# HARDY CITRUS

by Tom McClendon

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# INTRODUCTION

Citrus culture is usually associated with Florida, south Texas, and other areas where commercial production is centered. Many people outside these areas attempt to grow the familiar oranges, grapefruits, lemons and limes. While readily available, commercial citrus freeze and discourage further attempts.

In the southeastern UnitedStates, various kinds of citrus trees can be grown successfully in home landscapes well north of where they are usually seen. Though less familiar, less readily available, and often less palatable than commercial types, there are many citrus species and hybrids which can be grown outdoors in the Deep South, particularly the northern portions of Florida, the coastal regions of North Carolina, South Carolina, Georgia and Texas, and the lower regions of Alabama, Mississippi, and Louisiana. Some are reliable even well inland of these areas. The hardier citrus have attractive evergreen foliage, fragrant white flowers, and colorful fruit which can be used in various ways.

Woodlanders, Inc., aninternationalrareplant mail-order nursery in Aiken, South Carolina, began propagating and offering the hardier citrus after noting the occasional citrus tree in various southern locations and further observations at the Florida Citrus Arboretum at Winter Haven in early 1990. In late December of 1989 a severe and prolonged freeze devastated commercial groves in the area, and many trees in the arboretum's large collection were killed or severely damaged. Still, there were other trees which received little or no damage. Propagules from these hardier types have now been growing outdoors in Aiken in Zone 8 for a number of years with minimal winter injury. In November of 2003, fruits of 16 different types of hardy citrus fruiting outdoors in Aiken were exhibited at the first annual Southeastern Citrus Exposition in Columbia, South Carolina.

You will find information in this publication on many types of hardy citrus including names, descriptions, and culture, plus characteristics and uses of the fruit.

Bob McCartney

Woodlanders, Inc.
Aiken, South Carolina

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Hardy Citrus for the Southeast

By Tom McClendon

Design and layout: Jeff Stevens

Additional material on Chang Shou kumquat by Bob Snyder

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See page 34 for a full listing of photographic credits.

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# Citrus North of Florida

Along with palms, bananas and bold flowering plants, citrus help define the subtropics. With deeply-hued evergreen leaves, fragrant blossoms, and ornamental and usually edible fruit, few other plants are as handsome and useful. The beauty and utility of these plants have helped them spread around the world. Originating in Asia, citrus were slowly dispersed to Europe during the Roman Empire and the Crusades. Christopher Columbus carried citrus on his second voyage to the New World, and later explorers spread citrus throughout the Americas and beyond. It's not much of an exaggeration to say that citrus carry within their genes the very history of the world.

This history is no less storied in the southeastern Untied States than elsewhere. Here, citrus have been grown outside of Florida for more than 300 years. The first English settlers in South Carolina carried with them citrus from Barbados and other Caribbean islands, reasoning that Charleston's climate would be milder than that of Spain, which lay farther north. In Georgia, General James Oglethorpe ordered that oranges be planted in Savannah and at Fort Frederica on St. Simon's Island, and these trees thrived for more than 100 years. At one time or another, nearly every coastal Southern state has had commercial plantings of citrus, and some, including Alabama and Louisiana, still do.

It should come as no surprise that commercial plantings of citrus have been devastated periodically by cold in the Southeast, just as they have been in Florida. It's also true that few areas are suitable for commercial plantings outside of the Sunshine State, southern Louisiana, and Texas. However, that does not mean that all areas of the Southeast are unsuitable for commercial plantings, and we certainly do not want to discourage gardeners from planting citrus in the home garden—far from it. Now more than ever, gardeners should include citrus in their land- scapes. In the last decade there has been a flurry of interest in hardy cit- rus. New varieties from Asia have begun to enter the market, and citrus breeders in the United States have begun to create fascinating and hardy cultivars. In addition, there is a renewed interest in old cultivars devel- oped by the United States Department of Agriculture and elsewhere more than a hundred years ago.

By choosing the right variety and giving some thought to the needs of the plant in your climate, gardeners in much of the Southeast can grow some type of citrus. Not all will produce commercial-quality fruit, but all will be beautiful plants with ornamental and culinary uses—not to mention a great conversation piece.

### The Citrus Family Tree

Citrus have been cultivated for so long that the origins of many types are unknown. As a result, there are several different ways of classifying citrus. Some researchers use the Swingle method, which recognizes fewer types as species. The Japanese researcher Tanaka recognized nearly every cultivar as a species, including those that have since been demonstrated to be clear hy- brids (such as Yuzu, which Tanaka described as *Citrus junos* but which researchers demonstrated to be a hybrid between Ichang papeda and a mandarin). It has been suggested that all of the mainstream commercial citrus types are intermediates between two basic types, the pummelo and the mandarin.

