



UNIVERSITY OF  
**FLORIDA**

IFAS EXTENSION

## **Cold-Hardy Citrus for North Florida** <sup>1</sup>

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### **Introduction**

The Florida citrus industry is about 400 years old, having been started with the settlement at St. Augustine and other areas along the St. Johns River. The industry was centered in north-central Florida until the big freezes of 1894-95 caused it to move further south.

Today, there are over 340,000 hectares (850,000 acres) of citrus growing in peninsular Florida - all south of Gainesville and most of it south of Leesburg. Recurring severe freezes have limited attempts to grow citrus outside the current citrus belt.

The home grower is at a disadvantage with regard to climate in trying to grow citrus in north and west Florida. It will freeze every year. In fact, there is a 60-80% probability that -5°C (24°F) will occur each year, a 40-60% probability of -7°C (20°F) and a 20% probability of -9°C (16°F). Such temperatures are not conducive to growing most citrus, as citrus species are basically subtropical or tropical crops.

The duration of freezing temperatures can be more critical than the minimum temperature. For example, serious damage may not occur during a brief drop to -5°C (24°F), but could result after several

hours at -3°C (26°F). Moreover, previous exposure to cold increases the plant's ability to withstand cold. As the days shorten and nights get cooler, plants slow active growth and attain cold-hardiness. Satsuma may withstand -9°C (15°F) in January when it is completely dormant and hardy, but it may be seriously damaged at -3°C (26°F) in mid-November.

### **Cold Protection**

The home fruit grower cannot control the climate, but there are certain other factors he can change which will influence the chances of survival of a citrus tree in north and west Florida. Moreover, there are several steps he can take to modify the immediate microclimate of a citrus tree and thus enable it to withstand freezing temperatures.

The first consideration is the selection of the proper variety. Kumquats and satsuma are the most cold-hardy, edible forms of citrus available and both will normally survive in north and west Florida. Moreover, trifoliate orange is the most cold-hardy of all citrus and an excellent rootstock for the others, as it will convey its hardiness to the scion variety budded on it. Thus, kumquat and satsuma budded on trifoliate orange rootstock are the hardiest

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combinations available. These will be discussed in more detail later.

The next consideration is planting site. Cold air drains downhill, so higher elevations will be somewhat warmer than sites at the bottom of a hill or slope. Usually, the south and southeast sides of a lake or other body of water will be warmer than the north side or sites with no water nearby. Planting on a slope or south of a body of water affords some cold protection. The average residential lot does not normally permit such consideration, however.

Planting on the south side of and at the correct distance from the house is almost a must. Most freezes and wind drift are from the north and northwest, thus the house will act as a windbreak, forcing the cold air up and over the house and citrus trees, leaving the area near the south side somewhat warmer. The house itself radiates considerable heat, part of which will be absorbed by adjacent plants, thus warming them.

Overhanging trees absorb heat radiated from plants and the ground, reradiating some of it to the ground. This is a temperature advantage, but growing citrus beneath other trees is not entirely satisfactory due to poorer growth and lower yields.

The soil under and around a citrus tree should be completely free of weeds, grass or mulch during the winter. Grass or mulch on the soil acts as an insulator, hence solar heat is prevented from entering the soil during the day and less heat is stored for release from the soil at night. A clean packed surface allows maximum heat absorption during the day and maximum heat radiation at night. Moreover, moist soil will absorb more heat than dry soil, so trees should be thoroughly watered 2-3 days before a bad freeze is predicted.

Finally, good tree health and nutrition will help the tree withstand freezing temperatures. Follow recommended cultural practices and fertilization to maintain the trees in the best condition. Fertilization, spraying and pruning should end in August or September in order to allow the trees to harden off completely before severe freezes are encountered.

Once the foregoing factors have been considered and the citrus trees are planted, the dooryard fruit grower must provide additional cold protection to the trees during severe freezes. Young citrus trees should be banked for the first 3-5 winters until the tree is large enough to better withstand cold.

Banking is simply a technique in which clean, surrounding soil is pulled up in a mound around the tree to cover the bud union and lower trunk. Thus, even if exposed parts of the tree are completely killed, the bud union under the bank will still be alive to grow back in the spring. Consult your local County Extension Office for full details on banking.

Additionally, trees may be covered temporarily with blankets, quilts, paper or other material as further protection against hard freezes. However, such materials should be removed each morning to allow the trees to take full advantage of incoming solar radiation.

## Cold-Hardy Citrus

Trifoliolate orange can withstand the lowest temperature of all citrus when it is mature and fully dormant, followed by kumquat, satsuma, calamondin, sour orange, mandarin, sweet orange, grapefruit, shaddock, lemon, lime and citron. Grapefruit, shaddock, lemon, lime and citron are not recommended outside the commercial citrus belt of Florida, so they will not be considered further in this fact sheet.

