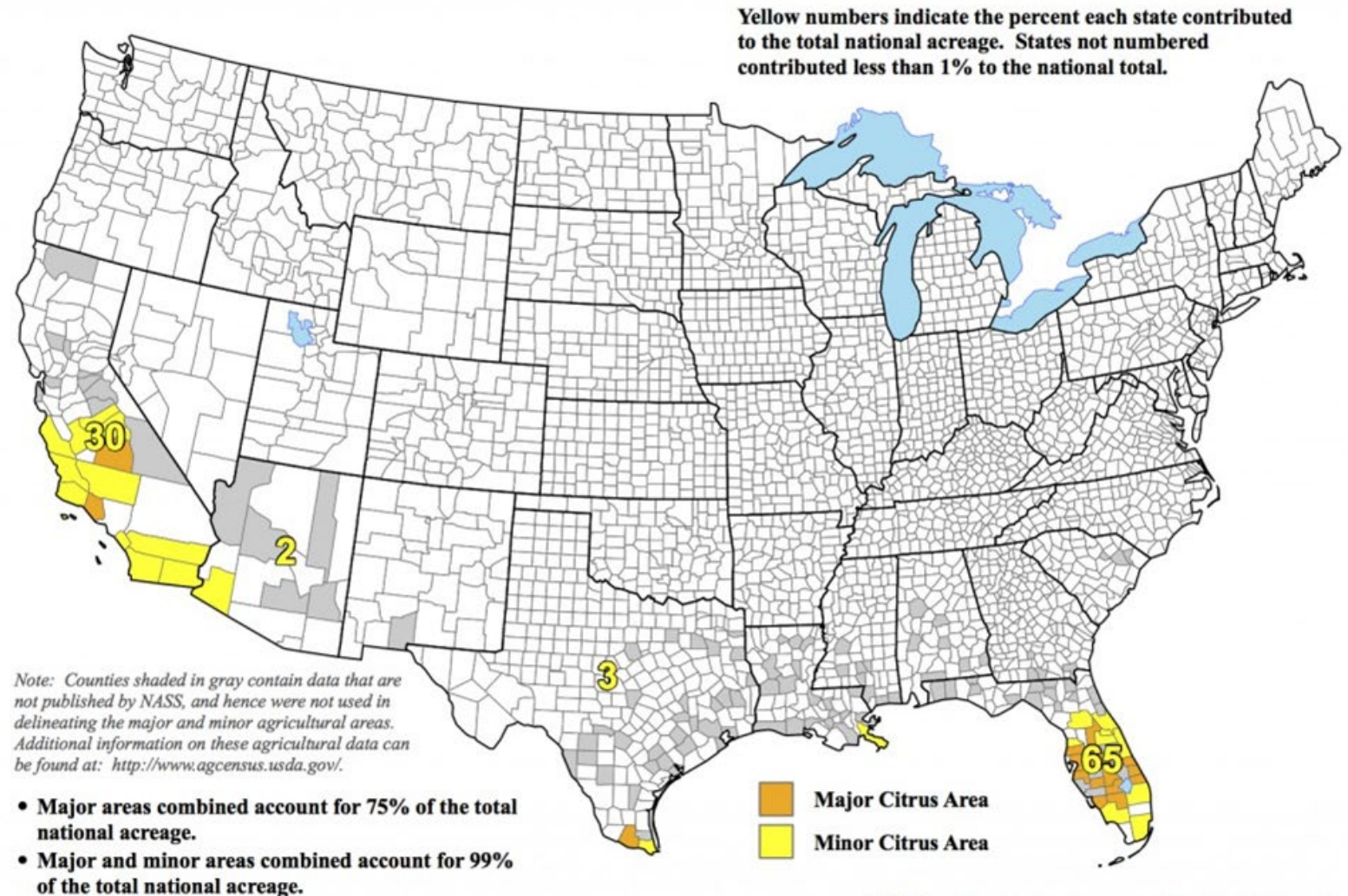
Nevada Citrus (How to Grow Citrus in Las Vegas (Zone 9b): A Desert Gardener's Guide - Van's Garden (vansgarden.com))

