



## IFAS EXTENSION

# Sweet Orange<sup>1</sup>

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### History

The sweet orange was cultivated in China for many centuries before it was introduced into Europe, most likely during the early fifteenth century. Columbus is credited with bringing sweet orange seed to the New World during his second voyage in 1493 and reportedly established plantings of sweet orange and other citrus in Hispaniola. The first plantings of sweet orange in what is now the United States were established in Florida between 1513 and 1565 in and around the settlement of St. Augustine and along the St. Johns River. Assisted by Spanish explorers and Indians, sweet orange spread rapidly throughout Florida. A sweet orange industry emerged during the late eighteenth century and attained considerable status by the winter of 1894-95 when two severe freezes virtually eliminated it. Since that time, a number of additional freezes have gradually pushed the industry south.

### Distribution

Sweet orange is grown throughout the world in tropical and subtropical climates with its range extending approximately 35-40 degrees either side of the equator. Although some sweet oranges are grown in tropical regions, most commercial acreage is

located in subtropical and Mediterranean climates where higher quality fruit is attained. Sweet orange is currently grown throughout central and south Florida (Figure 1).

### Importance

Sweet orange is the most widely grown citrus fruit in Florida and the world. With over 444,000 bearing acres (about 180,000 hectares) in production and an estimated annual production value of over \$850 million (1991-1992), Florida accounts for roughly 70 percent of U.S. sweet orange production. The importance of the sweet orange industry to Florida's agricultural economy is not likely to decline in the foreseeable future as vast expanses of south Florida continue to be developed for sweet orange production.

### Description

#### Tree

Sweet orange trees are moderately large, often 22 to 30 feet (7 to 10 meters) in commercial orchards, larger if unpruned. Trees are erect as seedlings, globose and slightly spreading as budded or grafted plants. Branches are strong and usually do not require pruning except for tree size control.

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## Leaves

Sweet orange leaves are dark green and approximately 3 to 5 inches (8 to 13 cm) long. The leaf blade is pointed at the apex and rounded at the base with a narrowly winged petiole. Short spines are found in the axils of most leaves. The leaves are evergreen, persisting as long as two to three years.

## Flowers

Sweet orange flowers are white and complete (contain all flower parts). Most cultivars (cultivated varieties) are self-pollinating because of the construction of the flower. However, bees assist the pollination process. Some cultivars have little or no viable pollen and/or few or no fertile ovules. Such fruit develop into seedless or near-seedless fruit.

## Fruit

Botanically, the sweet orange fruit is a specialized berry known as a hesperidium. Fruit size varies with cultivar and crop load but is usually 2 1/2 to 4 inches (6 to 10 cm) in diameter. The shape of the fruit is spherical to oblong, with a peel that is intermediate between grapefruit and tangerine in thickness. The peel is fairly smooth in some cultivars and somewhat rough, or pebbly, in others. Except for navel oranges, the peel adheres rather tightly to the flesh. Peel and flesh color are orange, but the intensity of color is a function of climate and cultivar. Low temperatures can intensify the orange and red colors of both peel and flesh.

## Seeds

The number of seeds per fruit is variable. Some cultivars are considered seedless for commercial purposes, having only 0 to 6 seeds, while others may contain 15 to 20 seeds or more. Cultivars may be conveniently classified as "seedy" or "seedless". The most important seedy cultivars include 'Parson Brown', 'Pineapple' and 'Queen'. Important seedless cultivars are 'Hamlin', 'Valencia' and the navel orange cultivars.

## Propagation

Sweet oranges usually come true-to-type from seed, however, growing trees from seed is undesirable. Seedlings are juvenile, which means they are thorny, have an erect, upright growth habit, and may not flower or fruit for 8 to 15 years. Sweet orange can be propagated vegetatively by cuttings, budding, or grafting. Budding and grafting are the more desirable methods because they are easily done and enable specific rootstocks and interstocks to be used. Budding is the preferred method for propagating nursery trees, while various grafting techniques are sometimes used when topworking existing groves. Budded or grafted citrus trees will usually produce fruit within three years, if properly cared for.

