

# Ambrosia from Your Backyard

GROWING CITRUS ON THE UPPER GULF COAST OF TEXAS

By

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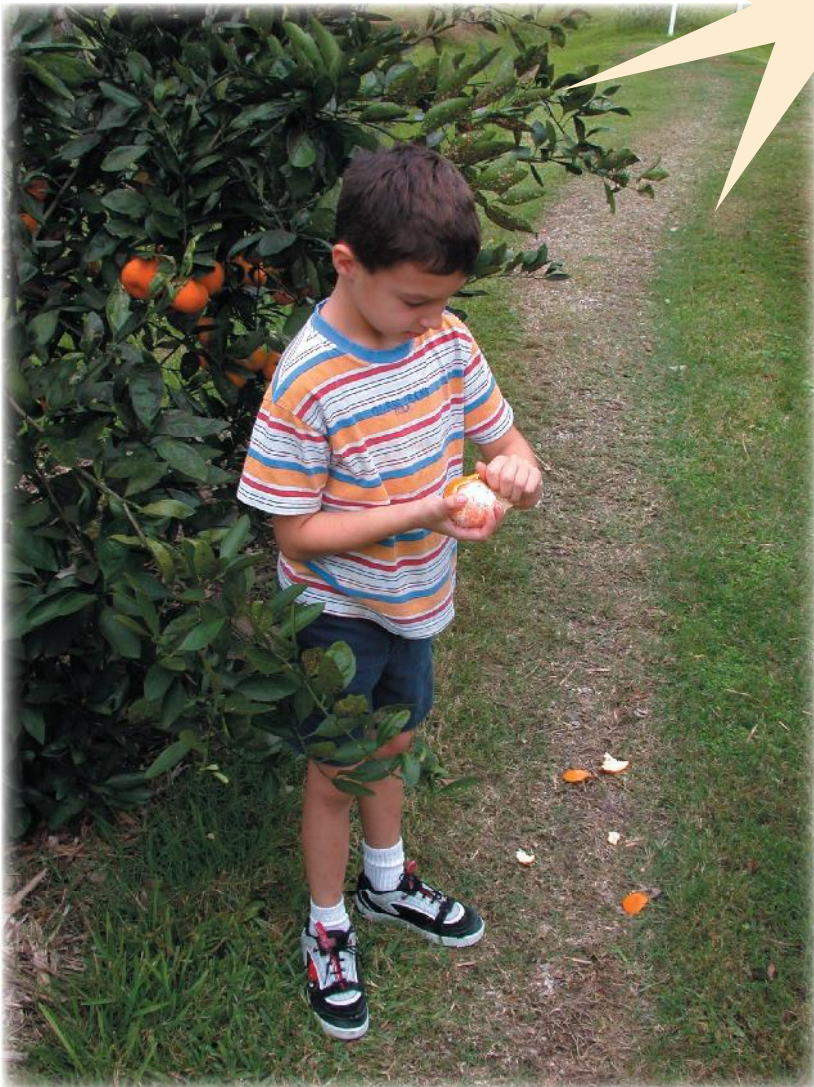
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# *Introduction*



The Upper Gulf Coast of Texas has a long history of fruit orchards. Figs were grown in San Leon. Pearland was named for large pear orchards. Old books tell of standing in a peach orchard and looking at Galveston Bay. The Powers family had a citrus orchard in Arcadia during the late 1800s.

True, the occasional “blue norther” makes citrus more of a challenge. However, the gracefully draping limbs and shiny, green foliage are desirable additions to the home landscape. All that plus the luscious bonus of fruit makes a good citrus tree worth the effort.

Growing citrus does not require extreme measures such as a Victorian glass house. Simply choosing varieties that are more cold-tolerant eliminates the greatest worry of the occasional freezing temperatures. This book features tried and true information contributed by local specialists who have learned what works by growing these trees on the Upper Gulf Coast of Texas for decades.

PHOTO CREDIT INFORMATION

The photos in this book came from two sources.

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## CHAPTER I

# *Citrus Varieties*

**T**he list of recommended tree varieties for the Upper Gulf Coast of Texas offers a wide range of choices. Lemon, lime, grapefruit and orange will grow and produce fruit in USDA Plant Hardiness Zones 8B and 9. Less known but equally delicious for eating fresh or cooking are clementine, kumquat, limequat, mandarin, minneola, satsuma, tangelo and tangerine. The various fruits and individual varieties are arranged alphabetically in this chapter.



*'Buddha's Hand' citron, GCMGA*



*'Bloomsweet' grapefruit, GCMGA*



*'Golden' grapefruit, GCMGA*

## Citrangequat

Hybridization of citrus has resulted in numerous off-spring with favorable characteristics. Kumquats and oranges contributed some of the genetics for this variety. It is used as a rootstock.

**'Thomasville'** . . . This hybrid variety is very cold-hardy to 15° F. The sour juice is used for beverages or cooking.

## Citron

The outstanding fragrance is utilized in making scent products. The thick peel is candied for use in cooking.

**'Buddha's Hand'** . . . This very ornamental variety is grown primarily for cooking and fragrance, and in potpourri. The rind is very thick and extremely aromatic. It is very sensitive to cold temperatures because it is an everbearing citrus that does not go dormant. It is also susceptible to gummosis disease.

Documented in India, the Middle East and later the Mediterranean area, it was brought to Puerto Rico and St. Augustine, Florida by the Spanish. Many growers treasure the intense fragrance of the blossoms and fruit. Puerto Rico is still an important area for growing and preserving the fruit for use in cooking.

## Grapefruit

An early mutation in the West Indies from a 'Shaddock' or 'Pummelo' is the original parent tree. Later documentation in 1750 describes trees on Barbados and in 1814 in Jamaica. Grapefruits were planted in Pinellas County Florida in 1823 and brought to Texas by Charles Volz in 1908.

Typically the fruits are large, round and yellow-skinned. The acid flesh is juicy and can be yellow, pink or ruby-red. The flower is white and self-pollinating. The trees mature to approximately 20–25 feet high with a 10–12 foot spread in width. Only moderately cold-tolerant, the tree needs protection if the temperatures are in the 20s.

The original hybrid between an orange and pummelo has been greatly improved by newer cultivars developed by Texas A&M University in the Lower Rio Grande Valley. The 'Ruby Red' and 'Star Ruby Red' varieties are rated highly for juicing and eating fresh, but usually need winter protection on the Upper Gulf Coast of Texas.

**'Bloomsweet'** . . . This is considered by Urban Harvest to be the best selection for this area. It is a cross between pummelo and sour orange. The pear-shaped fruit is large with golden, easy-to-peel thinner skin. The yellow/orange flesh is seedy but juicy and mildly sweet. Fruit matures from November through December; however, it will dry if left on the tree too long. Because cold-tolerance is rated at moderate, protection is needed if temperatures get into the mid-twenties.

**'Golden'** . . . The golden orange flesh has a wonderful flavor, sweeter and less acid than other grapefruit. The chrome yellow fruit is uniformly produced on the tree. It has excellent aroma, is fairly seedy and very juicy.



Because of poor cold-tolerance, the tree needs to be protected. This variety is a personal favorite of citrus expert Sam Powers.

**'Henderson'** . . . This variety is a limb sport of an 'Hard Red' grapefruit found in the Henderson Orchard near Edinburg, Texas. The fruit is of excellent quality and is seedless. The flesh is two to four times redder than 'Ruby Red'. A pinkish red blush on the rind makes this fruit very attractive.

**'Marsh'** . . . This variety is commercially seedless and has a pale yellow, sweet flesh. It is a widely grown grapefruit variety in Florida and is used for commercial processing.

**'Ray Ruby'** . . . An improved 'Ruby Red'. It has more color, juice and sweetness. The fruit starts ripening in November. Winter protection is needed because of poor cold-tolerance.

**'Rio Farms Flame'** . . . This variety is a red grapefruit with a wonderful quality. A pinkish red blush develops on the rind when completely ripe. The fruit will hold on the tree for an extended harvest. It needs winter protection.

**'Rio Red'** . . . The fruit has a thick rind, soft flesh, high juice content and is low in seed production. It matures later than the 'Rio Farms Flame' grapefruit.

**'Sweeties'** . . . A cross between a pummelo and grapefruit produces a very sweet grapefruit.



*'Rio Red' grapefruit, GCMGA*

## Kumquat

These trees are the most cold-hardy of all the citrus, withstanding temperatures below 20° F.

**'Changshou'** . . . Also known as 'Fukushu' kumquat in Japan, it is a dwarf variety often grown in containers. The fruit is small, round and has a thin rind. It is normally eaten fresh with the rind or transformed in marmalades, jellies or jams.

**'Meiwa'** . . . This has a large round, very sweet fruit that is great for fresh eating, skin and all. It bears very heavily and is cold-tolerant down to 17° F or below for a short time. There is also a seedless variety. It is very ornamental in the landscape.

This is the preferred variety by both Sam Powers and Terry Cuclis. The quality of the fruit is rated much higher for eating fresh.

**'Nagami'** . . . This very ornamental, small tree produces bright orange, very tart oval fruit nearly year round. It is green, slow-growing, with an upright form to 8 feet tall by 6 feet wide. The fruit is tarter than the 'Meiwa' and much less seedy.

It is the most popular commercial variety used to make candies, jams and sauces.

**'Nagles Seedless'** . . . This is a seedless 'Meiwa' variety developed by the late Dr. Stuart Nagle of Clear Lake, Texas. It is not as sweet as 'Meiwa'.



*'Meiwa' kumquat, GCMGA*

## Lemon

It is thought that lemons originated in North India or Burma. The true lemon is not cold-hardy.

**‘Frost Eureka’** . . . ‘Eureka’ is the most widely grown lemon variety in the US. It has a well-distributed harvest season through late winter, spring and early summer. The rind thickness is medium to thin, and the fruit is very juicy with a high acid level. Seeds are few and often non-existent. It is not cold-tolerant.

**‘Galgal’** . . . This lemon produces a large, sweet-acidic fruit. It is not cold-tolerant.

**‘Improved Meyer Lemon’** . . . This is really the star lemon for the Upper Gulf Coast of Texas. The ‘Improved Meyer’ lemon is a virus-free variety that makes a small tree of 10 feet high by 8–10 feet wide. They are noted for heavy production of large, excellent tasting fruit, favored by all the great chefs. It is best to pick the fruit before the skin turns completely yellow. This variety is everbearing, but the fruit in August will be somewhat sour, while in January the flavor will be sweeter. The large fruit usually has a moderate number of seeds. Though cold-tolerant to the low to mid-20s, it is recommended to provide winter protection.

**‘Ponderosa’** . . . The enormous, round fruit is a real conversation piece and is moderately juicy and fairly acidic. It is a cross between a lemon and citron and is very fragrant, flowering and everbearing with fruit maturing throughout the year.

**‘Spanish Variegated’** . . . The variegated tropical lemon has pink flesh and a tart taste. Because of the need for winter protection, this variety is stunning used as an ornamental container plant.

**‘Sulcata’** . . . This variety is excellent for growing in a container. It is tropical and everbearing with very fragrant white flowers and large, sweet fruit.

**‘Ujukitsu’** . . . Sometime this is called the “lemonade tree.” This variety is a Japanese cross between a lemon and an orange. It produces large pear shaped, easy-to-peel fruit which ripen to an attractive yellow color in December. It is almost seedless with a low acid, mild, sweet flavor that is unlike other citrus — a delicate lemon taste but with absolutely no tartness. The tree grows to about 10 feet by 10 feet. This heavy producer will yield 600–900 lemons per year when mature. A must have for every citrus grower. The fruit from Sam and Ginger Powers’ tree is outstanding.



*‘Improved Meyer Lemon’, GCMGA*



*‘Spanish Variegated’ lemon, GCMGA*



*‘Ujukitsu’ lemon, GCMGA*

## Lemonquat

Hybrid crosses of kumquats for cold-tolerance and lemons for flavor have resulted in trees that are excellent choices for the Upper Gulf Coast of Texas.

**'Sunquat'** . . . These citrus varieties are gaining the attention of many growers in Texas. The small fruit is eaten whole like a kumquat and, when fully ripe, have a wonderful tropical flavor. The trees are compact and attractive in the landscape.

A lemon pie made using fruit of his 'Sunquat' impressed Terry Cuculis with its tangy, rich flavor.

**'Yuzquat'** . . . This is a 'Nagami-Japanese Mountain Lemon' hybrid. Fruit is eaten whole, rind and all. It is hardy to about 18° F.

## Lime

Limes were first documented in Malaysia and are a tropical fruit. Thus, winter protection is a major consideration.

**'Australian Finger'** . . . This tropical tree is a real conversation piece with its tiny leaves. It produces a small, green, elongated fruit that is mostly seedless. Planting it in a container allows for winter protection.

**'Bearrs'** . . . This is the same as the 'Persian' and 'Tahiti' limes. It is larger, more cold-tolerant and has less pungent rind oil aroma than the 'Mexican' lime.

**'Kaffir'** . . . Also known as 'Kieffer' and 'Kuffre' lime, the fruit is small and round with a thick, bumpy and tough rind. The pale green flesh is seedy with sour juice. The 'Kaffir' leaves are used like bay leaves in Asian cuisine.