- **Dwarf Varieties:** These are ideal for Las Vegas because they can easily be grown in containers, allowing for mobility during extreme weather conditions.
- **Heat-Tolerant Varieties:** Consider choosing citrus types known for their heat tolerance. Valencia oranges and Lisbon lemons are excellent choices as they can better withstand the intense summer heat.
- **Cold-Hardy Varieties:** Las Vegas winters can get cold enough to damage some citrus trees. Varieties like the Meyer lemon and Satsuma mandarins are more resistant to cold and are likely to succeed.
- **If you are growing in a pot then you can experiment with other varieties, and see if it can tolerate direct sun and chilly winters without protection, before committing to in-ground.**

United States: Citrus

US Citrus Producing Areas Map

<http://fillyourplate.org/blog/wp-content/uploads/2013/04/citrus-1024x791.jpg> :



US Citrus Production and Value 2018-2020

Citrus Fruits 2020 Summary USDA August 2020

State and season	Bearing acreage	Production ¹			Value of production ²
		Total	Utilization		
			Fresh	Processed	
	(acres)	(1,000 tons)	(1,000 tons)	(1,000 tons)	(1,000 dollars)
Arizona					
2017-2018	7,300	40	32	8	34,197
2018-2019	7,300	54	37	17	42,680
2019-2020	7,300	72	52	20	50,002
California					
2017-2018	265,300	3,536	2,824	712	2,400,330
2018-2019	269,000	4,264	3,072	1,192	2,123,811
2019-2020	269,700	4,192	3,208	984	2,305,524
Florida					
2017-2018	400,900	2,228	221	2,007	795,007
2018-2019	387,100	3,472	230	3,242	1,143,538
2019-2020	380,500	3,283	267	3,015	957,767
Texas					
2017-2018	24,400	272	175	97	100,618
2018-2019	24,500	350	141	209	89,850
2019-2020	23,800	233	124	109	85,146
United States					
2017-2018	697,900	6,076	3,252	2,824	3,330,152
2018-2019	687,900	8,140	3,480	4,660	3,399,879
2019-2020	681,300	7,780	3,651	4,128	3,398,439

Citrus Greening Control (HLB)

Citrus greening (Huanglongbing) disease is a serious threat to all citrus in the USA. Go to the following USDA website and all HLB websites for each citrus producing state to find out how to deal with it.

[USDA APHIS | Citrus Greening](#) or

<https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/citrus/citrus-greening>

USDA Citrus Greening-Read more here.

<https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/citrus/citrus-greening>

Huanglongbing (HLB), also known as citrus greening, is the most serious disease of citrus. The disease is spread by the Asian citrus psyllid (*Diaphorina citri*) (ACP), which has been present in Florida since 1998. ACP transmits the bacteria to the tree when feeding on new shoots. There is no cure for this disease and all commercial varieties of citrus are susceptible to HLB.

In citrus-producing areas with little or no HLB incidence, early detection and removal of infected trees are critical to prevent spread of the disease. However, it is difficult to identify HLB-infected trees because they may remain asymptomatic for months to years after infection. Control of the ACP vector and removal of diseased trees are key to maintaining productive citrus.

The Impact of Huanglongbing (HLB) on Citrus Tree Planting in Florida (ufl.edu)

The Impact of Huanglongbing (HLB) on Citrus Tree Planting in Florida
Introduction Huanglongbing (HLB) is a bacterial disease of citrus that until recently was confined to Asia and Africa. In 2005, the disease was first discovered in Florida. Since then, it has spread rapidly and now can be found in all counties in the state that contain commercially produced citrus. HLB represents one of the strongest threats to the largest citrus producing state in the United States.