## Climate and Cold Tolerance

Sweet orange is a cold-sensitive plant grown in tropical and subtropical regions throughout the world. Sweet orange trees do not enter a true state of dormancy during the winter as do temperate fruit trees such as apple and peach. As cooler temperatures develop, growth slows and continued exposure to cool temperatures induces various physiological changes which increase tree cold-tolerance. However, these processes can be reversed by intermittent warm temperatures which, in turn, reduce cold-tolerance. Growers should plant early season cultivars where there is a considerable risk of damage by cold so the crop can be harvested before there is a possibility of losing it to a freeze. Site selection, always an important consideration, is particularly critical in regions subject to cold winter temperatures. For additional information on citrus cold protection, see Fact Sheet HS121, *Cold Protection Methods*, at <http://edis.ifas.ufl.edu/ch077> and Fact Sheet HS141, *Site Selection*, at <http://edis.ifas.ufl.edu/ch024>.

## Seasons of Bearing

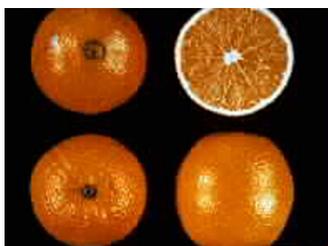
Sweet oranges mature over a relatively long period in Florida, the earliest cultivars attain first legal maturity about October and the latest ones about March. The fruit of all cultivars can be "stored" on the tree for several months without losing quality, thus extending Florida's sweet orange season to 10 to

11 months. Commercial sweet oranges in Florida are divided into three broad categories by season of ripening. Early season oranges are those which will usually reach legal maturity before December. The most widely grown cultivars of early oranges are 'Hamlin', 'Parson Brown' and navel oranges. Midseason oranges ripen from December to March and include 'Pineapple', 'Queen', 'Sunstar', 'Gardner' and 'Midsweet'. 'Valencia', Florida's primary late maturing orange, ripens as early as March and is often held on the tree into the summer months.

### Sweet Orange Groups

Sweet orange cultivars can be categorized into four distinct groups: round oranges, navel oranges, blood oranges, and acidless oranges. Most oranges of economic importance are round oranges. Included in this group are 'Hamlin', 'Pineapple', 'Valencia' and many others.

Navel oranges are characterized by a small, secondary fruit embedded in the styler end of the primary fruit (Figure 2). This "extra" orange is more pronounced in some fruit than others, being inconspicuous in some cases and quite prominent in others. Fruit of navel oranges are typically large, seedless, early ripening, easily peeled, and sectioned.



**Figure 2.** Navel orange.

Red coloration associated with anthocyanin pigments in the flesh and peel distinguish blood oranges from other sweet orange groups. Red pigmentation varies with climate and can be intense when blood oranges are grown in regions with large diurnal fluctuations in temperature. 'Ruby', 'Moro' and 'Tarocco' are blood orange cultivars which can be grown in Florida, but red coloration is usually poor in Florida's warm, humid climate.

The acidless oranges are a small group of very low-acid cultivars characterized by a sweet, but insipid, flavor. Although grown for local consumption in Mediterranean regions, Egypt, Spain, Brazil and Mexico, they are of minor importance in most citrus producing regions.

### Sweet Orange Cultivars

Navel orange history suggests that the navel orange has been grown in the Mediterranean region for several hundred years. The Portuguese probably introduced navel oranges to Brazil. 'Washington', the most economically important navel cultivar, is believed to have originated as a mutation in Brazil during the nineteenth century prior to its introduction to the United States in 1870.