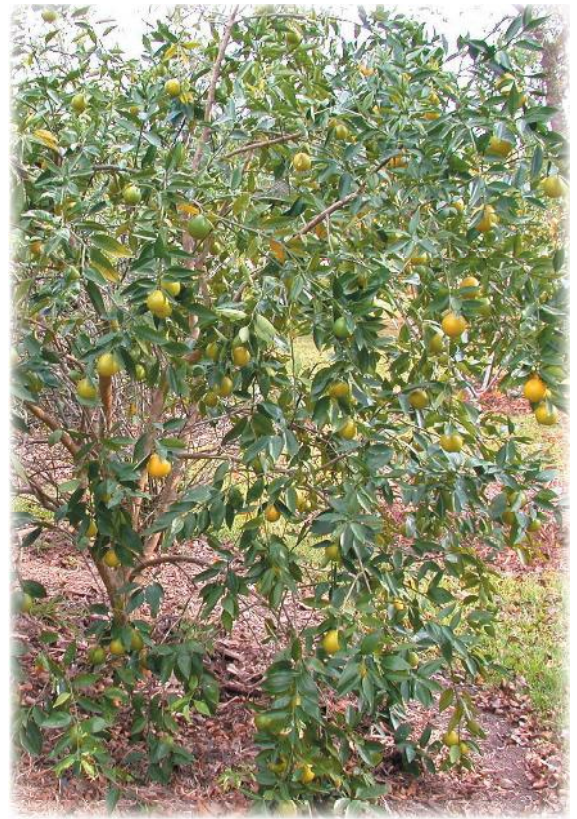
**'Mexican Thornless'** . . . This thornless, everbearing variety is a heavy producer of small green fruit, excellent for using in drinks and cooking. It is a recommended variety for growing in a container because it is not cold-tolerant. The fruit has a pale yellow color, strong lemon-lime odor and a sharp, clean, sour taste. It is everbearing like the 'Key' lime.

**'Palestine Sweet'** . . . This lime is highly favored in the Indian sub-continent and throughout the Near and Middle East. The fruit is medium in size and round in shape, often with a small nipple. This lime is very juicy, tender and sweet with very low acidity. It is often seedless or has very few seeds.

## Limequat

Hybridization of many citrus with kumquats has resulted in numerous varieties that have the desirable characteristics of the parents. They will be both flavorful and more cold-tolerant.

**'Eustis'** . . . An everblooming, everbearing hybrid of a lime and kumquat that is slightly hardier than a true lime. It is a prolific producer of small, round yellow fruit with a thin, edible skin. The fruit is moderately



*'Sunquat' lemonquat, GCMGA*



*'Mexican Thornless' lime, GCMGA*

juicy, with a sour, but clean lime tasting flavor. A mature tree will be 6 feet tall by 4 feet wide. It needs protection in cold temperatures.

**'Lakeland'** . . . This variety is a cross between the Mexican lime and a round kumquat. It produces the largest fruit of any lime or limequats variety for this area. The 6 foot tall by 4 foot wide tree prolifically bears very juicy, intense lime-flavored mottled green fruit. It is somewhat cold-tolerant.

**'Tavares'** . . . This cross between a Mexican lime and 'Nagami' kumquat is an excellent lime substitute. The flavor is similar to the Mexican lime but the tree is slightly hardier. It can withstand a moderate freeze of 28–30° F. The oblong, bright yellow fruit is tangy and almost seedless. The tiny foliage makes this a good selection for the landscape.



*'Atlas Honey' mandarin, GCMGA*

## Mandarin

These colorful, easy-to-peel fruits with excellent flavors are popular choices for the Upper Gulf Coast of Texas. They are divided into four main groups: Mediterranean, king, satsuma and tangerines. Most are self-pollinating; however, some varieties are more prolific with another pollinator. Alternate bearing is a negative trait of some varieties.

**'Atlas Honey'** . . . The fruit has a deep orange exterior, is thin-skinned and has a glossy texture. It has a slightly flattened shape with no neck. It is very juicy, peels and segments easily and has many seeds. The fruit matures in late October. The dwarf tree is unusually cold-hardy for a 'Ponkan' mandarin.

**'Atlas Koa'** . . . This variety is a seedling selection of 'Pong Koa' that has exceptionally fine flavor and a good texture. The skin peels easily and it is fairly cold-hardy. This variety is one of the best flavored of all citrus, a real gourmet fruit.

**'Clementine Honey'** . . . This is a very popular mandarin that produces high yields of a nearly seedless, sweet, very small, tender, juicy, acidic fruit. It matures from late fall into winter. Because it is not very cold-hardy, winter protection is advised.

**'Cleopatra'** . . . The fruit of this mandarin is small with a dark orange-red peel. The apricot-colored pulp is of good quality, but it is seedy. This beautiful cold-hardy citrus with its fragrant white flowers is highly prized as a small ornamental tree for the landscape and performs well in heavy clay or sandy soils. The fruit can remain on the tree until the next crop matures which makes it highly ornamental and attractive.

**'Dancy'** . . . This is a mid-season citrus, producing small to medium sized fruit with excellent flavor. They are bright red and are relatively seedy. 'Dancy' is thornless and cold-hardy.

**'Darlene'** . . . This variety is from budwood collected from a Mandarin tree in northwest Houston that has been in existence in for over 40 years. It is very sweet and ripens early.

**'Fairchild'** . . . This orange has a deliciously sweet flavor. The rind is a deep orange, thin and easy to peel. It is moderately seedy. This is the favorite mandarin of Ginger Powers.



*'Fairchild' mandarin, GCMGA*

**‘Mandarin’** . . . This variety is a delicious, easy to peel, sweet orange. It is easy to grow, great as a large container plant, or if planted outside, protect from hard freezing cold. The white flowers are very fragrant.

**‘Kinnow’** . . . This medium sized mandarin matures later in the season. The fruit has a very high sugar content, which to many palates is syrupy-sweet despite reasonable acidity. It has a strong tendency to bear heavy in alternate years.

**‘Nova’** . . . This variety is a cross between ‘Clementine’ and ‘Orlando’ tangelo that produces excellent, rich-flavored fruit in mid-season. The medium to large fruit has deep orange-red rind color that is easy to peel. It will be seedless if grown without cross-pollination.

**‘Page’** . . . An early maturing, thornless and very productive citrus variety that is often called an orange. They are well-colored, round, smooth and small. It can be seedy if pollinated.

**‘Pong Koa’** . . . The large fruit is very uniform in shape, size, and yellow-orange color and has a fairly thin peel. The quality is outstanding. The outstanding, clear medium orange flesh is juicy, sweet and very full-flavored. It is fairly cold-tolerant, but be prepared to protect the tree in the event of a hard freeze. ‘Pong Koa’ is highly recommended by Sam Powers though it is very seedy. Both texture and flavor of the fruit is outstanding.

**‘Rio Honey’** . . . This is a hybrid of ‘Clementine’ mandarin that produces a very sweet, 3–4 inch flattened oval fruit with just a few seeds. It has a zipper skin and ripens mid-to-late season. It is a heavy bearer and forms a graceful, pendulous tree with lance-shaped leaves.

**‘Seedless Kishu’** . . . Of Chinese origin, this variety produces bright orange, seedless fruit that is sweet, has a mild flavored juice, easy to peel and very popular in Asia. It produces large crops of small 2–3 inch fruits that hold well through an extended harvest. The dwarf, round-shaped tree is good for a container even though it is moderately cold-hardy.

**‘Sunburst’** . . . A hybrid of ‘Robinson’ and ‘Osceola’, this mandarin matures early and has an outstanding deep reddish-orange rind color. It is high in sugar and acidity.

**‘Tonkan’** . . . This variety shares many similar qualities and characteristics with ‘Ponkan’ mandarins, such as being a fairly large citrus, peeling easily and when mature, it has a sweet pleasant, low acid flavor. This variety is cold-hardy.

**‘W. Murcott A. Fourer’** . . . Bearing heavily in alternate years is characteristic of this mandarin. The fruit is medium sized with outstanding quality, high sugar content and good acid level resulting in an intensely rich flavor.

**‘Willowleaf’** . . . This has an easy-to-peel light orange rind and a flame-orange, tender pulp. The juicy, but seedy flesh has an apricot taste.



*‘Kong Poo’ maderin, GCMGA*

## Mandarinquat

A hybrid of a mandarin and a kumquat, it is flavorful like a mandarin and more cold-tolerant like the kumquat.

**'Indio'** . . . This variety blooms in the summer, and the smooth, red-orange rind is edible. The two inch fruit has a slightly tart taste. The abundant crop of fruit can stay on the tree without losing quality.

## Mandelo

This hybrid is more cold-tolerant than grapefruit and is often grown in this area as a substitute.

**'Mandelo'** . . . This is a hybrid between the 'Frau Mandarin' and a low acid 'Pummelo' that was developed in Riverside, California. The fruit is very juicy, good with a unique flavor that sometimes resembles watermelon. Its best home use may be for juicing though it can be eaten as grapefruit. The tree is both precocious and prolific, with some tendency to alternate bearing. Even in the off crop years, it still seems to have ample fruit for the home grower. It forms an attractive tree, well shaped and medium sized. It can be dwarfed by growing in a container.

## Orange

Sweet oranges are native to the Indian sub-continent, but were quickly spread by nomadic traders across Asia into Europe. Columbus planted oranges on the island of Hispaniola during his second voyage to the New World in 1493. Oranges are the most widely grown sub-tropical fruit in the world.

**'Ambersweet'** . . . A new hybrid, 'Ambersweet' is a cross between an orange, a grapefruit and a tangerine. It is a large, pear-shaped fruit most comparable to a navel with lots of deep orange-colored juice and a unique, spicy flavor.

**'Armstrong Early'** . . . The fruit ripens in September and has an exquisite flavor. This small tree shows excellent fruit production and survives temperatures to 20° F or lower. In 1992, Bonnie Childers said, "every back yard on the Texas Gulf Coast should have one."

**'Calamondin'** . . . This small, upright, decorative tree can be grown indoors or outdoors in a container. It is a very decorative plant, and one variety has green and white variegated foliage. The fruit is kumquat size, round and bright yellow/orange. The sour fruit makes good marmalade and as juice for drinks or to flavor seafood. It is cold-hardy to the mid-teens.

**'Jadabacaba'** . . . A variety that bears clusters of sweet fruit in the late summer to early fall, it has a compact growth habit with closely spaced leaves. It is a small, very ornamental tree with good cold hardiness.

**'Marrs'** . . . This juicy, seedless orange has low acidity. It produces heavy crops of medium size fruit and tends toward alternate bearing. It is grown commercially for the fresh market and home grown fruit is considered tastier than store bought. It is a favorite of Texas Rio Grande Valley growers.



*'Ambersweet' orange, GCMGA*

**‘Midnight’ Valencia** . . . An early maturing orange, this variety has medium cold-tolerance. The fruit has a high juice content, better flavor, near seedless and a larger size than a ‘Valencia’ orange.

**‘Parson Brown’** . . . The fruits have a deep orange interior and a rich flavor. There are 10–12 seeds per orange. The skin is thick with a slightly pebbled peel. ‘Parson Brown’ can be planted in the ground or in a container. If grown in a pot, it will only reach approximately 8 feet in height.

**‘Pineapple Sweet’** . . . It is a medium to large fruit with light orange color. The sweet, spicy flavor and juicy flesh commend this citrus. It tends to be alternate bearing.

**‘Republic of Texas’** . . . This variety is documented back to 1847 near Angleton and Santa Fe, Texas. It is the only cold-hardy orange that is being grown for the Upper Gulf Coast region. The medium to large size, round fruit is very flavorful. The tree matures at approximately 15 feet by 15 feet if not pruned. It is a great, sweet orange that anyone should grow. With its sweet, tangy flavor, this is a favorite of Terry Cudlis.

**‘Rohde Red’ Valencia** . . . A Valencia orange with deep orange rind has the flavor of a juicy, ripe delicious apple. It is round and has a dimpled rind with few seeds. It ripens from March through June.

**‘Variegated Calamondin’** . . . This is a small, kumquat size fruit with excellent sour juice. It is great for use in cooking (such as with fish dishes) and for lemonade. The cold-hardy tree has compact, fine textured variegated green and white foliage, white flowers and the orange to red fruit is borne in clusters. It is highly ornamental when used as a container plant or planted in the landscape.

**‘Variegated Valencia’** . . . This is the most important commercial orange variety worldwide. In the US, it is grown mostly in Florida and California. It is the latest to mature each season and bears heavily in alternate years. The fruit is medium to large size, well-colored with a slightly acidic taste except when fully mature. It has high juice content. Provide cold protection if the temperature will go to 26° F or lower.

## Blood Orange

One of the sweet oranges, blood oranges contains anthocyanin pigments which cause the flesh to have the characteristic red color or red spots. Cool nights are necessary to develop the red hues and distinctive flavors.

**‘Moro’** . . . This juicy, medium-sized fruit has a very distinctive aroma. The red to pink pulp is nearly seedless, depending on the number of cool nights. It bears fruit in clusters near the end of the branches. It tends to bear heavily in alternate years and is moderately cold-hardy.

**‘Ruby’** . . . A medium-sized variety that is second only to the ‘Moro,’ with juicy red to pink flesh and few seeds. It is moderately cold-hardy.

**‘Sanguinelli’** . . . The fruit is small to medium size and oval in shape. The flesh is tender and is very juicy. It is sweet and less acidic than some blood oranges but has the same pronounced taste. The tree is of medium size, vigorous, thornless and productive.



*‘Republic of Texas’ orange, GCMGA*



*'Bond N33' navel orange, GCMGA*



*'Cara Cara' orange, GCMGA*



*'Chandler' pummelo, GCMGA*

**'Tarocco'** . . . Virtually seedless, the flesh is rich and fragrant with an ideal balance between sweetness and acidity. The fruit is medium to large, rounded with a slightly pointed collar terminating in a medium sized neck. Rind peels easily with barely any release of rind oil. When the fruit is fully mature, the flavor is quite outstanding. It is among the best of Mediterranean oranges.

**'Vainiglia Sanguinelli+'** . . . This is an acidless, sweet and very juicy orange with pink flesh. The round fruit is medium in size, has some seeds and a smooth orange rind of medium thickness.