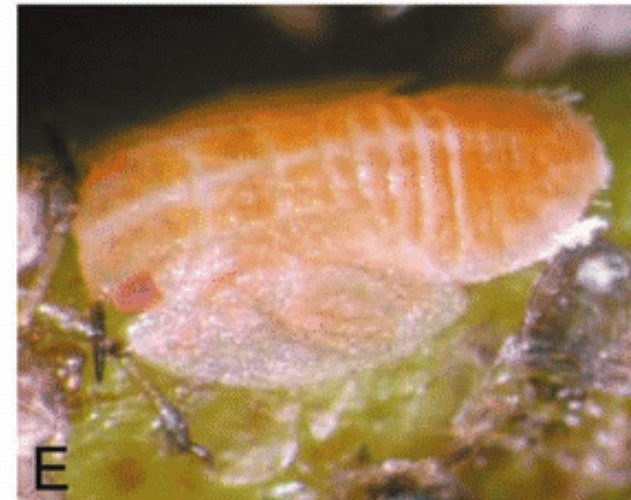
In the 2007-08 season, Hodges and Rahmani (2009) estimated that the economic impact of the citrus industry on the economy of Florida was \$8.9 billion. HLB affects citrus trees by blocking the phloem or the vascular system of the tree limiting its ability to uptake nutrients. It is spread by a small leaf-feeding insect: the Asiatic Citrus Psyllid (ACP). The characteristics of the disease are mottled leaves and small misshapen fruit. Large fruit drop is associated with the disease, but even if fruit remains on the tree until harvest, the fruit is undersized and contain bitter juice rendering it of no economic value.

Continued...Two approaches have evolved to combat the disease. The first approach is generally credited to Bové, who is also credited with first identifying the disease. In the Bové approach, an aggressive scouting program is initiated. Any tree found that exhibits symptoms of HLB is immediately eradicated. A program to suppress the ACP population is also initiated. The Achilles' heel of the Bové program is that infected trees may not exhibit symptoms for up to two years (in the case of mature trees) after becoming infected. Thus, eradicating only symptomatic trees will not eliminate the disease. Diligent implementation of this approach should suppress the level of disease inoculum so that annual tree losses are economically tolerable. Another disadvantage of this approach is the so-called "bad neighbor" effect. If a single grower among a contiguous planting fails to follow the Bové approach, their grove will continue to serve as a source of inoculum. Another issue is that if the level of infection is too high before the disease is discovered, it may be necessary to eradicate an entire block. University of Florida economists have estimated that the Bové method increases per acre grove maintenance costs by approximately \$400 annually, an increase of 33 percent (Muraro).

The Impact of Huanglongbing(HLB) on Citrus Tree Planting in Florida (ufl.edu) – continued.

A grower in southwest Florida, faced with a high of level of infection, decided to implement another approach to deal with HLB. Since HLB blocks the phloem of citrus trees, he devised an approach of feeding trees through their leaves, thereby by-passing the phloem. This approach is known as enhanced foliar nutrition. Under this approach, scouting for the disease is halted, and symptomatic trees are not eradicated. This approach has shown some success in masking the effects of the disease enabling trees to produces significant volumes of fruit. It elevates the cost of grove maintenance ranging from \$200 to \$600 per acre.

Symptoms of HLB (A-yellowing of leaves on twigs, A-twig dieback, B-mottled leaves, C-small misshapen and miscolored fruit, D-the vector-the citrus psyllid, E-psyllid larvae.



The most notable and financially destructive symptom of HLB is the production of small, irregularly shaped green fruit. While the top of infected fruits will turn a more normal color when ripe, the side opposite the stem remains green.

(Huanglongbing Disease - Symptoms, Causes, & Treatment - Fusion 360 (fusion360ag.com))



Huanglongbing Disease - Symptoms, Causes, & Treatment - Fusion 360 (fusion360ag.com)

Asian citrus psyllids transmit huanglongbing disease when they feed on citrus tree leaves.

Huanglongbing disease is not curable—treatment regimes generally focus on controlling the psyllid population.

ID of Citrus Leaves
See species descriptions on page
445-459.

Lemon, *Citrus limon* Burmann, fruit and leaves: www.sunset.com and dreamstime.com



Sweet orange, leaves and fruit

Citrus sinensis Osbeck

[dreamstime.com](https://www.dreamstime.com)



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Mohammed Anwarul Kabir Choudhury | Dreamstime.com



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ID 2594681

GabrielDome | Dreamstime.com

Sweet orange fruit and leaves, *Citrus sinensis* Osbeck



Persian Lime, *Citrus latifolia* Swingle, leaves and fruit

[dreamstime.com](https://www.dreamstime.com)



Persian Lime, *Citrus latifolia* Swingle, fruit and leaves

[dreamstime.com](https://www.dreamstime.com)