For our purposes, we recognize the following as valid species or stable horticultural forms:

| | |
|---|---|
| Trifoliate Orange | *Poncirus trifoliata* |
| Ichang Papeda | *Citrus ichangensis* |
| Kumquat | *Fortunella* spp. |
| Sour Orange | *Citrus aurantium* |
| Mandarin | *Citrus reticulata* |
| Sweet Orange | *Citrus sinensis* |
| Grapefruit | *Citrus paradisi* |
| Lemon | *Citrus limon* |
| Pummelo | *Citrus maxima* |
| Lime | *Citrus aurantifolia* |

# Our Southeastern Climate

This publication is designed to guide gardeners living in the southeastern United States who wish to grow citrus outdoors. We make no claim to understand the state of Florida, and if you live in that state, please consult a good guide for your area. We do hope to give basic guidelines for people living in our region, including the states of Virginia, North Carolina, South Carolina, Georgia, Alabama, Tennessee and Mississippi. It is not intended to tell people what to do or that they can't grow citrus. After all, the Southeastern Palm Society was founded specifically to test the limits of hardy subtropical plants, and we encourage members to do just that.

Despite a reluctance to proclaim that a specific cultivar or species will or will not survive in a given climate, some basic observations need to be made. Generally speaking, if you live in an area that has winter minimums that commonly drop below 10°F, you will be able to grow only the hardiest varieties of citrus, and some of these will have to be protected in extreme weather. Many of these will be deciduous, or nearly so, in colder winters. Immediately southward are areas that commonly stay above 10°F but will drop lower every five years or so.

The environs around Raleigh, North Carolina southwest to Atlanta, Georgia and Birmingham, Alabama fall into this category. These areas can grow the hardier varieties such as *Poncirus trifoliata* hybrids and *Citrus ichangensis* hybrids with little trouble most years. (See the description of these later.) During cold winters there may be some twig and limb damage, and extremely cold winters could see temperatures that kill even the hardier types to the ground.

Still farther south are the true Zone 8 areas, ranging from about Norfolk, Virginia, south to Fayetteville, North Carolina, and west to Columbia, South Carolina, and Augusta, Georgia, and to Montgomery, Alabama and Jackson, Mississippi. These areas commonly do not fall below 15°F but can see lower temperatures on occasion. Here the hardier varieties can be grown with ease and some of the hardier commercial types such as kumquats and Satsuma mandarin can succeed if given protection.

The warmest areas in the Southeast are along the coast, and from a line east of Charleston, South Carolina south to Claxton and Waycross, Georgia, early ripening oranges, grapefruits, and certain lemons can succeed admirably.

One mistake people sometimes make is in choosing varieties that are unsuited for their climate. It's a familiar scenario: someone picks up an "orange tree" at a roadside stand in Florida and plants it in the ground at their home in suburban Atlanta. Then at the end of winter, all that remain are frozen leaves and dead twigs. "Citrus won't grow here," becomes the official pronouncement.

The fact is that there are several factors that need to be considered before deciding that a particular species or cultivar is suitable. First, the cultivar needs to be generally hardy for your area. There's not much sense in trying key limes in Atlanta, unless you want to grow citrus in a container. Second, the source of the plant needs to be reliable; you want to know that what's planted in the ground is what you think you are growing. Third, the tree needs to be generally healthy and well fertilized before winter sets in. Fourth, decide if possible whether or not to grow a tree on its own roots or to get a tree that has been grafted on a rootstock. Some varieties cannot survive on their own roots and must be grafted. Lastly, be prepared to take basic steps to protect any marginally-hardy trees in winter.

No matter where you live, choose varieties that ripen fruit as early as possible. The better cultivars for our area will ripen fruit before December 1. All parts of the Southeast are susceptible to extreme freeze events, and it's no fun trying to harvest five bushels of fruit as the temperature plummets. (After all, you will need that time for protecting any experimental palms!) For example, even though Valencia orange trees grow well in coastal Georgia, they are not recommended because Valencia oranges do not ripen until mid-March, and a hard freeze any time before then will destroy the entire crop. Better to pick earlier sweet oranges and buy Valencias at the grocery store.

# Sun, Soil, Water

Citrus are subtropical or warm-temperate plants adapted to growing in sandy alluvial soils along floodplains. Soils can be infertile sands, but citrus grow best in medium-fertile, well-drained soils of neutral to slightly-acid pH. A few species, particularly kumquats, prefer highly fertile volcanic soils. Most citrus species in the wild function as understory plants, and William Bartram in the 1770s reported that feral groves of citrus in colonial Florida grew well underneath the native magnolias, live oaks, and *Sabal palmetto*. Rainfall in the areas of Asia to which citrus is native is plentiful and evenly distributed.

To a degree, many parts of the Southeast greatly resemble the native habitat of citrus. Soils along floodplains in the Southeast tend to be sandy, though fertility can be low. Rainfall patterns are similar to Southeast Asia, but distribution in the Southeast can be very sporadic, and each growing season will have dry spells. In some years the terms "growing season" and "drought" can seem downright synonymous. Moreover, inland parts of the Southeast tend to have rainy winters and drier summers, which can stress subtropical plants during both seasons. Periodic droughts are the norm.