Navel oranges are particularly suited to Mediterranean climates where they attain good external and internal color and excellent dessert quality. Fruit mature early, are commercially seedless and are known for their large size, crisp texture, outstanding flavor and ease of peeling and sectioning. Generally the more tropical climates are less suitable for navel orange production but high quality fruit can be grown in both Florida and Brazil. Navel oranges are primarily grown for fresh consumption. When used for juice, a bitterness often develops, making juice unpalatable if it is not consumed within a short time.

Navel oranges are susceptible to a variety of environmental stresses and physiological disorders and require more careful management than other sweet oranges. Poor fruit set and extensive fruit drop continue to reduce yields of navel oranges. The navel orange is an unstable mutation of sweet orange and readily mutates further, sometimes in an undesirable way. High mutation rates emphasize the need for careful selection of nursery trees propagated from registered, true-to-type budwood. The most popular cultivar is 'Washington' but a number of others such as 'Summerfield', 'Dream' and 'Barrington' have arisen as mutations.

'**Hamlin**' arose as a chance seedling in an orchard planted in 1879 near DeLand by Judge Issac Stone. The orchard was later purchased by A. C. Hamlin, for whom the cultivar was named. 'Hamlin'

increased in popularity following the 1894-95 freeze and gradually replaced 'Parson Brown' as Florida's major early season cultivar. Fruit are medium-small, round and contain few if any seeds (Figure 3). The peel is thin, relatively smooth and usually poorly colored, especially early in the season. Additionally, juice color is poorer than that of most mid and late-season cultivars commonly used for processing. Fruit can be harvested before the danger of frost and early harvesting may increase tree cold-tolerance for this cultivar. Although fruit quality is inferior to many other cultivars, high productivity, seedlessness and earliness of fruiting make this cultivar quite popular in Florida.

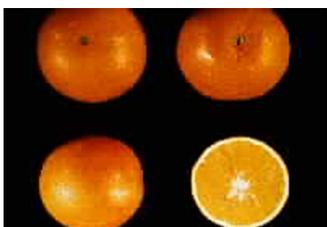


Figure 3. 'Hamlin' orange.

'Parson Brown' originated as a chance seedling at the home of the Reverend N. L. Brown near Webster, Florida in 1856. About 20 years later, J. L. Carney bought the propagation rights and named it 'Parson Brown.' It quickly became the leading early-season sweet orange in Florida until about 1920. Fruit are medium-large and round with a thick, distinctly pebbled peel (Figure 4). Peel and juice color are generally poor, comparable with 'Hamlin.' Juice quality is also poor, being somewhat low in both sugars and acids. 'Parson Brown' is still propagated in Florida, but to a much lesser extent than its early season rival, 'Hamlin'.

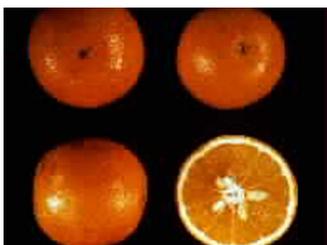


Figure 4. 'Parson Brown' orange.

'Ambersweet' is a sweet orange hybrid released in 1989 by Dr. C. J. Hearn of 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, with good juice and flesh quality making this a good variety for both fresh and processed use (Figure 5). A nearly seedless variety in solid plantings, fruit can have up to 30 or more seeds in mixed plantings. Although this is a relatively new variety, it appears to be a good choice for both commercial and dooryard citrus growers.

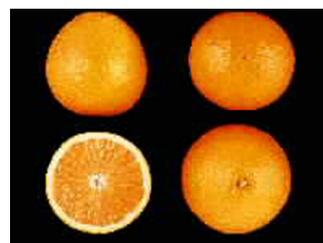
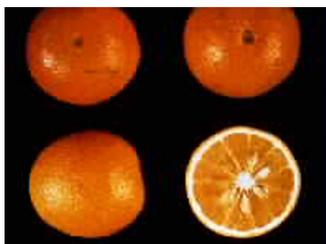


Figure 5. 'Ambersweet' orange.