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ID 36051238

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Tangerine, *Citrus reticulata* **Blanco, fruit (goodfon.com)** **and leaves (dreamstime.com)**



**Tangerine,
*Citrus
reticulata*
Blanco,
leaves**

[Blogspot.com](#)



**Grapefruit, *Citrus
paradisi* Macfadyen, leaves
justfunfacts.com
*and garden.org***



Photo source: public.asu.edu

Pummelo, *Citrus maxima*
Berm., leaves and fruit (http://idtools.org/id/citrus/citrusid/images/features/wavy_margins.jpg)



**Trifoliate orange, *Poncirus trifoliata* (L.)
Rafinesque, leaves and fruit
(*Plantsusda.gov*)**



**Mexican Lime,
Citrus aurantifolia
L., leaves**

Davesgarden.com



Mexican Lime, *Citrus aurantifolia* L., leaves and fruit

**Talbottnurseryandpoultry.
com**





Kumquat, *Fortunella* spp., leaves and fruit

Dreamstime.com





**Kumquat, *Fortunella* spp.,
foliage and fruit**

ehow.co.uk



Kumquat, *Fortunella* spp., leaves

Minnesotacitrustrees.com

Kumquat, *Fortunella* spp., Leaves

[pinterest.com](https://www.pinterest.com)
[dreamstime.com](https://www.dreamstime.com)



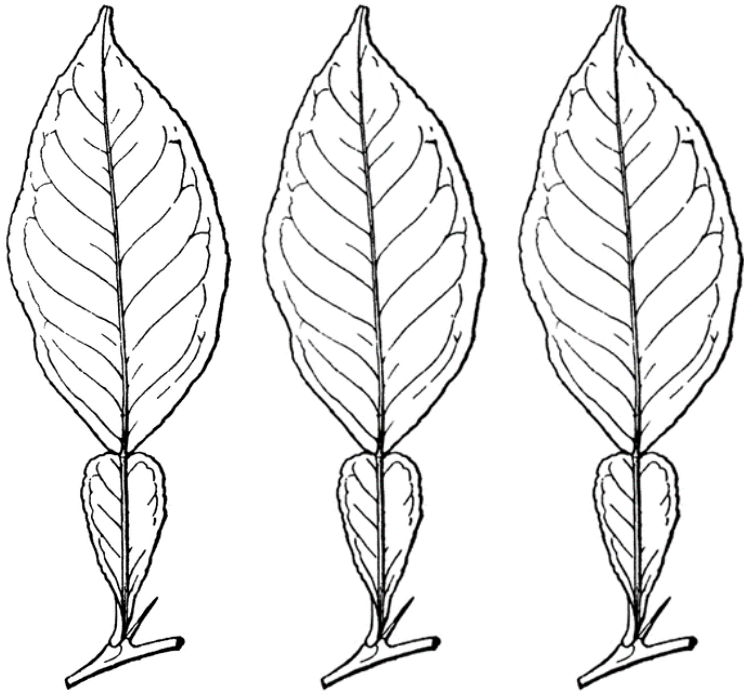
**Sour orange,
Citrus aurantium
L., drawing
[pinterest.com](https://www.pinterest.com)**



Bigarrade violette

Sour orange, *Citrus aurantium* L., leaves and fruit

etc.usf.edu Herbsandremedies.club



Sour orange, *Citrus aurantium* L., leaves

itp.lucidcentral.org

pinterest.com



**Sour orange,
Citrus aurantium
L., fruit and foliage**
blogspot.com
itp.lucidcentral.org



Sour orange, *Citrus aurantium* L., leaves and flowers

oscartintori.it itp.lucidcentral.org



**Bergamot sour
orange, *Citrus
bergamia* Risso.,
fruit and leaves**

**Justfruitsandexotics
.com and
istockphoto.com**



Bergamot, *Citrus bergamia* Risso., leaves

[istockphoto.com](https://www.istockphoto.com) and
[Dreamstime.com](https://www.dreamstime.com)





**Rough lemon, *Citrus jambhiri* Lush.,
leaves and fruit**
[idtools.org](https://www.idtools.org)
[etsy.com](https://www.etsy.com)