### Navel Orange

These sweet oranges originated in the Mediterranean and were named because of a secondary fruit that semi-develops at the blossom end that forms a pit or "navel" in the thick peel. Trees appeared in Brazil and were brought by the USDA to San Augustine, Florida in 1873.

**'Bond N33'** . . . This is a wonderful navel orange grown by Terry Cuculis who has given the variety the name 'Bond N33'. Currently, the Fruit Study Group of the Upper Gulf Coast of Texas is unable to identify this orange. The large, round, juicy fruit has excellent flavor and is easy to peel. It does need protection from cold temperatures.

**'Cara Cara'** . . . Discovered as a branch sport of 'Washington' navel, this variety is a proven favorite of many home gardeners. It produces a rich fruit with low acidity and a tender flavor. The flesh has a deep pink flesh similar to a grapefruit that develops as winter progresses.

**'Everhard'** . . . Another bud sport of 'Washington' navel, it produces a small fruit characterized by a very small or no navel. It is a consistent producer and is seedless. The fruit has a sweet flavor.

### Orangequat

As a hybrid, the fruit has characteristics of the parents. It can be eaten skin and all like kumquats.

**'Nippon'** . . . This cross between a kumquat and satsuma mandarin produces a deep orange fruit like a kumquat but larger. The rind is sweet and the pulp is juicy and slightly acidic. It is cold-hardy.

### Pummelo

Pummelo is the largest of all citrus varieties. Seeds were introduced to the East Indies in the nineteenth century by Captain Shaddock. The distinctive aroma and taste leave no doubts that they are the parents of subsequent generations of newer grapefruit varieties. Characterized by very thick rind and tough segment membranes, the flavor ranges from sweet to very acid.

**'Chandler'** . . . The sweet, pink-fleshed fruit is often the size of a volleyball. The thick rind is smooth and yellow. With a nearby pollinator, it can be very seedy.



**'Sarawak'** . . . This variety is a cross between an orange and a pummelo with the pummelo taste and a sweet, orange flavor. It ripens slowly and is a favorite of the Asian community.

**'White Reinking'** . . . A prominent neck on this large fruit is not unusual. Clusters are borne inside the canopy of the tree. The white flesh is pleasantly flavored and very seedy, while the thick, bright yellow rind is easy to peel.

## Satsuma

The satsuma probably originated in China, but it is first documented in Japan over 700 years ago. The first fruit was imported in 1878 that was shipped from the port of Satsuma, Japan through the efforts of the US minister, General Van Valkenberg. One million 'Owari' trees were shipped from Japan in the years 1908 through 1911. This variety was instantly popular because the fruit matures and reaches the public market early. A severe freeze in 1911 and a hurricane in 1915 moved the citrus industry in Texas to the "Winter Garden" located near Uvalde, Crystal City, Pearsall and the Lower Rio Grande Valley.

**'BC'** . . . This variety was developed by Bonnie Childers of Lumberton, Texas, who is responsible for the largest number of important and distinctive satsuma cultivars in Texas. The fruit is large and loose skinned with great taste. It is hardy to 20° F or lower.

**'BC 2'** . . . A seedling of 'Armstrong Early' orange was collected by Bonnie Childers. It is a delicious, early maturing satsuma, and is very cold-hardy to 20° F or lower. This variety is a personal favorite of Bonnie Childers.

**'Dobashi-Beni'** . . . This variety has all the pluses: very cold-hardy, early producer, nearly seedless, zipper skin, and a mild, sweet taste. Fruit that is harvested later in the season will be sweeter. The branches of the small to medium size tree have a drooping growth pattern. This is an excellent choice for the urban garden.

**'Kimbrough'** . . . The juicy fruit is a large size, has excellent flavor and fewer seeds than most satsumas. The fruit matures late with the harvest usually in November. This is a very cold-hardy variety down into the low to mid teens. This is a variety that Bonnie Childers has grown for many years.

**'Miho'** . . . Japanese growers started this variety in 1984 from a seed of 'Miyagawa' satsuma. The smooth, thin skin fruit develops in the late summer into fall and is best harvested around Thanksgiving. The rind is thin, smooth and leathery. The small to medium-size tree has elliptical leaves and the branches grow in an upright pattern.

**'Mr. Mac'** . . . A variety developed by Murphy W. McEachen, the Agricultural Extension Agent of Plaquemines Parish, Louisiana, renown for establishing the citrus industry after hard freezes in 1952, 1957 and 1963. This is an old line clone of an 'Owari' satsuma. It has been grown for several years at the Texas A&M University Research Center in Uvalde. This outstanding variety is recommended by Bonnie Childers for an urban garden.



*'Kimbrough' satsuma, 2003 Citrus Show, GCMGA*



*'Miho' satsuma, TAMU*



*'Mr. Mac' satsuma, TAMU*



*'Owari' satsuma, GCMGA*

**'Neapolitan'** . . . A later maturing variety, it is easy to peel, has a sweet flavor and is seedless.

**'Okitsu-Wase'** . . . This early maturing mandarin originated in Japan in 1940 and is very cold-tolerant. It has a very loose rind, and the juicy, virtually seedless flesh has a mild, sweet flavor.

**'Owari'** . . . This is the original satsuma and is still considered by many growers to be the best for the Upper Gulf Coast of Texas. It is a vigorous tree and the fruit has excellent flavor, great production and few seeds. Fruit is late maturing and is best when harvested in early November. The tree is hardy to 22° F or lower.

**'Satsuma'** . . . This seedling of unknown origin has proven to be a good choice for the Upper Gulf Coast of Texas. It has large fruit, a very loose, bumpy skin and is sweet and less acidic with a distinct tropical flavor. It makes a fairly small tree that survives well to 20° F or lower. Terry Cuclis rates this variety as one of his favorites.

**'Seto'** . . . This variety was developed in Japan from a seed of 'Mi-yagawa' satsuma in 1984. The flattened fruit has smooth, thin skin and matures in November near Thanksgiving. The small to medium-size tree has oblong leaves and the branches have a drooping growth pattern.

**'Vermillion'** . . . A seedling from 'Owari', this variety produces excellent fruit on vigorous trees.



*'Mineola' tangelo, GCMGA*

## Tangelo

A cross between tangerine and grapefruit produced the tangelo.

**'Minneola'** . . . This cross between tangerine and grapefruit bears large size, easy to peel fruit with good taste. It has a delicious and unique flavor, but is only moderately cold-hardy. It bears a large fruit with a necked shape. The sweet, tart, honey-like juice is prized for its quality. Harvest season is from December to April.

**'Orlando'** . . . A cross between 'Duncan' grapefruit and 'Dancy' tangerine, this variety produces fruit that is tender and very juicy, with pale orange flesh. It has a very sweet taste with low acidity. The fruit matures early. It is not cold-hardy.



*'Orlando' tangelo, GCMGA*

## Tangerine

These are one of the four classes of mandarins that are popular trees for the Upper Gulf Coast of Texas. They are sweet, easy-to-peel and cold-tolerant. Trees will produce large crops of fruit when mature.

**‘Bell’** . . . This is a mandarin hybrid with sweet acidic taste. It is fairly cold-tolerant and bears heavy most years. The fruit is easy-to-peel.

**‘Changsha’** . . . The brilliant red, sweet, acidic fruit is seedy. It matures early in the fall and the tree is very cold-tolerant.

**‘Kat Mandarin’** . . . The original tangerine, it produces small fruit with seeds. The sour taste is useful as juice in drinks or for cooking.

**‘Tonkan’** . . . This tree is cold-hardy and shares many similar qualities and characteristics of ‘Ponkan’ mandarin. It also bears fairly large fruit, peels easily, and when mature, has a sweet, pleasant, low acid flavor.

## Tangor

The hybrid of a tangerine and orange cross, the fruit is sweet and juicy.

**‘Murcott’** . . . This is a medium-late maturing, alternate bearing and very cold-hardy citrus. The fruit has a smooth yellowish orange color. It has a high juice content that is sweet and distinctively rich flavored.

**‘Ortanique’** . . . A most reliable and productive variety that matures late in the season at the same time as ‘Valencia’. The fruit is smooth with a pale orange rind. It is extremely juicy and sweet, with well-balanced acidity and a strong, rich aroma.

**‘Temple’** . . . The thin rind is easy to peel and has a distinctive scent to its oil. The seeded flesh is full of robust and spicy flavor, with a tangy, tart aftertaste. It is a mandarin-orange hybrid.

**‘Umatillo’** . . . A cross between a blood orange and mandarin, it produces fruit that is oblate to round, with red-orange peel and orange pulp. It is very juicy, has a rich sweet-acid flavor and is of fine quality. It produces late in the season.

## Hardy Citrus Hybrids

These varieties are unique and grown for special purposes.

**‘Yusage’** . . . This cross between a ‘Citrange’ and ‘Yuzu’ is very sweet.

**‘Yuzu’** . . . This cold-hardy citrus is grown primarily for the very thick rind. It is used for cooking, flavoring foods, and making vinegar. The fruit is extremely seedy and not very juicy. The tree is narrow, upright and thorny, similar to trifoliate orange. ‘Yuzu’ is essential to Japanese cuisine. It is also favored by California “fusion” chefs who blend Oriental and American ingredients to create exciting new flavors and combinations.



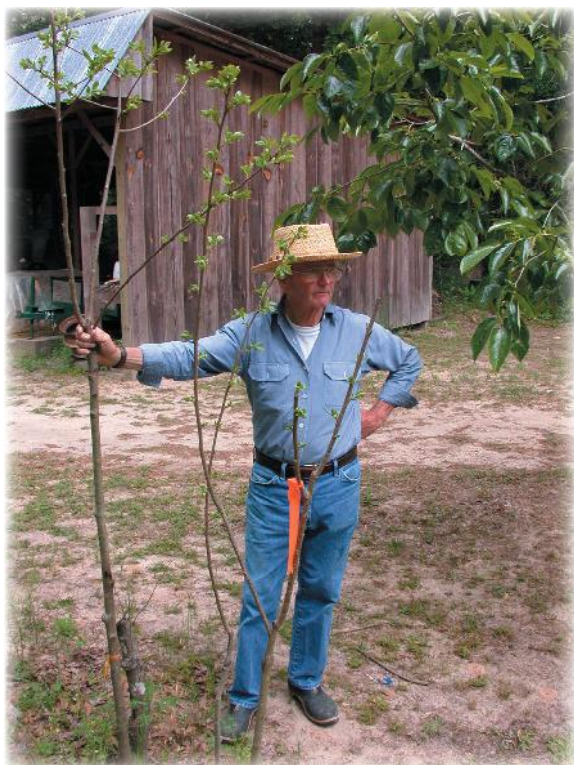


## CHAPTER 2

# *Citrus Growers & Their Citrus Tips*

**G**rowing and studying citrus is the passion of several gardeners on the Upper Gulf Coast of Texas. In this area, the citrus industry has flourished and waned with the weather, but the allure of finding the best varieties and methods continue to draw Bonnie Childers of Jefferson County, and Terry Cuclis and Sam Powers of Galveston County into experimenting in their home orchards.

## Bonnie Childers — The Soft-spoken Champion of Satsumas



*Bonnie Childers of Lumberton, Texas, GCMGA*

Bonnie Childers first encounter with horticulture was picking cotton as a little kid, on a cotton farm in Ripley, Mississippi where he was born in 1930. His whole life has been spent in the South — Mississippi, Louisiana, and East Texas — and it is on the Gulf Coast that his enduring contribution to horticulture will be felt.

He's easy going about his funny name...Bonnie. "I was just hung with that name," he says patiently. For part of his life, he went by his initials "B.L.," the practice of many people with unusual names. However, while he worked as a lab technician at DuPont for many years, he was affectionately referred to as "Bonnie Pecan", because his passion for grafting pecan trees in the region was so legendary.

Childers' fascination with citrus trees started in 1968, when Dr. Arlie Powell, a renowned fruit specialist, demonstrated how to T-bud citrus trees to a gardening audience in Orange, Texas. Childers was fascinated at how taking just a bud from a branch and grafting it beneath the skin of another branch would result in a great, productive tree. Powell became his mentor and his friend from that point on.

In the late 1960s, he started a citrus nursery, focusing his experiments on the 'Changsha' tangerine — an attractive, productive, cold-tolerant variety on its own rootstock. But the quality of the fruit, he discovered, was not as good as that of the satsuma tree. It was from that point on, his heart belonged to satsumas.

The great freeze of 1983 destroyed one nursery in which he was a partner — 70 big trees. Some nursery stock that had been covered with pine bark grit survived the freeze, and his was the only nursery that had citrus trees for sale the following spring. To this day, his biggest regret was not doing, as another mentor, Fletcher Granbury, had taught him: to bank big trees with dirt over their graft line, as high as one can. That way, a freeze will kill off the top of the tree, but the trunk and graft will remain unharmed.

Since then, Childers has dealt with many varieties of satsuma and other citrus trees, but has some true favorites, all satsumas:

- 'BC-1' is a great satsuma that survived the historic 1983 freeze, on its own roots.
- 'Owari' is a tried-and-true satsuma that has been around since 1878. It has sprouted many new varieties from its sports.
- 'Armstrong Early' is a great tasting satsuma, except for its first year. It is pictured on the front cover.

Though Childers is retired now from both the petrochemical and nursery businesses, he still grafts trees for the Doremus Wholesale Nursery in Warren, Texas. He teaches many classes every year, in the Jefferson County area — passing on the knowledge that he acquired from his mentors, Powell and Granbury. "I'm very indebted to them both," explains Childers. "Powell was a fruit specialist, and taught at Texas A&M



*Bonnie Childers giving tips for growing citrus, GCMGA*

University, University of Georgia, and Auburn University. Granbury had orchards in Louisiana, and shipped fruit all the way to New York City until the 1929 freeze destroyed his trees. I met him in 1969, and was taught the finer points of selecting buds for grafting, among other things.”