The '**Pineapple**' sweet orange originated from a seedling planted near Citra by the Reverend J.B. Owens around 1860. It was so named because of its delicate fragrance. Following the 1894-95 freeze, it became Florida's principal midseason cultivar and has retained this status ever since. 'Pineapple' fruit are seedy (usually 15 to 25 seeds), somewhat flattened at each end and medium-large in size (Figure 6). The peel is moderately thick, fairly smooth and develops a beautiful reddish-orange color when night temperatures drop below 55°F (13°C). Texture and juice quality are excellent and have contributed to the popularity of this variety. Trees tend toward alternate bearing and heavily cropped trees are sometimes quite susceptible to cold damage. Trees may exhibit a condition known as preharvest drop where much of the fruit falls to the ground immediately prior to harvest. Moreover, once mature, fruit do not store well on the tree. 'Pineapple' remains the primary mid-season sweet orange cultivar in Florida with a commercial harvest season extending from December until February.

'Queen' reportedly arose as a seedling of unknown origin in a Lake Hancock grove near Bartow. Propagation of this cultivar began about 1900 and it was first named 'King'. However, its name was later changed to 'Queen' to avoid confusion with 'King' mandarin. It is much like



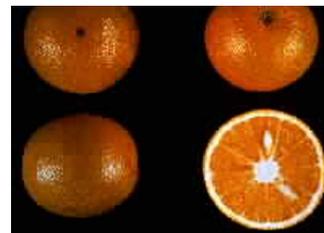
**Figure 6.** 'Pineapple' orange.

'Pineapple' and ripens at about the same time. Claims have been made that it is more cold-tolerant, higher in soluble solids, less seedy, and holds better on the tree than 'Pineapple'; however, there are no data to substantiate these claims.

'**Jaffa**' was introduced into Florida by H. S. Sanford during the early 1880s. Being a cold-tolerant, high-quality, mid-season cultivar, it quickly increased in popularity. However, 'Jaffa' has several serious faults including a strong tendency toward alternate bearing and susceptibility to *Alternaria*. May contain from 0 to 6 seeds per fruit. Less seediness may be expected when this cultivar is planted in solid blocks. 'Jaffa' is currently of minor importance to Florida's citrus industry.

'**Valencia**' is the leading cultivar of sweet orange in both Florida and the world. The origin of 'Valencia' is uncertain and there is no evidence to support the common assumption of Spanish origin. Many believe it originated in Portugal because it is indistinguishable from a cultivar grown there. Trees were originally imported to this country about 1870 by S. B. Parsons, a Long Island nurseryman. The cultivar first reached Florida in 1877 when E. H. Hart of Federal Point purchased trees from Parsons. Initially named 'Hart's Tardier', 'Valencia' later acquired its current name because of similarities between it and a cultivar growing in Valencia, Spain. Fruit are medium-sized, round to oblong, commercially seedless and of excellent internal and external quality (Figure 7). The peel, juice color and eating quality are the standards of excellence by which other sweet orange cultivars are judged. 'Valencia' is Florida's primary late-season cultivar with a commercial harvest season extending from March until June. Fruit store exceptionally well on the tree but may re-green during late spring or early summer. Moreover, the late, extended harvest season creates some special management problems, namely,

fruit remain on the tree throughout the cold winter months and two crops may be present on the tree following bloom. Comprising over 40 percent of Florida's sweet orange acreage, 'Valencia' should remain Florida's premier sweet orange cultivar for some time to come.



**Figure 7.** 'Valencia' orange.

'**Lue Gim Gong**' is a seedling of 'Valencia' and indistinguishable from it. It arose near Deland and has been propagated in Florida to some extent. The cultivar is so similar to 'Valencia' that the names have often been used interchangeably in Florida nurseries. There is probably no justification to consider it a separate cultivar.