**Alemow, *Citrus macrophylla* Wester.,
fruit and foliage**
ipmimages.org





**Alemow, *Citrus macrophylla* Wester.,
wings and fruit**

www.idtools.org and fruit: itp.lucidcentral.org



**Kaffir lime,
Citrus hystrix DC leaves and fruit
(blogspot.
com)**

Citrange (trifoliate orange x sweet orange)

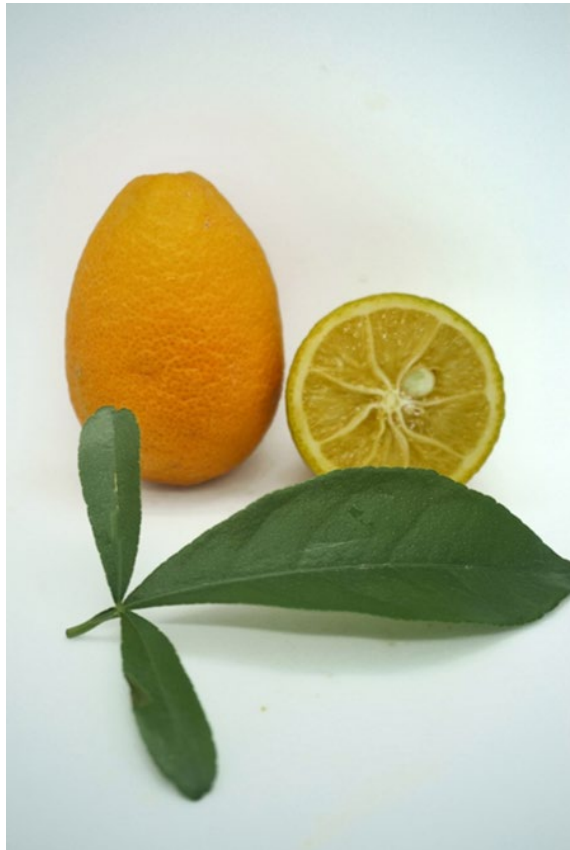
Leaves and fruit

homecitrusgrowers.co.uk agrumilenzi.it



Thomasville citrangequat (citrange x kumquat)

<https://agrumilenzi.it/> and Blogspot.com



Orangequat (orange x kumquat) fruit and foliage

plants4presents.co.uk
oscartintori.it





Limequat (lime x kumquat) fruit and foliage

**[Pinterest.com](#) and
[ipmimages.com](#)**



Citron
(*Citrus*
***medica* L.)**
fruit and
foliage

Wikipedia.com

**Citron, *Citrus medica* L.,
leaves
and fruit**

idtools.org
[Wikipedia.com](https://en.wikipedia.org/wiki/Citrus_medica)



**Citron, *Citrus medica* L.,
leaves
and fruit**

[Wikipedia.com](https://en.wikipedia.org/wiki/Citrus_medica)
[Healthbenefitstimes.com](https://www.healthbenefitstimes.com/citrus-medica/)



Cuban Shaddock fruit and leaves

(<http://edulisgardens.com/inside-of-a-cuban-shaddock-sour/>)
oscartintori.it



Cuban Shaddock, *Citrus maxima* Berm., leaves

www.houzz.com





Ponderosa lemon
(lemon x citron)
fruit and leaves

(<https://images-na.ssl-images-amazon.com/images/I/417jYbKf19L>.

[AC .jpg](#))

(hicksnurseries.com)

Tangelo leaves

(tangerine x
grapefruit)

thetreecenter.com



Citrus Species Characteristics

Characteristics common to the three citrus genera and their species are as follows (adapted after Ziegler and Wolfe, 1975; Jackson, 1991):

- 1. The fruit is an hesperidium, a specialized berry with a leathery rind. See figure on previous page.**
- 2. There are oil glands in the leaves, bark, and rind.**
- 3. The juice contains sugars, organic acids (citric acid, ascorbic acid, etc.) and pigments.**
- 4. The plants are thorny shrubs or trees with fragrant flowers.**
- 5. The plants are evergreen, except the *Poncirus* which is deciduous. Leaves live for two years on plants of the evergreen species.**

Selected characteristics that the sweet oranges have in common are as follows (adapted after Swingle and Reece, 1967):