Some sweet oranges, some mandarins and calamondin have sufficient cold-hardiness to be grown north of the commercial citrus belt, but south of a line drawn from the mouth of the Suwannee River through Gainesville to Green Cove Springs and then up the St. Johns River to the ocean (Figure 1). They can be successfully grown in this area in most years.

## Sweet Oranges

Varieties of sweet oranges [*Citrus sinensis* (L.) Osbeck] which can be grown in this area are navel, 'Hamlin' and 'Parson Brown.' These oranges mature in the early to late fall so that fruit would normally be harvested before a severe freeze would be expected.

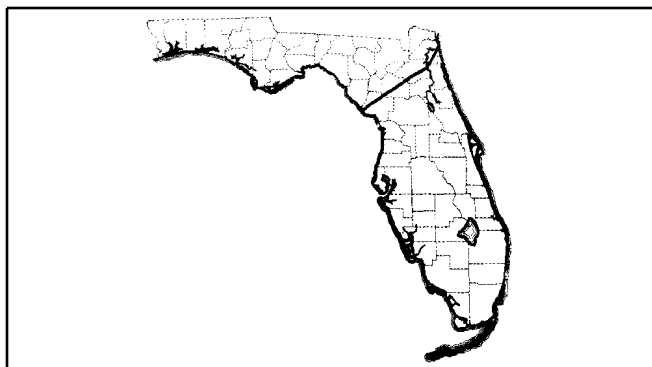


Figure 1.

These varieties are discussed in detail in another fact sheet, so consult the local County Extension Office for more information. The preferred rootstock is trifoliolate orange for maximum cold-hardiness, with sour orange being second choice if trifoliolate orange is not available.

### Mandarins

The mandarins (*Citrus reticulata* Blanco) and mandarin hybrids for this area include 'Dancy' tangerine, 'Orlando' tangelo, 'Robinson' tangerine and 'Cleopatra' mandarin. All but 'Cleopatra' are discussed in another fact sheet, so consult the local County Extension Office for more information. The preferred rootstock for cold-hardiness is trifoliolate orange, but sour orange or 'Cleopatra' mandarin will be easier to find. 'Cleopatra' mandarin is used as a rootstock for other citrus in the commercial industry; thus it may be available only as seedling trees. Its fruit are bright orange-red, typically mandarin, and somewhat acid. Its principal value in dooryards is for ornament, as it is attractive and bears fruit year round.

### Calamondin

The calamondin (*Citrus madurensis* Loureiro) can substitute for other acid citrus. It is widely grown as an ornamental in Florida and California. Calamondin is particularly attractive as a container plant and is used extensively throughout the U.S. as a house plant. It originated in China and is widely distributed throughout the Orient.

Calamondin is mandarin-like in many respects, but also resembles kumquats. The tree is dwarf and bushy, being quite showy when laden with mature fruit. It is nearly thornless, with small, broadly oval leaves.

The fruit is small and oblate, with a flattened or depressed blossom-end. The peel is yellow to yellow-orange, very thin and smooth, easily separable at maturity. There are 5-9 segments, the axis is small and semi-hollow. The flesh is orange-colored, juicy and acid. The seeds are few, with green cotyledons. The fruit holds well on the tree.

Calamondin can be propagated by seed and by cuttage, although seedlings may not fruit for several years. It does not require a rootstock and is itself a suitable rootstock for kumquats.

## North and West Florida

The most prominent citrus fruit which are sufficiently cold-hardy to grow throughout north and west Florida are satsuma and kumquats.

### Satsuma

The satsuma mandarin (*Citrus unshiu* Marcovitch) apparently originated as a chance seedling in southern Japan sometime before 1600 A.D. It is now grown in subtropical areas throughout the world, but the most important industry is in Japan where the satsuma accounts for the majority of the citrus planted. Satsuma can be grown in the U.S. from Florida to Texas along the Gulf Coast and in Arizona and California.

Satsuma is the most cold-tolerant of commercial citrus, with mature, dormant trees having survived  $-9^{\circ}\text{C}$  ( $15^{\circ}\text{F}$ ) without serious injury. Consequently, it is adapted to regions that are too cold for other citrus, as it has not proven commercially acceptable in milder regions of the subtropics.

There are several groups or varieties of satsuma, although the majority are 'Owari' or varieties which arose from 'Owari' by bud mutation. 'Silverhill' is a nucellar seedling selection of 'Owari' which was named in Florida about 1931 and it appears identical to 'Frost Owari' in California. Satsumas propagated in Florida may be called 'Owari', 'Silverhill,' or simply satsuma.