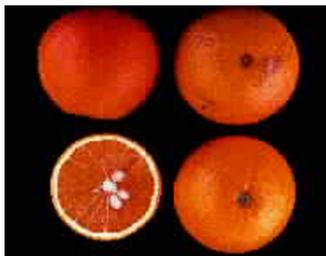
### Summer Oranges

There are several 'Valencia' type oranges for which later maturity or better holding quality have been claimed. 'Pope Summer' is planted commercially to some extent, but little systematic testing of it and other so-called summer oranges has been conducted and claims for their superiority have not been substantiated. For a summary of sweet orange cultivars see Table 1.

### Cultivars Suggested for Trial Use

'Sunstar', an open-pollinated seedling of 'Berna', was selected in 1976 at the A. H. Whitmore Foundation Farm near Leesburg. Fruit are medium-sized, round or slightly flattened at the base and moderately seedy (about 12 seeds per fruit) (Figure 8). Fruit obtain legal maturity in mid-January but hold well on the tree throughout March. Peel and flesh color are good and juice color scores are approximately one point higher than 'Hamlin' and 1.4 points lower than 'Pineapple'. Yields and pounds of solids per acre are high, roughly equivalent to 'Hamlin'. Although 'Sunstar' has not been tested extensively in Florida, field trials indicate it is adapted to central Florida. 'Sunstar' shows potential

for use as a mid-season orange for processing and fresh consumption and is recommended for trial use in Florida.



**Figure 8.** 'Sunstar' orange.

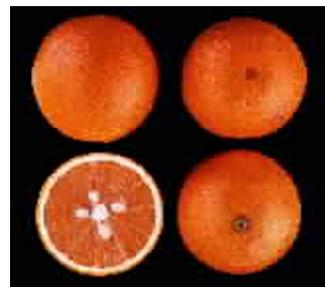
'Midsweet' is a 1976 selection from open-pollinated seedlings of 'Homosassa' orange planted in 1962 at the A. H. Whitmore Foundation Farm near Leesburg. Fruit are medium-sized, round, moderately seedy (about 12 seeds per fruit) and obtain legal maturity in late January but store well on the tree through March (Figure 9). Peel and flesh have good color at maturity and juice color scores are about one point higher than 'Hamlin' and 1.3 points lower than 'Pineapple'. Yields and pounds of solids per acre are comparable to 'Hamlin' and greater than 'Pineapple' or 'Valencia'. 'Midsweet' has not been tested extensively in Florida, but field trials indicate it is adapted to central Florida. 'Midsweet' is recommended for trial use in Florida as a mid-season orange for processing or fresh consumption.



**Figure 9.** 'Midsweet' orange.

'Gardner' is a 1976 selection from open-pollinated seedlings of 'Sanford Mediterranean' planted in 1962 at the A. H. Whitmore Foundation Farm near Leesburg. Fruit are medium-sized and round with a well-colored, moderately thick and somewhat pebbly peel (Figure 10). Yields and pounds of solids are less than 'Hamlin' and about equal to 'Pineapple'. Juice color is good, with color scores about 1.5 points higher than 'Hamlin'. 'Gardner' has not been tested extensively in Florida,

but limited field trials indicate that it is well suited to central Florida conditions. 'Gardner' is recommended for trial use in Florida as a mid-season orange for processing and fresh consumption.



**Figure 10.** 'Gardner' orange.

### Recommended Sweet Orange Budlines

When purchasing trees, careful consideration should be given to the selection of high quality trees from registered budlines of proven performance. The Florida Department of Agriculture and Consumer Services, Division of Plant Industry (DPI) has maintained and evaluated extensive plantings of budlines for many sweet orange cultivars including navel oranges, 'Valencia', 'Hamlin', 'Pineapple' and others. Budlines have been tested on a variety of commercially important rootstocks and in many cases old budlines have been compared with nucellar budlines. Cumulative yields over a 10 year period have differed by as much as 30 percent between the highest and lowest yielding budlines for some cultivars. Growers should become familiar with the higher yielding budlines and request them by number when purchasing trees. High yielding budlines for the major sweet orange cultivars grown in Florida are given in Table 2 .