- 1. Medium sized trees with a rounded top. Hardy to 20 degrees F. (McNeil, 2001).**
- 2. Twigs angular when young usually with slender, somewhat blunt spines in the leaf axils.**
- 3. Leaves medium-sized, pointed at the tip, rounded at the base.**
- 4. Petioles narrowly winged, articulated with the twig and the leaf blade.**
- 5. Medium-sized, white flowers, single or in small clusters in the leaf axils, distinct fragrance.**
- 6. Calyx with 5 lobes, petals 5, stamens 20-25.**
- 7. Ovary with 10-13 locules, yielding 10-13 fruit segments.**
- 8. Fruits medium-sized (5-9 cm. diam.), subglobose, oval, or flattened globose, pulp sweet.**
- 9. Peel thin, smooth, bright orange, usually tight, not bitter, core solid.**
- 10. Seeds white inside, embryos usually numerous, cuneate (wedge shaped), ovoid.**

Selected characteristics that the true lemons have in common are the following (adapted after Swingle and Reece, 1967):

- 1. Tree medium to large, vigorous, upright-spreading, open, usually with short, slender thorns. Hardy to 25 degrees F. (McNeil, 2001).**
- 2. New growth and flower buds purplish.**
- 3. Leaves pale green, large, ovate, pointed at the tip, margins serrated.**
- 4. Petiole wings minute, articulated with the blade.**
- 5. Petals white above, purplish below, stamens numerous 20-40.**
- 6. Flowers single, or in clusters, occur throughout the year.**
- 7. Fruit oval with a broad apical mammilla (nipple), 8-10 straw-colored segments, acid.**
- 8. Peel yellow when ripe, moderately thick, tightly adherent and dotted, fragrant.**
- 9. Seeds small, ovoid, pointed, smooth, white inside.**

Characteristics that the grapefruit have in common are as follows (adapted from Swingle and Reece, 1967):

- 1. Large, round-topped tree; dense foliage. Hardy to low 20's F. (McNeil, 2001).**
- 2. Twigs angular when young.**
- 3. leaves (larger than sweet orange, smaller than pummelo),. ovate, blunt tipped; large wings on petioles (but smaller than those of pummelo) but not subcordate.**
- 4. Large flowers, single or in small clusters, calyx 5-lobed.**
- 5. Fruits large, 9-13 cm. diameter (but smaller than pummeios), pulp vesicles rather large, coherent, very juicy and tender fleshed; peel adherent, thicker than sweet orange but thinner than pummeio.**
- 6. Seeds smooth, white, polyembryonic, smaller than those of pummelo (not yellow, nor ridged as those of pummeio).**

Pummelo Characteristics (adapted from Swingle and Reece, 1967; and Hodgson, 1967)

1. Large, spiny, round-topped tree. Hardy from mid to low 20's F. (Davies and Jackson, 2009)(McNeil, 2001).

2. Twigs angular, often pubescent

3. Large or very large leaves, oval or elliptic oval, blunt-tipped, broadly rounded base, often subcordate or overlapping the winged petiole, midrib and large veins often pubescent

4. Petioles broadly winged, cordate, usually pubescent

5. Flowers very large, single or in clusters or subterminal inflorescences

Pummelo Characteristics

Young twigs pubescent

Leaves finely pubescent along midribs beneath

Petioles usually very broadly winged

Wings commonly overlapping the leaf blade

Fruit size usually large to very large

Fruits mainly round, obovate, or pyriform

Rind usually thick or very thick

Segments usually open at suture, core semi-hollow or hollow

Flesh usually firm, sometimes crisp

Flavor highly variable

Capillary membranes readily separable

Seeds monoembryonic

Fruits borne singly

Grapefruit Characteristics

Twigs glabrous

Leaves glabrous

Petioles broadly winged

Wings rarely overlapping the leaf blade

Fruit size medium to large

Fruits mainly oblate. round, or obovate

Rind thin to medium thick

Segments closed at suture, core solid or semi-hollow

Flesh tender and delicate

Flavor distinctive

Capillary membranes difficulty separable

Seeds polyembryonic

Fruits mainly borne in clusters

Common Tangerine/Mandarin Characteristics-(adapted from Swingle and Reece, 1967; and Hodgson, 1967)