The satsuma tree is moderately vigorous, medium-small, very productive and markedly cold-resistant. Greatest cold-hardiness is attained on

trifoliolate orange rootstock, which also causes some dwarfing of the tree.

The fruit is medium-sized, medium-oblate to subglobose, slightly necked and virtually seedless. The peel is thin and leathery, easily separable from the fruit and bright reddish-orange in color, although good peel color may not develop until after fruit maturity. There are 10-12 segments, which are loosely separable, around a hollow axis. The flesh is orange-colored, tender and juicy. The juice is quite sweet, with moderate sugars and low acid content; quality is excellent.

The fruit matures in October-November but holds poorly on the tree, becoming puffy and losing quality so that it must be picked promptly. The fruit stores well after harvest.

### The Kumquats

The kumquats (*Fortunella* spp.) are undoubtedly of Chinese origin, the Nagami variety having been introduced to Europe and the U.S. from China in the middle of the last century. Other varieties were introduced into the U.S. around the turn of the century. Kumquats are most widely grown in China, Japan, Taiwan and Malaysia.

Kumquats are primarily grown for ornament in California and the Gulf Coast states and for use of the fruit in the gift-package trade in Florida. The fruit may be eaten fresh, peel included, but it is most frequently preserved as marmalade or candied whole fruit.

Kumquats exceed even satsuma in terms of cold-hardiness, being able to sustain -12°C (10° F) when fully dormant. Active growth occurs only at relatively high temperatures, so the plants remain semi-dormant during late fall, winter and early spring in warm temperate climates. They normally bloom long after citrus and cease active growth earlier in the fall, which contributes to their cold-hardiness.

The plant is a shrubby evergreen tree, rarely 3 m (10 feet) tall, densely branched with few or no thorns. The leaves are small and simple, with hardly any petiole wings. Trifoliolate orange is the preferred rootstock for kumquats grown in cold regions, which further reduces tree size.

The fruit are generally small, globose, obovate or oblong to oval. The fruit are very showy, being borne in large numbers, yellow to bright reddish-orange in color. The peel is medium-thick, fleshy, tightly adherent, aromatic and spicy. The seeds are few, with green cotyledons. The flesh is yellowish-orange, moderately acid, and has little juice. The axis is small and solid. The fruit matures in the fall and holds well on the tree without appreciable loss in quality.

There are 4 varieties of kumquats grown in Florida:

- Nagami (oval) kumquat [*F. margarita* (Lour.) Swing.] is the most popular. Its fruit are oval, 3-4 cm (1 1/4-1 3/4 inches) long, about 2/3 as wide. The fruit have 2-5 seeds and are pleasantly flavored, with deep peel color.
- Meiwa (large round) (*F. crassifolia* Swing.) is a large and round kumquat with a thick peel and sweet taste. The fruit are commonly 2 1/2-3 1/2 cm (1-1 1/2 inches) in diameter and nearly seedless.
- Marumi (small round) [*F. japonica* (Thumb.) Swing.] is round, smaller than Meiwa, rarely exceeding 2 1/2 cm (1 inch) in diameter, with 1-3 seeds. The peel is thinner and somewhat sweeter than Nagami, but the flesh is somewhat acid. The tree is usually more thorny than either Nagami or Meiwa.
- Hongkong [*F. hindsii* (Champ.) Swing.] has the smallest of all true citrus fruits, being hardly more than 1 cm ( 1/2 inch) in diameter. Its fruit are round with relatively large seeds. They are virtually inedible, being quite tart. The plant is very small and thorny.

### Other Citrus

In addition to satsuma and kumquats, both of which should be readily available in nurseries, there are a couple of other types of citrus which have excellent cold-hardiness.

'Changsha' tangerine is very much like the satsuma which it resembles greatly. The fruit itself is about the size of a satsuma, with bright orange peel. The quality is not as good as satsuma and the fruit is very seedy. The tree is a bit more upright-growing

than satsuma and is probably more cold-hardy than satsuma and kumquat, having been observed growing and fruiting as far north as Ft. Worth, Texas.

Little is known about 'Changsha' in Florida, as it apparently is not propagated commercially. There are a few specimen trees around the state and it seems to do well in Gainesville. It comes true from seed and the seedlings will produce within a few years.

'Thomasville' citrangequat is a hybrid between trifoliolate orange, sweet orange and kumquat which was developed about the turn of the century in attempts to combine the cold-hardiness of trifoliolate and kumquat with the quality of sweet orange. It is as cold-hardy as kumquat, having fruited in Tuscaloosa, Alabama.

The fruit is medium-small, globose to oval, orange-yellow, seedy and somewhat acid until fully mature. The trees are vigorous and thorny, with mainly trifoliolate leaves.

It is doubtful that this variety is available as it apparently is not being propagated at the current time.