Right now, Childers is experimenting with satsumas that show promise of high sugar content. In his home’s utility room, he has some new varieties: a ‘Kawana’, a ‘Kishu’, a ‘Nepolitana’, a ‘Silver Hill’, a ‘Miho’ and a ‘Seto’. He sometimes finds new varieties on the Internet, but only gets certified disease-free trees.

However, he keeps three favorites in his yard, where he resides: ‘Armstrong Early’, ‘Owari’, and ‘Kimbrough’. They are early, mid, and late season satsumas. All share tremendous heartiness, good disease resistance, and abundant production of great-tasting fruit.

Childers feels his main contribution has not been in developing the citrus of the Gulf Coast, but in teaching hundreds of gardeners budding and grafting techniques in garden club and Cooperative Extension classes all over East Texas.

## Citrus Tips from Bonnie Childers

*Know what you’re buying. It’s not good to just go to the local garden and home improvement store and buy what they have. It may not be adapted for your area or correctly labeled.*

*Try to get citrus on Flying Dragon rootstock, which will result in a semi-dwarf tree which is easier to pick and maintain.*

*Try to buy bare root instead of container grown trees, if you can.*

*Do a soil analysis to get an accurate assessment of what fertilizer and soil amendments to use.*

*Fertilize citrus trees between March and June.*

*In drought, water once or twice a week.*

*To protect citrus from freezes, bank dirt up high over the graft in late fall, and rake back when fear of frost is over in the spring.*

*Spray with a horticultural grade oil three times in winter, after fruit has been picked, and again on first flush growth in March. For aphid and whitefly infestations, a non-detergent liquid dishwashing soap dissolved in water is good to spray on bottoms and tops of leaves — three times, three days apart.*

## Sam and Ginger Powers — Variety Rules



*Sam and Ginger Powers of Arcadia Station, Texas, GCMGA*

When you go to Sam and Ginger Powers' house in Arcadia Station (beside Santa Fe) Texas, you could literally live off the land. Any season of the year, there's always something delicious to eat in the yard — loquats, blackberries, peaches, plums, pears, figs, grapes, persimmons, kumquats, jujubes, papayas, monstera — and all kinds of citrus, many of them rare and interesting. The Powers are authors of our most interesting and amusing publication on fruit growing, in which they record their hilarious and sometimes misbegotten experiences with fruits and their numerous varieties: *The Edible Landscape*.

The Powers family bought this land in Texas in 1895, after reading brochures touting it as a tropical paradise in which anything grew. "Pure hype," notes Sam dryly. Sam's grandfather did indeed establish a robust citrus orchard, and shipped oranges east by way of the nearby railroad.

Sam and his family survived the great 1900 storm, huddling his family behind a sand knoll outside his house — because his house was going to blow over. But Sam's grandfather lost his orange orchard to the hard freeze some years later.

Sam truck-farmed vegetables after that, and grew more cold-hardy fruit trees — pears and figs. Sam's father was doing dairy farming on the family land when Sam was born there in 1930. Sam didn't take up horticulture or agriculture until after he retired from his job as a lab and instrument technician at Amoco Oil, in 1988.

He met his wife Ginger — raised in nearby Freeport — at a local college, and married her in 1956. They built their house themselves on a 3½ acre parcel of the original Powers land — just in time for Hurricane Carla to hit in 1961.

Fortunately, they had built it well, and didn't get damage despite Carla's 130 mph winds and torrential rain. Though they maintained little vegetable gardens over the years, Sam's friends — Arnold Lippert and Ted Tedley — got him involved in the Galveston County Master Gardener Program and into growing fruit trees. "What was I going to do in retirement anyway?" Sam says. "I couldn't catch fish!"

Sam and his friends went all over the region, collecting varieties of different fruits as many enthusiasts do — by trading and grafting. Though Sam started some citrus trees from seed, he grafted most of his citrus trees on his grandfather's hearty *Trifolata* rootstock.

During the hard freeze of 1989, most of Sam's citrus trees were still in pots, so he dragged them indoors. However, he and Ginger decided to build two greenhouses to house their tropical and citrus collections. They bought the materials from a commercial grower that had gone out of business in 1990. Their daughters had raised show rabbits for many





*Powers' greenhouse, GCMGA*

years, and they located the greenhouses over the generously-fertilized soil where the rabbits had been. The trees planted there loved it and thrived.

Through their many years of relentless experimentation, they know who the best performers are in fruit varieties — and which aren't. They developed their own plum variety, named the 'Powers Plum', and are often visited by citrus experts intent on hybridizing some of their rare trees. Specialty nurseries are always seeking their advice.

Among the bewildering number of varieties they've raised and tested, Sam and Ginger have some favorite citruses. 'Steed's Golden Grapefruit' is a wonderfully-flavored grapefruit for eating and juicing. It has an orange interior. The rare 'Ujukitsu' lemon-orange can be peeled and eaten like a tangerine. It has no sourness — just a delicate, sweet lemony flavor. The 'Improved Meyer' lemon is the best lemon for cooking and juicing. They enjoy the mandarin oranges more than the satsumas — especially the 'Fairchild' mandarin and seedy, but flavorful 'Pong Koa'.

Never resting on their laurels, the Powers are charging off into raising many exotics, like star fruit and pawpaw.

Beside their driveway, their daughter erected a humorous sign: "Gardens Tours, 5 cents." If Sam and Ginger Powers collected a nickel from every person who has toured their fascinating and diverse edible garden, they'd be millionaires.

As for that 1895 brochure that assured land buyers they could grow anything in Arcadia Station, Texas — well, the kick is, in spite of gumbo soil, hurricanes, freezes, droughts, insects, and floods, Sam and Ginger really have grown just about everything.

## Citrus Tips from Sam and Ginger

*Be careful how you prune citrus trees. It's a mistake to prune off the bottom branches. Prune tops carefully to maintain a reasonable height only. Citrus fruit is produced on last year's wood, so you can lose your fruit production when you prune — and if you're not careful, you can kill the tree too.*

*Get a hearty rootstock, like Trifoliata. Flying Dragon is good too, but you don't need it on trees that naturally dwarf, like kumquats.*

*Plant citrus trees in the ground, don't keep them in pots. Locate them in a sunny sheltered area, like the south side of a house when possible.*

*When planting, make the hole 1 inch larger than root ball, breaking up the soil on the side of the hole with a spading fork — so the soil doesn't form an underground container.*

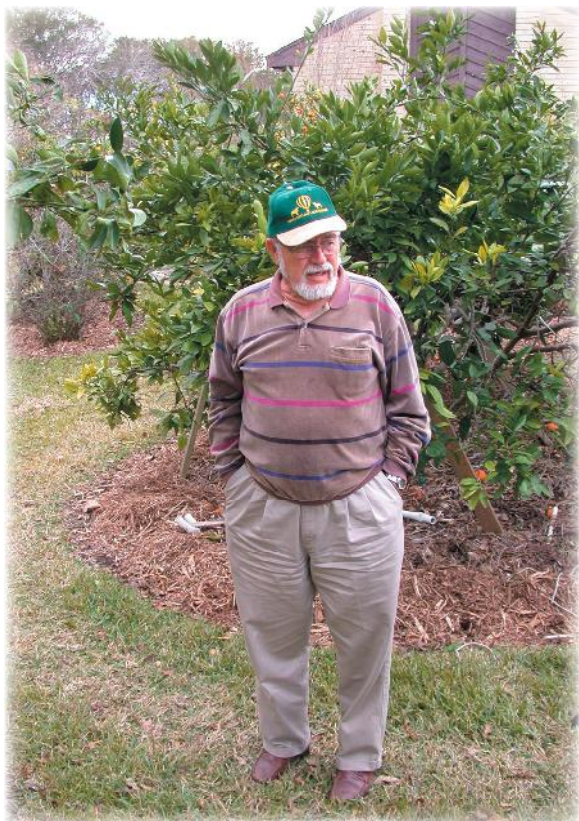
*It's not necessary to place citrus in a raised bed, if water doesn't stand in the area for more than 24 hours after a rain.*

*Don't put your watering system too close to the trunk of a citrus tree. If it's a drip or spray system, locate it three feet away from the trunk. The trunk can rot out from watering, and you can get soil-borne diseases too. You can spray a horticultural oil to control insects but do not use regular dormant spray on citrus in the summer above 1/4 strength.*

*Pick the fruit off a newly-planted tree for the first couple years. The fruit won't be good quality in the first year, and it will slow down the establishment of the tree.*

*Let St. Augustine grass grow around the base of the tree — but not Bermudagrass nor native grasses. It'll help hold moisture in, and will keep soil from cracking during droughts.*

## Terry Cuclis — A Magnificent Blend of Ancient and Modern



*Terry Cuclis of League City, Texas, GCMGA*

“I grow things I like to eat!” says citrus expert Terry Cuclis, our most enthusiastic and jovial Master Gardener. Typically Greek in his generosity and hospitality, he loves to share what he knows and what he grows.

Every year, he gives several public seminars on growing fruits and vegetables, and leads the much-anticipated Galveston County Master Gardener Tomato and Pear Tasting, supplying the tables of luscious produce from his own home garden and orchard. And if you go to his home, prepare to sample something rare and wonderful while participating in fascinating conversation.

Terry Cuclis was born in California of Greek parents. His father died when he was very young, and his mother moved back to the ancient island of Crete where her family was. Unfortunately, World War II broke out, and he spent 3 years under severe German occupation in Crete, scrounging for food and fresh water. The Germans kept all the meat for themselves, and fishing became difficult. His family had to eat snails, gather wild greens, grow most of their food in the garden, and even steal almonds and figs from the trees to survive.

Three years after the war, Terry came back to Santa Cruz, California — a move that was supposed to be temporary, but turned out to be permanent. He went to University of California, Berkeley, majoring in electrical technology, and then worked on missile systems until his company won a contract to design and build NASA’s Mission Control, at the new Johnson Space Center in nearby Nassau Bay, Texas.

Terry moved to Texas in 1963, and helped design and build the huge screen display in Mission Control, which is still used to this day. There, he met his wife Velda, who worked as a financial analyst in his company. They married in 1975. Terry was promoted into management, but the space program began to get less interesting by 1979. As the NASA bureaucracy kept growing, Terry dreamed of retiring — only his bosses wouldn’t let him. Finally, when Velda retired in 1994, Terry did too. “I was 62 years old then, and my bosses couldn’t stop me,” he laughs.

Though Terry and Velda had always had gardens and a few fruit trees in the suburban neighborhood where they lived, they bought a two-acre plot of land in a more rural area of Galveston County, and built their comfortable, modern house out there in 1985. Though he grew lemons and oranges while he lived in California, he didn’t grow citrus again until he moved to this house in the country.

In his soul, Terry is an adventurer, who loves to try new things. He grows several dozen heirloom tomato varieties every year, but is always trying new varieties too. The same is true of his orchard, where he has several great varieties of fruit trees: many Asian and European pears, several figs, along with some peaches, nectarines, apples, apricots, mulberries, jujubes, loquats, papayas, avocados, persimmons, pomegranates, and quince — and even some rare and spectacular pawpaws, which he hand-pollinates. Among his nut trees, he grows black walnuts, pecans, and chestnuts. In his raised beds, he even has an assortment of blueber-



*Planting citrus at Carbide Park, GCMGA*

ries, very unusual for the Galveston County area. As with tomatoes, he loves exploring heirloom varieties of fruit too. For instance, he got three cuttings from fig trees growing at Thomas Jefferson's Monticello, and found them to be productive and interesting.

He has many splendid citrus trees too, of course. And he is always eager to share his rare and wonderful citrus fruit with friends and strangers alike. His favorites include:

- Though he gets good production from his sweet 'Owari' satsuma, his 'Satsuma Satsuma' is his favorite – bursting with a slightly tarter but wonderful orange flavor.
- The hearty 'Republic of Texas' orange has wonderful flavor too, though it has many seeds.
- His rare and interesting hybrid 'Sunquat' (he calls it "lemonquat") can be used for wonderful lemon desserts.

Though he doesn't hybridize fruit trees himself, he does some grafting. "I love to graft several varieties onto one tree," he says, proudly pointing to one citrus tree that has one limb containing 'Valencia' oranges and another of satsumas. He has pear trees which also have several varieties growing on one main tree.

Never tired of trying new things, Terry plans on planting some olive trees on his land — echoes of his childhood in Greece and California. While touring his garden in December, one couldn't help observe that among the new and rare varieties of spinach, onions, and garlic in his numerous beautifully-kept raised beds were the humble bitter greens he survived on in Greece, during the German occupation.

To see the garden is to know the man: a splendid blend of ancient and modern, at home in both the distant past of horticulture and the future of the space age. Like Homer's questing hero, Odysseus, he is a restless traveler through new and amazing terrain, but even forgets the course back to his ancient home.