- 1. Small tree with slender twigs. Very cold resistant. 18-20 F., satsuma 14-18 (McNeil 2001)(Anderson and Ferguson, 2019).**
- 2. Leaves thin and broadly or narrowly lanceolate with very small wings which are line-margined. Blade notch-pointed with main vein prominent above and below.**
- 3. Spines small and few or lacking.**
- 4. Flowers small, single or in small clusters in leaf axils.**
- 5. Fruit very small to medium, oblate to highly compressed (depressed globose to subglobose), with thin, loose peel, rind and sections easily separable, open core, flavor range from bland to rich and fragrant, color range from pale yellow-orange to deep red-orange; seedy, slightly seedy, or seedless; seeds small, pointed at one end, with greenish cotyledons.**

Common West Indian lime characteristics (adapted from Hodgson, 1967; Swingle and Reece, 1967)

- 1. Small to medium-sized bushy tree with many slender twigs having many short, very sharp, slender spines.**
- 2. Foliage dense with small (5-7.5 cm), broadly lanceolate, pale green, blunt-pointed leaves with winged petioles. New growth faintly purple-tinted but soon fades, especially in warm weather.**
- 3. Flowers and buds small, white, in clusters of 2 to 7, rarely single, 4 to 5 petals, 20 to 25 stamens, stigma deciduous, flowering all year but mainly spring and late summer.**
Flowers and flower buds faintly purple-tinged but color soon fades especially in warm weather.
- 4. Fruit very small, round, obovate or short-elliptical; sometimes with slight neck; base also rounded but usually with a slight nipple. Rind thin, smooth, leathery, tightly adherent, glandular dotted, greenish-yellow at maturity. Segments 9 to 12, flesh color greenish-yellow, tender, juicy, fine-grained, highly acid, moderately seedy, highly polyembryonic.**
- 5. Seeds small, oval, white inside. Fruit mature year-round but mainly in winter, earlier in hot climates. Fruit drops when mature.**
- 6. Tree is very cold sensitive (28°F)(McNeil, 2001).**

Common Tahiti lime characteristics (adapted from Hodgson, 1967)

- 1. Vigorous tree, medium to medium-large, spreading, dense green foliage, nearly thornless. Cold sensitive at 26-27°F (McNeil, 2001); almost as cold hardy as the true lemon tree.**
- 2. Medium-sized leaves, broadly lanceolate, winged petioles, new growth faintly purplish.**
- 3. Medium-sized flower buds and flowers; flowers faintly purplish; flowering all year but mainly in spring.**
- 4. Medium-small fruit, oval, obovate, oblong or short elliptical; base rounded sometimes slightly necked; apex rounded and with slight nipple; seedless; thin, smooth, adherent rind; mature color pale lemon yellow; 10 segments; axis small and solid. Flesh color pale greenish-yellow; tender, juicy, very acid. Styler end breakdown of overmature fruit.**
- 5. Everbearing but mainly with summer crop in hot climates (southern Florida), or winter crop in cooler climates (southern California).**

Common Calamondin Characteristics (adapted after Hodgson, 1967):

- 1. Medium-sized tree, upright, columnar, nearly thornless, productive. Hardy between 10 and 20 F. (McNeil, 2001). 18 F. on [Wikipedia, Cold Hardy Citrus](#).**
- 2. Small, broadly oval leaves.**
- 3. Very small fruit, oblate to spherical, apex depressed or flattened. Holds on tree well.**
- 4. Orange to orange-red rind, smooth, very thin, finely pitted, easily separable, sweet and edible.**
- 5. Nine segments, small semi-hollow axis.**
- 6. Orange-colored flesh, juicy, tender, and acid.**
- 7. Few, small, plump seeds, polyembryonic with green cotyledons.**

Common Rangpur Lime Characteristics (adapted after Hodgson, 1967):