**Table 1.** Summary of sweet orange cultivars.

Cultivar	Average Fruit Size	Seeds/Fruit	Season	Comments
'Washington' navel	Large	Seedless <sup>1</sup>	Early	Shy bearer, large fruit
'Hamlin'	Medium-small	Seedless <sup>1</sup>	Early	Small fruit, productive
'Parson Brown'	Medium	Seedy	Early	Pebbly peel
'Ambersweet'	Medium	Variable <sup>2</sup>	Early	Excellent quality, early orange
'Pineapple'	Medium	Seedy	Mid	Will not "store" on tree
'Queen'	Medium	Seedy	Mid	Similar to 'Pineapple'
'Jaffa'	Moderately medium	Seedy <sup>2</sup>	Mid	Subject to splitting
'Sunstar'	Medium	Moderately seedy <sup>2</sup>	Mid	New cultivar, trial use only
'Midsweet'	Medium	Moderately seedy <sup>2</sup>	Mid	New cultivar, trial use only
'Gardner'	Medium	Moderately seedy <sup>2</sup>	Mid	New cultivar, trial use only
'Valencia'	Medium	Seedless <sup>1</sup>	Late	Premium quality
'Lue Gim Gong'	Medium	Seedless <sup>1</sup>	Late	Similar to 'Valencia'
'Pope Summer'	Medium	Seedless <sup>1</sup>	Late	Similar to 'Valencia'

**Table 2.**

Variety				
Navel Oranges	'Hamlin'	'Parson Brown'	'Pineapple'	'Valencia'
<b>Old Lines</b>				
N-4-2-1-(STG <sup>1</sup> )-X-E	H-1-4-1-X-E		Pi-1-27-11-X-E	V-123-11-4-X-E
('Choate')	H-8-1-4-X-E		Pi-53-10-10-X-E	V-123-13-4-X-E

Table 2.

Variety				
Navel Oranges	'Hamlin'	'Parson Brown'	'Pineapple'	'Valencia'
N-63-18-2-(STG)-X-E	H-8-1-5-X-E		(Citra strain)	V-472-3-63-(STG)-X-E
('Port Mayaca')				(Rohde Red)
N-SPB-194-10-2-(STG)-X-E				V-472-11-43-(STG)-X-E
('Varn')				(Rohde Red)
N-DPI-70-9-13-(STG)-X-E				V-51-3-3-X-(STG)-X-E
('Summerfield')				
VRN-DPI-104-(STG)-X-E				
('Cara Cara') (For trial only)				
Nucellar Lines				
N-S-F-56-11-X-E		PB-S-SPB-1-2-3-X-E	Pi-S-F-59-37-X-E	V-S-F-55-23-X-E
N-S-F-56-12-X-E		PB-S-F-56-2-X-E	Pi-S-F-60-3-X-E	V-S-F-55-1-X-E
N-S-F-60-15-X-E		PB-S-F-59-1-X-E	Pi-S-SBP-150-10-3a-X-E	V-S-F-55-4-X-E
N-S-F-60-18-X-E				V-S-F-55-28-X-E
N-S-F-60-19-X-E				V-S-SPB-1-12-5-X-E <sup>2</sup>
				V-S-SPB-1-12-7-X-E <sup>2</sup>
				V-S-SPB-1-12-12-X-E <sup>2</sup>
				V-S-SPB-1-14-19-X-E <sup>2</sup>
				V-S-SPB-1-14-31-X-E <sup>2</sup>

Table 2.

Variety				
Navel Oranges	'Hamlin'	'Parson Brown'	'Pineapple'	'Valencia'
				V-S-SPB-1-18-31-X-E <sup>2</sup>
				V-S-SPB-1-21-33-X-E <sup>2</sup>
<sup>1</sup> STG indicates shoot-tip grafting to eliminate one or more viruses. <sup>2</sup> Hughes Memorial Foundation Nucellar 'Valencia'.				