## Citrus Tips from Terry Cuculis

*When planting a citrus tree, locate it in a sunny place. Ensure good drainage, building up the planting site about one foot above the surrounding ground.*

*Test the soil. If the soil is heavy clay and the pH is high, amend the soil in the planting hole by mixing good soil or peat moss with the existing soil.*

*Avoid or strictly limit pruning a citrus tree. Citrus fruit grows on second-year growth, and pruning will hurt production. Bushy citrus trees seem to be healthy and productive.*

*Keep the area around citrus trees clear of debris where bugs might hide. Mulch every year or so with 2–4 inches of fine mulch. Because the pH is high in his soil, Terry sometimes uses pine needles for mulch, to help acidify the soil too.*

*Use good compost or high nitrogen (21-0-0) fertilizer on citrus. Fertilize four times a year between February and September to encourage new growth. A half-cup of epsom salt can be sprinkled four times a year, for magnesium deficient soils.*

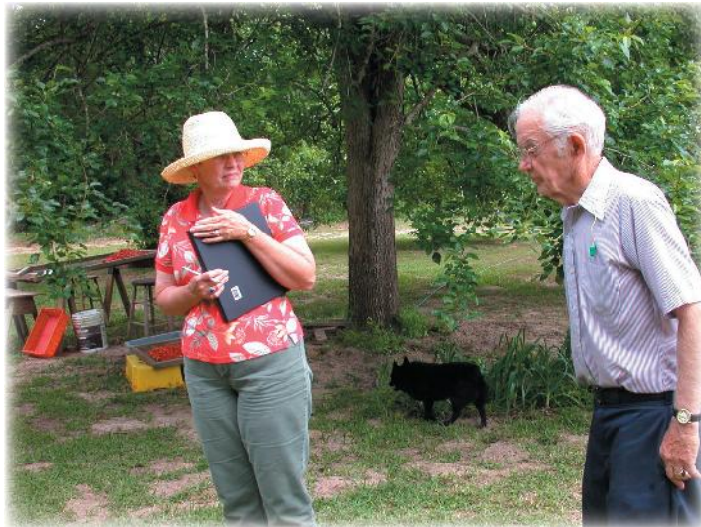
*In hot dry weather, water trees once or twice a week.*

*To prevent freeze damage, small trees can be banked with soil, or covered completely. In larger trees, put on Christmas tree lights and cover with sheets, if possible.*

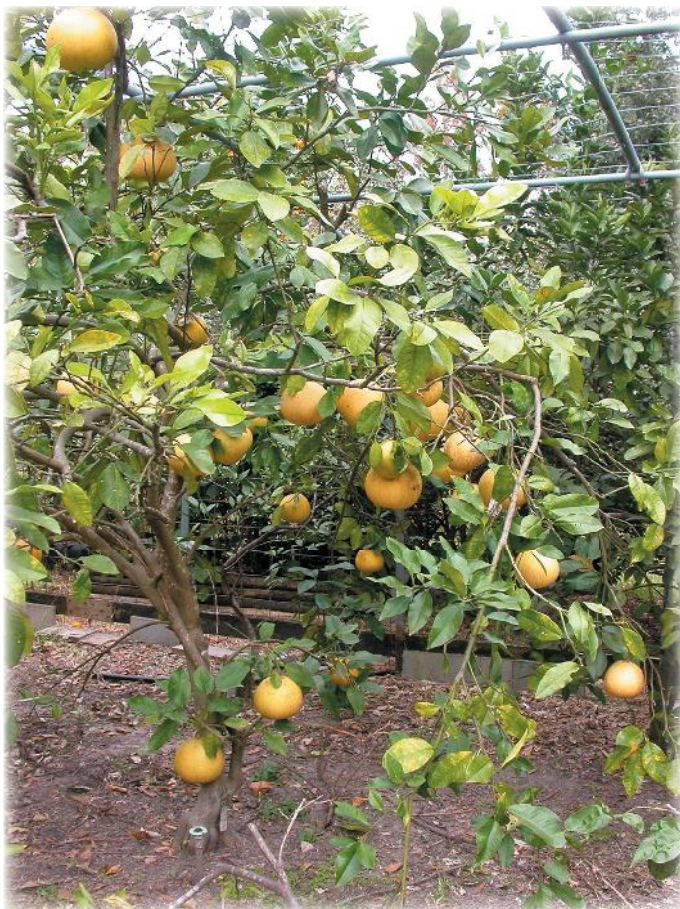
*Personally, Terry does not like to spray his trees with chemicals, but there are fungicides, insecticides, and herbicides available that people may use. Terry has found that spraying may not be necessary at all, especially if one buys disease resistant citrus varieties. If spraying is absolutely necessary, he uses horticultural oil. He removes stink bugs by hand and smashes them. He finds that eventually, "stink bugs get the message," and stop bothering his plants.*



*"This 'Trifoliata' was my grandfather's tree. I still use it as citrus rootstock." Sam Powers. GCMGA*



*Dr. Bill Ethridge during his interview with MG Anna Wyrzys, GCMGA*



*"'Bloomsweet' is considered the best grapefruit for this area." Urban Harvest*



## CHAPTER 3

# *Culture*

**T**he two primary root zone requirements for successfully growing citrus are deep soils and good drainage. Soils of the Upper Gulf Coast of Texas are deep and range from pure sand, sandy loam and silt to gumbo clay. Sand is gritty, loose and relatively infertile. Gumbo is fertile, but it is a slippery, sticky clay when wet and rock-hard when dry. The gardener blessed with sandy loam is very fortunate.

It is important to know the composition of the soil. Adding compost and sand to heavy clay soil will loosen the soil and make it friable. At the opposite end of the soil spectrum, sand will not hold moisture well. Adding organic materials (compost or humus) will increase water retention and fertility. It is the “pay for it now or pay for it later” principle. Improving the soil is hard work, but it is important to successfully growing citrus.

If possible, planting in the native soil is best and a lot less work. For planting in clay soils, Galveston County Master Gardener Sam Powers recommends excavating the hole with a digging fork. Using a shovel or spade will form a smooth skin on the walls of the hole that will dry rock hard and create a “clay pot.” If a shovel is used, pierce the vertical sides of the excavation to break or roughen the interior walls of the hole. This will promote better drainage and encourage the roots to penetrate out into the surrounding soil.

There are three main considerations about water and soil moisture that need attention. First, surface drainage; second, the ability of the soil to absorb and percolate water; and third, the level of the water table should be researched. Excess water should drain or percolate from the root zone within 24–36 hours.

Surface drainage is easily addressed by raising the soil level and ditching, but determining soil percolation and the level of the water table requires testing.

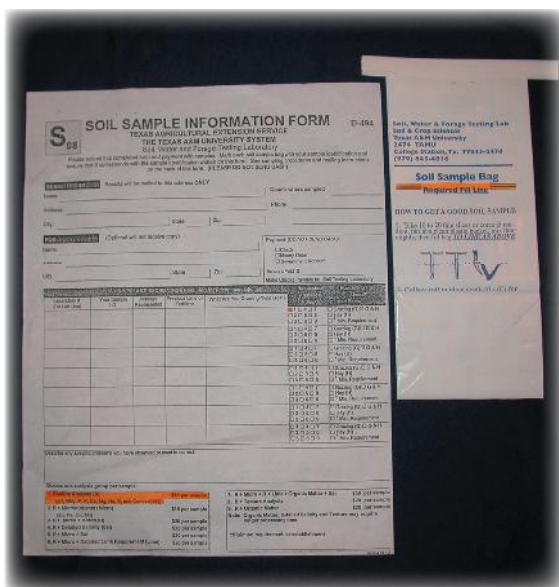
The level of the ground water should be at least 5 feet below the soil surface. To test for this and the percolation of the soil, use a posthole digger or auger to dig a hole 5–6 feet deep. Water will seep in from the surrounding soils. Use a tape measure to determine the level of the ground water in the hole. If the water table is too high, good fill dirt can be added to the surface to raise the ground level. This should cover an area approximately 10 feet in diameter to accommodate the spreading roots as the tree matures.

Soil percolation is a more serious problem because gumbo clay can act as a holding pit or retention pond while sand and sandy loam will perk quickly. To ascertain the ability of the soil to percolate, fill the hole with water. The hole should drain within a day to a day and a half.

A soil test is recommended prior to doing any planting. The sample bag and form for the standard soil fertility test is available through your local office of Texas Cooperative Extension. The instructions for collecting the soil sample are on both the collection bag and the form. The Routine Analysis (option #1) tests for pH (acidity and alkalinity), nitrates (nitrogen), phosphates (phosphorus), potassium, calcium, magnesium, sodium, sulfur and conductivity. In addition to the Routine Analysis, other soil analyses are also available. Enclose the soil sample, completed form, and payment in the bag. Test results will be returned to the address listed on the top of the form.

Send the sample to:

Soil, Water and Forage Testing Lab  
 and a Crop Specialist  
 Texas A&M University  
 345 Heep Center  
 College Station, TX 77843-2474  
 TFW@aggcenter.tamu.edu



Soil Sample Information Form, GCMGA

The Routine Analysis is a reliable source for information in determining the levels of soil nutrients. In Galveston County, the soils are predominately alkaline with pH ranges above neutral (pH 7). A pH range of 6–8.2 will support the growth of citrus.

The most common nutritional supplement is nitrogen. Typically, local soils have a high natural phosphate content that can cause problems with the availability of iron and zinc. Phosphate forms a chemical bond with these two elements that is not readily dissolved by water. By adding additional phosphorus through fertilizers, iron and zinc deficiencies may increase.

Avoid soils that are high in sodium or salts and caliche (limestone.) Salts will burn the roots and caliche is stone hard and very alkaline.

## Site Selection

Select a site in full sun. If possible, a southern exposure of a building will meet the sunlight requirements and give some added protection from the usual two-times-a-winter “blue northers.” Trees should be planted 6–8 feet from buildings, sidewalks and driveways. Septic drain fields should be avoided. A dedicated place in the landscape is preferred, because competition from other trees, shrubs and flowers will interfere with fruit production.

## Planting

Dr. Bill Ethridge of Lumberton, Texas recommends planting citrus trees in January or February, after the last possible freeze. Select a tree approximately 2–4 feet tall with several sturdy side branches. Trim branches that are below 18–24 inches above the ground to allow room for “banking” the tree trunk during the winter.

Remove all the vegetation from an area approximately 6 feet by 6 feet. The root zone of the tree needs to be 12–18 inches above the surrounding ground level. Dig a shallow hole and place the root ball in the center of the depression. (Be sure to leave at least 1 inch of the root ball above ground level, but more height is recommended.) Gently remove at least 1 inch of the potting media from all sides of the root ball to expose roots.

Place native soil around the outside filling in up to approximately half of the root ball. Water in thoroughly and fill in voids. Continue placing soil up the sides and on top of the root ball, sealing the roots from the air. How the tree is planted will determine if the roots make good contact with the surrounding soil and grow out from the base of the tree.

Bonnie Childers states that the roots of container grown trees have been trained to grow in a circle by the confines of the pot. He suggests several methods to encourage the roots to grow outward into the surrounding soil. He advises loosening and unwinding the circular growth habit of the roots established by the pot. He removes most of the commercial potting media and spreads the roots on the ground surface in all directions.



*Citrus growing in full sun, GCMGA*



*Pot bound roots, GCMGA*

Another method to force rooting is to make four vertical cuts equally spaced around the sides of the root ball. New roots will form and grow out ward. Third, if the tree is in the ground, take a sharp shovel and make vertical cuts perpendicular to the tree around the edge of the root ball to force growth of new roots. These steps promote new root growth into the surrounding soil to firmly anchor the tree. Also, more than one tree has been girdled to death by its roots.

For planting citrus trees, Terry Cuclis digs a very shallow hole and allows approximately twelve inches of the root ball above the ground level. He removes at least one inch of the media from all surfaces of the root ball. After placing the root ball in the hole, Terry mounds the native soil up around the exposed roots and gently packs the soil before thoroughly watering the newly planted tree.

After the tree is planted, measure out from the trunk approximately three feet and build an earthen dam around the tree creating a “well.” Fill this with water and allow it to soak into the soil. The well will be utilized when watering the newly planted tree for the next few months before it eventually collapses. Water should be applied to a newly planted tree at least once a week for the first month by rainfall or supplemental watering. As the tree roots become established, the frequency of watering should be determined by using a moisture meter and only add water as needed.

Dr. Bill Ethridge recommends spacing citrus trees approximately 15–20 feet apart, depending on the expected mature size. Close proximity to other trees or buildings will limit the growth and yield as well as encourage insects and diseases. It is harder to prune, harvest and spray for pests in overcrowded conditions.



*Watering System, GCMGA*

## Watering Established Trees

Citrus needs approximately 50 inches of available moisture annually. Thus, a supplemental water source is good insurance for drier years. Typically the top 3 feet of soil holds between 3–7 inches of water creating a reserve of available moisture.

Determining available moisture is critical during the warmer months of April through September. An inexpensive watering gauge can be made using a can approximately 2 inches tall (from pet food or tuna.) Place the can covered with wire mesh in a central location where it is exposed to all the weather elements. Be sure this can is filled with water after a rain or when providing supplemental moisture. When the 1½–2 inches of water in the can evaporates, it is time to apply additional moisture. During cooler months, available moisture can be cut back to approximately 1 inch of water. Water deeply, but moist does not mean soggy wet.



It is important that adequate moisture is available in September and October for trees to “harden off” before the arrival of cold weather. “Hardening off” is a physiological process that helps condition a plant for colder temperatures. Also, trees with adequate soil moisture are less affected by freezing temperatures than those growing in dry conditions. Moist soils hold and conduct heat more efficiently.

Because citrus bark is thin and fragile, Sam Powers stated that sprinkler systems should be placed several feet away from the base of the tree. Hard blasts of water will damage and kill trees. Soaker hoses and drip systems should be planned to supply moisture for the whole root system. Exercise caution to prevent over-watering of trees in greenhouses. Wet soils promote fungal diseases such as gummosis or root rot. Correcting soggy soil conditions will allow a tree to heal.

## Soil Nutrients and Fertilizing

Citrus has medium nutritional needs and does require several elements for growth and fruit production. The air provides carbon, hydrogen and oxygen. Nitrogen, phosphorus and potassium are called macronutrients because they are needed in larger quantities. Calcium, magnesium and sulfur are secondary elements and generally present in sufficient amounts. Many commercial fertilizers contain the micronutrients of copper, zinc, manganese, boron, chlorine and molybdenum. Gardeners need to be aware that excessive boron is toxic to plants.