- 1. Medium-sized, spreading and drooping tree, slender twigs, with few small thorns, vigorous, productive. Hardy to 16 degrees F. ([Wikipedia, Cold Hardy Citrus](#)).**
- 2. Foliage dull-green, mandarin-like, new growth lightly purple-tinted.**
- 3. Flowers small, mandarin-like, buds and petals deeply purple-tinged.**
- 4. Fruit small to medium-sized, depressed globose, round or broadly obovate, sometimes with furrowed collar or low neck, often having slight nipple partially or entirely surrounded by a shallow furrow. Holds on tree well.**
- 5. Yellowish to reddish-orange rind, minutely pitted, smooth to slightly rough, thin, moderately loose.**
- 6. Orange-colored flesh, tender, juicy, strongly acid. 8-10 segments, loosely adherent, axis large and hollow.**
- 7. Seeds numerous [about 14], small, highly polyembryonic, with light green cotyledons.**

Two other forms of the Rangpur are the Kusaie lime and the Otaheite orange.

Common Sour Orange Characteristics (adapted after Swingle and Reece, 1967):

- 1. Medium-sized tree, rounded top. Hardy to low 20's F. (McNeil, 2001).**
- 2. Angular twigs, single, short, slender thorns, or stout, long thorns on vigorous shoots.**
- 3. Medium-sized leaves, ovate, blunt-pointed, broadly rounded to cuneate at the base, petioles rather broadly winged, sometimes narrower, narrowing rapidly to the wingless base.**
- 4. Large flowers, very fragrant with oil of neroli, 5-12 per cent male.**
- 5. Medium-sized fruits (usually), subglobose, slightly depressed at both ends (usually), thick peel, somewhat rough surface, brilliant orange with reddish tint. Fruit color in November and December and will hang on the tree for nine or ten months (Ray and Walheim, 1980).**
- 6. Ten to twelve segments, acid pulp, the core becoming hollow as fruit matures. Numerous seeds.**

Common Bergamot Characteristics (adapted after Hodgson, 1967):

- 1. Moderately vigorous, upright to spreading tree, thornless, medium-small to medium. Cold hardy to 28 degrees F.**
[\(https://foodgardening.mequoda.com/plant-profile/bergamot-orange-tree/\)](https://foodgardening.mequoda.com/plant-profile/bergamot-orange-tree/)
- 2. Large lemon-like leaves, but sharper-pointed, with longer and more broadly winged petioles.**
- 3. Medium-large, white flower buds and flowers with one bloom period.**
- 4. Small to medium-large lemon-yellow-colored fruits, oblate, round obovate, or broadly pyriform, frequently with a small navel, and usually with a persistent style.**
- 5. Numerous segments, solid core, moderately firm, pale greenish-yellow flesh, highly acid with a faint bitter aftertaste.**
- 6. Medium-thin rind, smooth to moderately rough, ridges, and adherent.**
- 7. Few or no seeds, highly monoembryonic, often not well-developed, cotyledons white or faintly green.**
- 8. Strongly pungent and agreeable aromatic oil in both foliage and fruits, similar to that of the sour orange leaf but not the fruit.**

Common Citron Characteristics (adapted after Hodgson, 1967):

- 1. Shrub or small tree, thorny, light gray bark, soft wood, thick-stemmed, straggly growing, short-lived, injury (31°F) and recovers slowly or not at all.**
- 2. Highly sensitive to freezing , rumpled blades, serrated margins; short, wingless petioles.**
- 3. Large, oval to oblong leaves.**
- 4. Large flowers, purple-tinged or not; variable, but often high proportion male (by pistil abortion), produced year-round.**
- 5. Large to very large fruits, usually oblong and blunt-pointed, with pronounced mammilla, and often a persistent style.**
- 6. Very thick, yellow rind, fleshy, tightly adherent; smooth, but often bumpy surface, rind oil pleasantly aromatic.**
- 7. Flesh is minute, not juicy, and firm.**
- 8. Juice is either acid or sweet.**
- 9. Numerous seeds, monoembryonic, with a pronounced beak and white cotyledons.**

Acid citrons:

- a. Purple flower buds and purple-tinged flowers.**
- b. Pink-colored new shoot growth.**
- c. Acid pulp.**
- d. Seeds have dark-colored inner seed coat and chalazal spot.**

Sweet citrons:

- a. No purple or pink coloration of flower buds, flowers, or new growth.**
- b. Sweet pulp (lacks acid).**
- c. Inner seed coat colorless, chalazal spot light yellow.**