### Macronutrients

- Nitrogen is vital for growth of all plant parts. It is essential to cell development in growing tips and leaves. It is needed for green chlorophyll in photosynthesis. Low levels of soil nitrogen causes yellowing of lower leaves. Because of heavy plant demands and leaching by water, this is the most common nutritional supplement.
- Phosphorus is essential for cell division and to form healthy roots, flowers and fruit. A deficiency will cause stunted growth, and poor flower and fruit production. Again, exercise caution in applying phosphorus because of the high level of this nutrient in local soils.
- Low levels of potassium or potash will cause stunted growth and yellowing of lower leaves.

### Micronutrients

- Boron is needed for protein synthesis and helps with flower set, fruit yield and quality.
- Calcium is necessary for cell division and plant growth. Calcium’s soil buffering characteristics are important to soil balance and aids with the availability of other nutrients. Low soil calcium levels shows in yellow or pale leaves.
- Too much copper is toxic to roots and leaves, but is necessary for plant growth and health. It increases flavor and sugar content in fruit.
- Iron deficiency appears as chlorosis (yellowing) in the leaves. Symptoms are pale yellow leaves with dark green veins. Cool soil temperatures can cause iron deficiency symptoms, but if it continues, apply



*Nitrogen deficiency, GCMGA*



*Iron deficiency, chlorosis, GCMGA*



*Magnesium deficiency, GCMGA*



*Zinc deficiency, GCMGA*



*2-year-old 'Seto' satsuma at Carbide Park, GCMGA*

iron chelates at the recommended rates.

- Magnesium is an essential element in chlorophyll, and a low level appears as yellowing leaves.
- Sulfur stimulates root development. Uniform yellowing and curling leaves are symptoms of a deficiency.
- Zinc aids in moisture absorption and chlorophyll production.

Newly planted trees can be fertilized when new growth resumes. Scatter the fertilizer granules evenly over the soil surface 1–2 feet past the drip line of the tree. Analyze the soil test that (hopefully) was done prior to planting the tree. If all the soil nutrient levels are within a normal range, the following recommended amounts of a nitrogen-containing fertilizer (17–21% nitrogen) can be used:

First year –  $\frac{1}{8}$  pound

Second year –  $\frac{1}{4}$  pound

Third year –  $\frac{1}{2}$  pound

Fertilizer can be applied in a single February application or split into two or three equal applications spaced throughout the growing season. Broadcasting the fertilizer evenly over the surface of the ground extending approximately a foot past the drip line of the foliage, will provide nutrients to the entire tree. Water the fertilizer into the soil thoroughly.

Terry Cuclis divides the annual amount of fertilizer and makes four applications during the growing season from February through September. In Galveston County’s warmer climate, trees continue active growth later into the fall.

Through years of growing citrus, Dr. Bill Ethridge has formulated a fertilizing program of using 1 pound (approximately 2 cups) of 21-0-0 nitrogen fertilizer for a tree that has been in the ground for 1 year. This is increased by 1 pound each year. Thus, a 12 year old tree needs 12 pounds of fertilizer. He fertilizes in January or February. Dr. Ethridge said, “Avoid fertilizing citrus trees after the end of June. Late fertilization will encourage vigorous growth, delay fruit maturity and decrease the cold hardiness of the tree.”

## Pollination, Maturity and Production

The average citrus tree will start with some fruiting at 3 years. Bonnie Childers and Sam Powers recommend removing all the fruit the first season of production. As the tree matures, fruit production will increase and have a better flavor. A grafted tree will fruit sooner than one grown from seed. The graftwood or scion is taken from mature wood on producing trees. When grafted to the rootstock, this mature wood will bloom and try to set fruit.

Most varieties of citrus will have four to five flushes of new growth each year. Though the spring flush is the most productive, it is possible to bloom and set fruit later in the growing season. Off-season fruit has a very thick peel and is “sheep-nosed” shape. The flavor and juice are usually poor quality. However, it is normal for semi-everbearing varieties such as lemons, limes, kumquats and ‘Calamondin’ oranges to flower and

set fruit year around.

Dr. Bill Ethridge writes, “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 until maturity.” If 3–7% of the flowers set and make mature fruit, it is considered a good crop.

Normally there are three periods of natural thinning or fruit drop. Immediately after bloom as much as 75–80% of the flowers may fall. Approximately two weeks later, the pea to marble sized fruit will self-thin. Again in May, the golf ball-sized fruit will fall. It is not unusual for fruit drop to continue until harvest. If there are still too many fruits on the branches after the May drop, manual thinning will insure larger, better quality fruit. Fruit should be thinned to approximately one every 3–4 inches on the limb.

The end of summer usually prompts a growth spurt. This can be the most active growing period as the temperatures cool with adequate available moisture.

Usually the fruits mature in the fall. Flavor and juice quality generally improves through the harvest season. Flavors and juice quality will not improve after the fruit is harvested. In many varieties, the fruit will hold on the tree and increase in size throughout the fall. The exceptions to this are some satsuma oranges and ‘Bloomsweet’ grapefruit which will dry and lose flavor if left on the tree too long.

### Container Grown Citrus

The smaller varieties such as ‘Calamondin’ orange, lime, kumquat, lemon and limequat will grow in containers for several years. With proper care and abundant sunlight, they will even produce fruit. Any shading will reduce the plant size and fruit production.

When selecting a container, the main considerations are a size that will be large enough to permit growth, good drainage and portability to move indoors during cold weather. Because the roots of container grown plants are less cold-hardy than those planted in the natural warmth of the ground, they need more cold protection. Because most lemons and limes are not cold-hardy, winter protection is necessary. Clay or terra cotta pots require more water because of evaporation through the porous container.

Allow the top inch of the potting medium to become dry, and then water very slowly to allow for absorption and drainage. Reduce the amount of water in the winter when growth slows. Use a water-soluble fertilizer and periodically leach excess fertilizer and salts by slowly running water through the container for several minutes.

Problems that typically occur are leaf drop caused by rapid changes in the amount of sunlight. A gradual acclimation to the indoor conditions will minimize this. Leaf drop and twig dieback will occur when the top gets too large to be sustained by the root system. In February, it is acceptable to prune off one-third of the top growth. This will also help to induce more branching.



*Off-season sheep-nosed fruit, GCMGA*



*Fruit drop after heavy fruit-set, GCMGA*



*Container grown citrus, TAMU*

## Pruning

Use clean, sharp crosscut pruning and lopping shears. Disinfect all equipment by spraying or dipping with a 10% bleach solution (one part bleach mixed with nine parts water).

The preferred time to prune is after the last frost and after harvest is completed. Dead wood and sprouts below the graft can be removed at any time. Cut out any branches that cross and rub other limbs. Water sprouts or branches that grow vertically from the scaffold limbs are usually weak and sap the nutrient flow to the growing tips and fruit. Removing water sprouts will help keep the interior of the tree open to sunlight. Sam Powers and Terry Cuclis are very careful with pruning because the new crop of fruit is produced on two-year-old wood.

## Weeds

Excessive weeds will retard growth and development by competing for available moisture, nutrients and sunlight. They also provide shelter for insects and weaken the tree making it vulnerable to the invasion of diseases.

Hand pulling under the foliage is the safest method. If spraying with an herbicide, do not wet the foliage or bark.

Use of pre-emergence herbicides under and near citrus is not recommended due to the possibility of herbicide damage. If a “weed & feed” fertilizer (combination of a herbicide and fertilizer) is used on surrounding lawn, use care to avoid applying “weed & feed” fertilizer too close to citrus. Always read and follow the manufacturer’s directions.

Three to four inches of organic mulch will deter weeds. To discourage foot rot disease, keep organic mulches 6–8 inches away from the trunk. Mulches also help with the retention of soil moisture and keep the roots cooler. As trees mature and the foliage canopy becomes dense, less sunlight will deter weed growth.

Galveston County Master Gardener Herman Auer states that maturing fruit that touches mulch will not rot and is less susceptible to pest damage.

Sam Powers grows St. Augustinegrass under his trees to shade the roots and prevent the soil from cracking during droughts.

## Freeze Protection

Protection during cold temperatures is vital to growing citrus north of the Lower Rio Grande Valley. The following factors will temper these worries.

- A strong, healthy specimen that has been properly fertilized will have more tolerance for cold temperatures.
- Keeping the trees and ground adequately moist will help during



*Fruit on mulch, GCMGA*

moderately cold temperatures.

- The case can be made for keeping clean, firm ground underneath the tree. This will absorb more heat and radiate it back up into the tree. But for occasional very cold temperatures, a back-up plan for additional protection is needed.
- A continual spray of water will provide some protection. Start the water at approximately 28° F in calm weather or at 30° F in windy conditions. Continue the water until the ambient temperatures are high enough to melt ice in the shade.
- A temporary shelter of rebar or pipes covered with bed sheets (two or more), blankets or quilts can be constructed. Drape over the top and down the sides to trap any radiant heat from the ground. Tie the cover to stakes to keep it in place. Clear or semi-clear plastic only will not offer enough insulation and will cause over heating if left in place under a full sun.
- Galveston County Master Gardeners provide winter protection with temporary covers and moderately priced greenhouses. Terry Cuclis constructs a framework covered with plastic, but under the plastic he uses Christmas tree lights to provide a heat source. Also, he wraps the trunks of vulnerable trees with foam pipe insulation that is secured in place with duct tape. Sam Powers and “Chuck” Myers construct greenhouses of either wood or pipe supports covered with ultraviolet light rated plastic sheeting or clear polycarbonate panels. The plastic and polycarbonate panels are removed during warm months to prevent overheating.
- Banking the tree trunk with soil is the best option in areas where temperatures normally can go to 15° F or lower. The first 18–24 inches of the grafted tree trunk must be protected. Prior to banking, spray the trunk with an insecticide to prevent an invasion of insects and a fungicide to protect against diseases. After the wood is dry, mound clean river sand mixed with coarse mulch or leaves around the tree trunk. Maintain the banked soil and fill any gaps



*Freeze protection, GCMGA*



*Summer greenhouse, GCMGA*



*Winter greenhouse, GCMGA*



*Re-grafted citrus tree, GCMGA*

that appear around the trunk.

In the Beaumont, Lumberton, and Kountz area of Texas, Bonnie Childers and Dr. Bill Ethridge use “banking” to protect their trees. At Thanksgiving they place a cylinder made from half of a 55-gallon plastic drum. This is open on both ends and slit on one side to allow placement around the base of trees. This is filled with a mixture of river sand and oak leaves. In March, the cylinder is carefully removed to avoid bark damage.

## Repairing Freeze Damage

If freezing temperatures cause damage, do not rush to prune too quickly. Damaged citrus wood will bleed easily, so wait to remove limbs until they are completely dry. Even though a flush of growth in March is common, additional damage can become apparent later. Watch for the distinctive zone or irregular ridge of bark tissue that marks the edge of dieback where the dead tissue shrinks and live bark continues to grow and swell. To minimize excessive bleeding, prune just above the live wood. Wound dressing is not necessary nor will it speed up the healing process.

In the case of dieback on banked trees, expect to have several shoots develop and form new scaffold limbs. If the grafted top is killed, the rootstock will sprout and can be re-grafted. Consider this as an opportunity to graft a newer, better variety.




*After freeze regrowth, GCMGA*



## CHAPTER 4

# *Diseases*

**B**ecause there have been so many diseases attacking citrus the last few years, it is vital to buy only certified and tagged disease-free trees from reputable nurseries. Gardeners are asked to keep an eye open for diseases since they can decimate the citrus trees in an entire region. The most common disease for the Upper Gulf Coast of Texas is sooty mold (shown on this page on leaves) which is marked with a .



Texas certified disease free tree tag, GCMGA



Raised, corky lesions of citrus canker, TAMU



Foot rot/gummosis on tree, GCMGA



Gummosis fungus on fruit, GCMGA

**Citrus Canker** reoccurred in 1995 in Miami/Dade and the Tampa Bay areas of Florida brought in on infected fruit or seedlings. This bacterium, *Xanthomonas campestris* pathovar *citri*, attacks all species of Rutaceae, such as grapefruits, oranges, lemons, limes and related citrus. The symptoms are circular lesions with a raised edge, a sunken, corky center and occasionally a surrounding yellow halo of chlorotic tissue. The definitive laboratory test is microscopic observation of masses of rod-shaped bacteria streaming from a sliced section of a lesion.

The disease is spread by wind driven rains, higher temperatures, over-head irrigation and contaminated equipment. Symptoms are most common on an early summer growth flush. There is no treatment, only containment and safe disposal of infected trees. Recent testing concluded that all citrus within 1900 feet of an infected tree must be removed and destroyed. Presently, citrus canker is not present in Texas. In Florida the following counties are affected: Miami/Dade, Broward, Palm Beach, Monroe and Polk.

**Citrus Greening** recently appeared in the United States. An Asian insect, the citrus psyllid, was found in 1998 in the southeastern Florida. The insect transmits the bacterium that attacks the vascular system of the plant. Symptoms of infection are stunted growth, misshapen fruit, bitter taste and eventually the death of the tree. It has severely impacted citrus in Asia and Southern Europe. In China, it is known as “Yellow Dragon Disease.”

**Cotton Root Rot** (caused by *Phymatotrichum omnivorum*) is a common fungus found in soils throughout the state. It causes rapid death but the leaves do not drop or defoliate. Young trees are more vulnerable. Sour orange rootstock is more tolerant to this fungus.

**Exocortis** is a viral disease affecting the rootstock varieties trifoliolate orange, Trifoliolate hybrids and Rangpur limes. It causes bark-shelling where new bark forms under the diseased tissue causing the old bark to shed from the tree. This can be visible from the soil line to the graft union. The tree loses vigor and eventually dies.

**Foot Rot or Brown Rot Gummosis** (caused by *Phytophthora* spp.) is a fungal pathogen that is indigenous to the soil. The symptoms are dark, water soaked areas on the lower trunk, oozing gum and the bark peeling in vertical strips. During prolonged wet conditions, the root structures are more susceptible to the ravages of the fungus. The tree will lose vigor, and foliage will become sparse with yellow veins. In a young tree, it will lose the leaves but possibly hold the fruit. Lesions eventually girdle the tree trunk causing death. Infections can be seen in all parts of the tree, roots, trunk, branches, leaves blossoms and fruit. Prevention is the best option. On older trees, avoid wounds to the trunk and monitor soil moisture to prevent overly wet conditions for extended lengths of time. A mature tree will heal if excess soil moisture is controlled.

**Greasy Spot fungus** (caused by *Mycosphaerella horii*) first appears as small yellow spots on the foliage and possibly on fruit. As the disease progresses, the spots become raised, dark brown and exhibit the characteristic greasy appearance. On grapefruit, the spots enlarge and grow together to cause conditions known as Greasy Rind Blotch and Pink



**Pitting.** The combination of extended periods of high humidity, high temperatures and possibly a Rust Mite infestation increases the damage to the foliage and fruit of affected trees. Control with a neutral copper or oil-based spray. Also, remove and dispose of the infected leaves and fruit to prevent additional infections.

**Melanose fungus** (caused by *Diaporthe citri* / *Phomopsis citri*) appears most often on young leaves, twigs and fruit and is more common on grapefruit. Leaf symptoms are small, round, dark sunken spots with a yellow halo. As the disease progresses, the spots become raised and corky, hence, the name “Sandpaper” melanose. Advanced infections cause leaf drop. Young twigs exhibit the same symptoms and eventual twig dieback. On the fruit, the raised, corky tissue causes the surface to have a rough texture.


“Mudcake” melanose is the name given to the rough surface as it spreads, cracking in irregular patterns. Heavy rains or dew will cause streaks on the surface of the fruit as the spores are washed down from the infected areas. Melanose appears to be worse in seasons following colder winters. Springs with long, rainy cycles and high humidity set up the optimum conditions for the growth and spread of the spores. Application of a fungicide after the petals fall and before the fruit is one-half inch in diameter is an effective control.

**Mesophyll Collapse** is not a disease though the symptoms are similar. Translucent spots appear on the leaves that progress to a light green then brown as the cells die. It appears with high temperatures and hot, dry winds. Damaged roots, mite infestations, and excessive moisture loss could be contributing factors.

**Psorosis or “Scaly Bark”** is a major viral disease affecting older trees. It is spread through infected budwood and some seeds. It is a problem on sweet orange, grapefruit and tangerines.

**Rio Grande Gummosis** is characterized by gum oozing from blisters on the trunk. Wood beneath the infection is pink to orange in color. Contributing factors can be freeze damage, high water tables and salt accumulation in the soil. The fungus is opportunistic in weak trees and is infectious.

**Scab** (caused by *Elsinoe fawcetti*) is a fungal disease that is most common on lemons, sour orange rootstocks and occasionally on grapefruit. It appears as a translucent leaf spot that grows into masses of corky tissue. The leaves will distort and twist eventually affecting the entire branch. Control with a fungicide.

 **Sooty Mold** is not a true disease because the several fungi associated with it do not feed on the tissues of citrus trees. Rather, the fungi feed on rich honeydew excreted by insects such as aphids, brown soft scale and whiteflies. Soot mold is a very common problem for all citrus varieties.

The amount of sooty mold is directly proportional to the number of honeydew excreting insects present. A heavy sooty mold coating on the fruit can result in fruit downgrading and economic loss to the grower. Heavy leaf coating can retard growth by interfering with photosynthesis



*Melanose fungus on a leaf, GCMGA*



*Sooty mold on a leaf, GCMGA*



*Sooty mold on fruit, GCMGA*

and other physiological functions of the leaf. Light fruit set and reduced yields often result.

Control measures are directed at insects which secrete honeydew, thus, preventing the development of sooty mold fungi.

The soil test report will tell you the level of nitrogen, phosphorus, potassium, calcium, and magnesium available to your garden plants. It will also indicate the pH (acidity or alkalinity) of your garden soil. For the most part, this is all you need to know to properly fertilize your garden soil, and insure a bountiful harvest.

An adequate soil test, properly done and properly interpreted, will go a long way toward insuring a bountiful harvest from this spring's garden.


**Tristeza** is a viral disease not currently present in Texas, but it is found in Florida and Louisiana. Sour orange and lime rootstocks are very susceptible. The symptoms are similar to root injury: slowing growth, sparse foliage, twig dieback and tree death. A key to diagnosis is the honeycomb appearance of tissue under the bark. It is recommended that trees purchased from out-of-state sources come from certified Tristeza free nurseries.

**Xyloporosis virus** causes wood pitting, bark-scaling and oozing gum. Sour orange is resistant, thus this is not considered a problem in Texas orchards.



## CHAPTER 5

# *Insects & Mites*

**T**he primary insect problems for the Upper Texas Gulf Coast of Texas are citrus blackflies, citrus whiteflies, leaf-footed bugs, and citrus leafminers (shown on this page on young leaves). The most common mite for the Upper Gulf Coast of Texas is the citrus rust mite. “Pests” most common to this area are marked with a .



Citrus Blackfly, GCMGA




Citrus rust mite damage on fruit, GCMGA




Citrus blackfly and whitefly commonly occur on the same leaf, GCMGA

**Aphid** . . . These small, soft-bodied sucking insects cause leaf cupping and curling. Aphids excrete a sweet, syrupy liquid (honeydew) that supports the growth of black sooty mold on the leaves and fruit. Control can be as simple as a blast of water from a hose nozzle, a spray of soapy water (1–2 teaspoons of non-detergent dishwashing liquid in a quart of water), or spray with summer weight horticulture oil. Also, ‘Butterfly Weed’ is a trap crop because aphids prefer it over other food sources.

 **Citrus Blackfly** (*Aleurocanthus woglumi*) . . . The juvenile form is a dark black, but because of wing coloration, the adult appears slate blue. The characteristic spiral pattern of the eggs is distinctive. It is a major cause of black sooty mold and can be treated with summer weight horticultural oil spray.

**Citrus Mealybug** (*Planococcus citri*) . . . The most noticeable characteristics are the cottony egg mass near the fruit stems and the segmented bodies with lateral waxy white filaments on the adult forms. Usually, they are found on the bottom and between fruit. All stages of the insect suck the plant juices from new growth and cause black sooty mold. Summer weight horticultural oil can be beneficial for control.

**Citrus Red Mite** (*Panonychus citri*) . . . This insect prefers hot, dry weather and causes damage very similar to the Texas Citrus Mite. Large populations can cause “firing” of leaves or sudden leaf death and even dieback of twigs. They feed primarily on new growth so populations explode in the spring and fall. These insects are more of a problem to grapefruit than oranges.

 **Citrus Rust Mite** (*Phyllocoptruta oleivora*) . . . Mites are difficult to see with the naked eye. Leaves turning a dull green and going limp, is usually the first evidence of feeding activity on both the foliage and fruit. The cellular damage to the rind will cause the fruit to “bronze” or “buckskin” becoming a dull, rusty-brown color. Though they avoid areas affected by morning dew and direct sunlight, the Citrus Rust mite thrives in warm, humid conditions. Populations appear to explode because new generations appear every 7–10 days. Massive infestations will cause trees to drop leaves and loose vigor. Light populations usually do not affect the quality of the fruit. In fact, moderate infestations result in sweeter fruit. Though the peak season is April through October, they do over winter on foliage and bark.

**Citrus Whitefly** (*Dialeurodes citri*) . . . Because of very short life cycles and low rates of reproduction this insect is a rare problem on new growth.

**Cloudy-winged Whitefly** (*Dialeurodes citrifolii*) . . . The most distinctive differences from the citrus whitefly are a dark shaded area on the wing and the habit of holding the wings open and flat. They are usually found on young foliage.

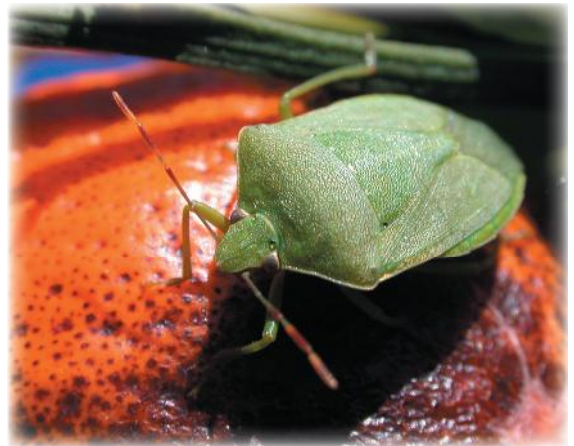
**False Spider Mites** (*Brevipalpus phoenicis* and *B. californicus*) . . . Populations start increasing in June and continue to reproduce through the summer months. They cause a spotty necrosis by injecting toxins into the rind cells.

★ **Western Leaf-footed Bug** (*Leptoglossus zonatus*), **Eastern Leaf-footed Bug** (*Leptoglossus phyllopus*), and **Green Stink Bug** (*Acrosternum hilare*) . . . These insects are major pests on citrus. They feed on the ripening fruit, causing premature color break and drop. Stink bugs puncture the flowers, leaves and fruit to suck the juices. This forms a hard callous in fruit flesh, discoloration and rotting. Adults over winter in weeds or debris and emerge in the spring to lay 300–500 eggs on the underside of leaves. The nymphs emerge in approximately 1 week and develop to adult stage in 5 weeks. Generally, there are two complete generations each year. Handpicking, good cultural practices and chemical treatments as the last resort are the best control options.



*Leaf-footed stink bug, GCMGA*

★ **Citrus Leafminer** (*Phyllocnistis citrella*) . . . This insect pest forms hard, dry trails through the inner leaf tissue. Remove and dispose of the affected leaves. Do not compost infected leaves. Bonnie Childers recommends spraying the new spring growth with summer weight horticultural oil. The adult leafminer moth will not lay eggs on an oily surface. The benefits of Neem oil spray are not proven.



*Green stink bug, GCMGA*

**Mexican Fruit Fly** (*Anastrepha ludena*) . . . Approximately the size of a house fly, the yellowish-brown female lays her eggs on the fruit. The larvae or maggots burrow in and eat the pulp. Reproduction is rapid because of the 20–30 day life cycle. This insect is a problem in Mexico.

**Orangedog Caterpillar** (*Papilio cresphontes*) . . . The common name ‘orangedog’ is because the head of the larvae of the giant swallowtail butterfly resembles a dog’s head. The caterpillar retains the wet, brown-and-white mottled body pattern until it forms the chrysalis case. It feeds on the foliage during the caterpillar stage and usually hides in the leaves to pupate. It is not a major problem to fruit production.



*Leafminer damage on a leaf, GCMGA*

**Plant Hopper** (*Metcalfa pruinosa*) . . . The grayish white adult resembles a citrus mealybug, but will hop when disturbed. There is one generation each season and the eggs over winter until the next spring. They feed on twigs and prefer grapefruit.

**Puss Caterpillar** (*Megalopyge opercularis*) . . . Occasionally classified as a stinging asp, this tan to gray furry insect larvae can deliver a painful sting when touched.



*Orange dog caterpillar, GCMGA*



*Adult stage of orange dog caterpillar (giant swallowtail butterfly), GCMGA*



Red spider mites, GCMGA




Whitefly, GCMGA

**Spider Mite** (*Tetranychus urticae*) . . . The adults build fine webbing on the underside of leaves and around new growth. They suck the plant juice causing a stippled, silvery appearance. Populations can explode during hot, dry weather. A strong spray of water or soapy water will dislodge the mites. Spray with a miticide if there is excessive leaf drop.

To determine an infestation without a magnifying glass, hold a sheet of white paper under suspect foliage. Tap the stem and look for “dots” or specks that move!

**Texas Citrus Mite** (*Eutetranychus banksi*) . . . This insect thrives in heat and low humidity. Shrinkage of the outer layer in affected leaves causes a gray coloration.

Additional stress from high winds, heat or a lack of soil moisture can cause leaf drop. Fruit is usually not damaged.

 **Whitefly** (family – Aleyodidae) . . . They feed on the underside of leaves and will cause black sooty mold. This weakens the plants and also transmits viruses. The rapid rate of reproduction means many generations within a growing season. A summer weight horticultural oil spray can help with the control of this abundant insect.

To control whiteflies, Bonnie Childers recommends spraying a non-detergent dishwashing soapy mixture once a day every third day for three intervals.

**Woolly Whitefly** (*Aleurothrixus floccosus*) . . . The pupae are covered with woolly, waxy filaments while the adults are a yellowish-white color. The female is usually found encircled by eggs.

## Scale Insects

Scale insects appear in two forms; armored and soft-bodied. Armored scales can be detected as hard spots on the stems or peel that can be removed by scrapping. Adults of these species are immobile. The armor is composed of body secretions mixed with cast off skins. Soft-bodied scales continue to move throughout their life cycle and are a major cause of black sooty mold.

### Armored Scale

**California Red Scale** (*Aonidiella aurantii*) . . . Adult females are circular and have a reddish armored cover with a dark center. With favorable weather conditions there are several generations in a season because the life cycle is approximately 60 days. They pierce and suck fluids from the leaves, twigs and fruit. Heavy infestations will cause the leaves to yellow, decrease the vigor of mature trees and kill tree seedlings.

**Chaff Scale** (*Parlatoria pergandii*) . . . This species is the major armored scale pest in Texas. The elongated armor is brown to gray in color. The fruit damage results in green spots. Preferred locations are the mid rib on leaves or depressions on the fruit.

**Florida Red Scale** (*Chrysomphalus aonidi*) . . . The dark brown to black armor with a light brown raised nipple identifies this species. Warm

weather promotes rapid life cycles of 6 weeks, thus there can be 4–6 generations in a growing season. They are found on fruit and leaves. Large populations will cause yellowing of the leaves, defoliation and decrease fruit production.

**Glover Scale** (*Lepidosaphes gloveri*) . . . This species is usually found with Purple Scale. The elongated armor is straight. Because of a low rate of reproduction, they are not considered a minor pest. Often parasitic wasps are found with this species.

**Purple Scale** (*Lepidosaphes beckii*) . . . The obvious comma shape and the brown/purple color of the armor are characteristic of this species. Rapid reproduction rates result in three or more generations in a growing season. Heavy infestations cause chlorotic spots, defoliation and fruit drop.

### Soft-bodied Scales

**Barnacle Scale** (*Ceroplastes cirripediformis*) . . . The distinctive pattern of the six peripheral scales topped by one scale in a dirty white color identifies this species. It is a minor insect problem.

**Cottony Cushion Scale** (*Icerya purchasi*) . . . The red plate located on the fluted egg sacs is the most easily recognized life form. Adults will form whitish masses near the fruit stem and on the mid rib of the leaves. Large populations affect the vitality of the tree and reduce fruit production. Spray with a summer oil if it is problematic on the bark or fruit stems.

**Soft Brown Scale** (*Coccus hesperidum*) . . . This species has an oval shape body of brown to light yellow coloration. The high reproduction rate and populations will cause black sooty mold to form in the excreted honeydew. This can reduce photosynthesis in the leaves and affect the vigor of the tree.

## Nematodes

Nematodes are various species of round worms living in the soil. Most are benign, but some are major pests. They invade the root system and feed on the plant tissue. The breach through the protective root covering allows other harmful bacteria and viruses to infect the tree. The infiltration of the vascular system diminishes the flow of nutrients to the tree causing a decline in vigor and possible death. However, they are primarily a problem of the Lower Rio Grande Valley.

**Burrowing Nematode** (*Radopholus similis*) . . . In soils infected with this nematode, trees exhibit the symptoms of widespread disease and spreading decline.

**Citrus Nematode** (*Tylenchulus semipenetrans*) . . . Soils in old orchard locations are the most commonly reported sites of infestation. The best control is choosing a tolerant rootstock. Currently, Swingle citrumelo rootstock is reported to have the most tolerance.

**Lesion Nematode** (*Pratylenchus spp.*) . . . Widespread wilting, lack of vigor, limited fruit production and poor response to watering and fertilizers are primary signs of this nematode.



*Cottony Cushion Scale, GCMGA*

## Other Pests

**Birds** cause damage to the developing and mature fruit. Young fruit will develop black scars when pecked by grackles. The birds will penetrate the peel to get to the pulp of mature fruit.

**Rabbits** destroy young trees in areas adjacent to woody or grassy areas. They chew and strip the young, tender bark. Wrapping the trunk will control this problem.

**Rodents** will chew and strip the bark from young trees, and girdle limbs causing dieback. At harvest time, they will feast on the mature fruits. Remove their habitat or use a bait product to control the population.

**Snails and other worms** can attack the mature fruit for a free meal. Remove all damaged fruit and under severe infestations use of a snail/slug bait product may be warranted.



*Bird Damage to fruit, GCMGA*



*Snail eating to the inside of orange, GCMGA*



*Catepillar eating an orange, GCMGA*



*Rodent damage, GCMGA*



## Beneficial Fungi, Insects & Mites

***Aschersonia* species and *Aegerita* species** of fungi will attack juvenile whiteflies on citrus. *Aschersonia* forms pink and reddish pustules on the back of the leaves. It also can be yellow, orange-red or brown. Mites feed on the fungus and spread it.

**The Braconid female wasp** lays her eggs on caterpillars and worms to provide food for the developing larvae.

**Beneficial predatory mites** in the family Phytoseiidae and fungi such as *Hirrutella tompsonii* do attack mites. However, during heavy infestations, predators cannot do it alone.

**Green Lacewings** (*Chrysoperla carnea*) are commonly found on foliage infested with aphids, blackflies and whiteflies. The characteristic stalked-eggs are placed by the females in a spiral near a food supply. The lacewing larvae or “aphid lion” feed on not only aphids, but also on spider mites, leafhoppers, thrips, moth eggs and other small larvae. The adults prefer the nectar, pollen and honeydew excreted by aphids, flies and scales.



*Beneficial fungus, Aschersonia, GCMGA*



*Green lacewing, GCMGA*



*Braconid wasps hatching, GCMGA*



*Green lacewing eggs, GCMGA*



*Leaf-footed bug damage on fruit, GCMGA*



*Split fruit from excessive soil moisture fluctuations, GCMGA*

## Physiological Problems

**Periodic fruit drop** is normal. The tree will self-thin three times during the growing season.

**Creases in the peel** are the result of cultural conditions including improper irrigation and fertilization.

**Fruit splitting** is caused by extended periods of low soil moisture conditions followed by excessive water.

**Dry, pithy sections in the fruit** are caused by drought conditions. Additional water will eliminate this problem.

## Cultural Problems

**Spotting and damage** to lower leaves and fruit can be the result of over-spray or drift of herbicides. Prevention through careful application of these products is essential.

**The symptoms of wind scar** are silvery to tan colored blemishes on the peel and on young trees, also cupping and dead edges on mature leaves. A windbreak can provide the needed protection to prevent this condition.



*Healing tree trunk, GCMGA*



*Sunscald on fruit, GCMGA*

Though not serious, **sun scald** will cause rough, irregular, tar-like spots on the leaf underside and leathery rind spots on the fruit.

**A build-up of salts in the soil** will cause leaf tip burn, yellowing and leaf edge dying with the eventual defoliation of the tree. Leach the salts from the soil by thorough watering. This is more common in container grown plants.

**Foot rot or Gummosis disease** can occur because of overwatering. It can cause yellowing first in the veins then the whole leaf. Correcting the problem of excessive soil moisture will allow the tree to heal and return to production.





## CHAPTER 6

# *Propagation*

**A**s with most gardening activities, considerable satisfaction may be gained from growing your own citrus trees. Many home citrus enthusiasts propagate their own citrus, or even change varieties by grafting one or more varieties of citrus on an existing tree.

Eighty-five percent of citrus seeds will come true to the parent tree. Only the pollinated flowers mature into fruit with seeds. Non-pollinated flowers will continue to produce fruit but without seeds.

Given practice — and a scoop of patience — home citrus growers can master the art of propagating their own citrus.



Citrus cutting, GCMGA



Rooted cuttings, GCMGA



Twin grafted tree, GCMGA



Trifoliate root stock, GCMGA

To keep citrus seeds viable, they must be kept moist. Wash the seeds in clean water to remove pulp and sweet juices. Place the seeds in a water-proof container, moisten and seal to prevent evaporation. Store the container in a dark, cool (40° F) environment. Ginger and Sam Powers wash and dry citrus seeds before spreading onto an absorbent paper towel. They fold the towel to cover the seeds and moisten with distilled water. Ions (minerals) in local tap water can affect the germination of the seeds. The towels and seeds are placed into a ziplock bag, sealed and placed in a warm location. Seeds will sprout within a couple of weeks.

Citrus will root from a cutting. Select a stem that is 9 months–1 year-old. Remove all or most of the leaves to prevent excessive transpiration and water loss. Trim the cutting to approximately 6 inches in length, dust the end with rooting hormone and carefully insert it into a sterile growing mix. Cover the pot and cutting with a plastic bag to maintain a moist, humid environment. Place this in an area of bright, indirect light. Rooting takes 6 weeks–2 months. Slowly acclimate the rooted cutting to the environment. Newly rooted cuttings must be transplanted carefully to not disturb the roots. For additional information, please refer to the 2...4...6...8...*Propagate*, Bulletin No. GC-217 available through the Galveston County Extension Office.

Look for the red tag on trees that are certified by the Texas Department of Agriculture as disease-free rootstock. Many diseases affect all parts of the citrus plant if infection is present. To insure disease-free plants, all purchases should be made through certified nurseries or growers.

Most citrus sold by commercial nurseries is grafted. Different rootstocks are used to achieve specific goals. Bonnie Childers firmly states that for citrus trees, what is in the ground is just as important as what is grafted to the top. He recommends Trifoliata or Flying Dragon as the preferred rootstocks for the Upper Gulf Coast of Texas. ‘Swingle’ citrumelo, and ‘Troyer’ and ‘Carrizo’ citrange do not go into dormancy. Thus trees on these rootstocks are not as cold-tolerant. Also these rootstocks produce very large trees.

## Specific Rootstock

**Sour orange** grows wild on the Upper Gulf Coast of Texas and will produce a small, very sour fruit with no flavor. This is the preferred rootstock for the Rio Grande Valley and South Texas orchards. It is slightly resistant to foot rot disease and is extremely thorny.

- **Trifoliata or Trifoliate orange** is more cold-hardy than sour orange and produces smaller trees. It is also slightly resistant to foot rot disease. It is easily recognized by leaflets that grow in a pattern of three. Trifoliate orange is well adapted to heavy, poorly-drained soils and is drought-tolerant once established. It is considered by most citrus growers to be the best rootstock for the Upper Gulf Coast of Texas.
- **Flying Dragon** rootstock is a dwarfing form of Trifoliate orange. It has all the same qualities as Trifoliate orange except that citrus grafted onto it averages only 6–8 feet in height. It is the preferred

rootstock for citrus in a small garden, container or for planting in high density. It is very cold-hardy. The zigzag growth habit of the stems is very distinctive.

**‘Swingle’ Citrumelo** is a vigorous rootstock that is widely used in Louisiana. Citrus grafted onto ‘Swingle’ rootstock produces high quality fruit suitable for eating out of hand. It is resistant to Foot Rot disease.

**Troyer and Carrizo citrange** is resistant to foot rot and Trestiza viruses.

## Budwood or Scion

Budwood, also known as scion, is a cutting from the mature wood of the desired variety.

- The budwood is taken from the previous growth flush not a new flush of leaves. The stems are round rather than angular.
- Newer tree varieties are virus free. Older selections can be infected by exocortis, xyloporosis and other viruses.
- Prior to collecting budwood, sterilize clippers and shears with a 10% bleach solution. Sterilize tools before moving to another tree to minimize transferring any diseases.
- Trim the budwood down to 6–8 inches in length, place into a dry plastic zip lock bag and store in a refrigerator. By using these steps, budwood will be good for 6–8 weeks.

Bonnie Childers recommends going back to the original parent tree for budwood if possible. This ensures the new trees will be true to the desired variety.

Galveston County Master Gardener Herman Auer utilizes several methods of grafting the budwood to the rootstock. He grafts in February when the new growth flush begins and the bark is slipping. His recommendations are to use the cleft or wedge graft for smaller rootstocks of less than 1/2 inch in diameter. T-budding and the Inverted T are used on rootstocks that are approximately 3/8–1/2 inch in diameter. He is very careful to select buds from a branch that has matured into a rounded limb.

Bonnie Childers cautions that the first two buds from the base of the new flush of foliage are “blind buds” and will not grow.

Growing citrus on the Upper Gulf Coast of Texas is not nearly as challenging as many other fruits. Make informed choices for tree varieties and use good cultural techniques, and there will be the “food of the gods” — *Ambrosia from Your Backyard*.



*Flying Dragon rootstock, GCMGA*





# *Creating the Ambrosia Orchard*

The Upper Gulf Coast of Texas is a unique, subtropical region characterized by hot humid summers and mild winters. The history of the Powers family's commercial venture with orange orchards tells a story of extreme agricultural trial and error. Most of the citrus industry moved 400 miles south, to the South Valley of Texas, after the hard freezes of the 1920s and 1930s decimated the burgeoning Gulf Coast citrus orchards of that era.

Hard lessons from later harsh winters served to encourage horticulturalists like Bonnie Childers to experiment with and develop new cold-hardy cultivars, forever searching for the perfect citrus tree for the Upper Gulf Coast.

The new Research and Demonstration Garden at Carbide Park, La Marque, Texas, under development by the Galveston County Extension Office and the Galveston County Master Gardeners, includes the beginnings of an exemplary citrus Ambrosia Orchard. Based on extensive planning done in 2004, the ground preparation and tree planting was started in March 2005.

Under the leadership of our pioneering Master Gardener Terry Cuclis, 12 different citrus varieties were chosen and planted. These 12 varieties are now thriving in the quirky climate and imperfect soil of Galveston County. Many more varieties will join them in the coming years.

The orchard has been established to achieve the goals of finding the best varieties for our region, demonstrating the best methods for growing citrus, and creating a living classroom for experimentation and teaching.

This orchard is a "living library", where knowledge will be accumulated, documented, and stored for future generations. Our local experts guided the tree selection to include today's well known cultivars. In the future, they will choose new varieties that show promise of hardiness, disease resistance, prolific fruit production, and excellent quality fruit. The public is invited to visit this prototype teaching garden and orchard, and watch its development. It is located in Carbide Park, 4102 Main Street (FM 519), La Marque, Texas 77568.

These test gardens and orchards exemplify the philosophy of our beloved County Extension Agent and County Master Gardener Program Coordinator, Dr. William M. Johnson: "Knowledge that is not shared is knowledge lost." Under Dr. Johnson's inspiration, leadership, and guidance, the following trees were lovingly planted in March, 2005:

- 'Improved Meyer' lemon
- 'Meiwa' kumquat
- 'Atlas Honey' mandarin
- 'Cara Cara' orange
- 'Marrs' orange
- 'Republic of Texas' orange
- 'Chandler' pummelo
- 'Miho' satsuma
- 'Okitsu' satsuma
- 'Satsuma Satsuma'
- 'Seto' satsuma

May they inspire you to create your own Ambrosia Orchard.



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