Like many plants, citrus prefer well-drained, loamy soil, tolerating light sands with ample fertilizer. Citrus can succeed in heavier clays as long as they are well drained, thought most citrus will do better if grafted on trifoliate orange (*Poncirus trifoliata*) when planted in heavy red clay. No citrus can stand wet feet and will rapidly decline under persistently wet conditions.

Citrus need to be well watered at all times. While they can be somewhat drought tolerant depending upon variety, all will do much better if given even moisture. Fruit set and retention will be much higher with adequate water. Citrus naturally will shed a number of fruit a month or so after blooming. Called the "June Drop," it is a normal process and nothing to be alarmed about, but if the trees are in a stressed state they can drop all the fruit—not a good thing. Even so, deep watering will amend this. Along certain parts of the Atlantic coast, winter is the drier season and special attention will need to be given to citrus during a time when most other plants are dormant.

### Drought Stress

One of the interesting habits of citrus is that they will often bloom heavily after a period of drought stress. This inclination was used by France's Louis XIV, who was particularly fond of the fragrance of orange blossoms. His gardeners induced orange trees into continuous bloom by drought-stressing them almost to the point of death and then watering them, which caused the trees to burst into bloom. In the same manner, large juvenile citrus trees can sometimes be tricked into blooming for the first time. It has been observed that maturing seedling citrus often will bloom for the first time after a rainy period immediately following a summer dry spell.

*I returned to my camp, where I had left my fish broiling, and my kettle of rice stewing; and having with me oil, pepper, and salt, and excellent oranges hanging in abundance over my head... sat down and regaled myself cheerfully.*

—William Bartram, in *Travels* (1775), describing the area around Lake George, Florida

# Fertilization and Pest Control

It goes without sayingthathealthy trees are easier to maintain than sickly, disease-ridden ones. A balanced fertilizer that contains micronutrients will go a long way toward this end. Citrus are a little tricky to fertilize. They appear to be more sensitive to deficiencies, and if nutrients are low when they enter a flush of growth, the new growth will immediately show the deficiencies. Correcting them is a challenge after that, so it's best to apply a consistent level of fertilizer during the growing season to promote strong, healthy growth. Slow-release fertilizers with a ratio of 8-8-8 are excellent, particularly if the fertilizer contains micronutrients such as iron, magnesium, and manganese. There are commercial "Citrus Special" fertilizers available, and these work very well on sandy soils. Before applying any fertilizer, it will be in your best in-

terest to have a soil analysis done to determine where your soil is deficient. (And if you live in the Southeast, your soil will be deficient in something.) Again, slow and steady is the key to fertilizing citrus.

In the Southeast north of Florida, it is best to begin fertilizing just before growth initiates in spring. This will range from late February in the extreme Lower South and as late as the beginning of April farther north. In all areas it is best to fertilize no later than July 1. The intent is to promote healthy, vigorous growth early on and then allow the tree to slow down as much as possible before fall. Very often, late summer can bring strong thunderstorms and tropical systems after a dry spell, and the sudden availability of water can trigger late flushes of growth in citrus, particularly if there is abundant fertilizer available as well. This late growth is particularly prone to freeze damage.

When compared to other fruit trees such as peaches and apples, citrus are practically carefree. They will tolerate a surprising amount of neglect and still fruit reliably, and the amount of maintenance required is low compared to other fruit trees. However, keeping citrus in optimal health will require some vigilance, because citrus are prone to a host of pests. Scale insects, spider mites, aphids, Asian leaf miners and whiteflies all attack citrus. Fortunately, most are easy to control. The most reliable tools, besides using good cultural practices, are horticultural and dormant oils and insecticidal soaps. The important thing to remember is never to use a systemic pesticide on any plant that you intend to eat.

Scales are white, brown or orange stationary insects that suck plant juices. They are most common on the undersides of leaves. Scale can be controlled with horticultural oil and a non-systemic insecticide. Oil sprays are most effective when the scale is in the crawling stage in spring and early summer. Once the insects become adults, they become immobile and form a hard shell, making them hard to kill without resorting to extreme measures. Usually two applications are necessary to bring them under control.

Spider mites are tiny red or orange arachnids that also feed on plant juices. Once a citrus plant has an infestation, the population of spider mites can quickly explode. The effect of spider mites usually is evidenced by yellow or orange speckles on the leaves and a severe infestation can discolor the entire leaf and severely stress the plant. The best prevention of spider mites is

Leaf miners leave a squiggly, shiny trail and deform the leaf.

White flies live and breed on the underside of citrus leaves.

Sooty mold slides off a citrus leaf after an application of horticultural oil.

adequate water, as the pests usually attack heat- and drought-stressed plants. You can try "syringing" water at low volume and high pressure to knock spider mites off the tree; this preserves the species that prey on spider mites. They can be controlled with horticultural oil and insecticidal soaps. Dormant oil must be used in fall and winter to kill the eggs. If you use a type of pesticide, make sure the label reads "miticide". Because they are arachnids, spider mites are not affected by some insecticides.

Aphids are another type of sucking insect. They are attracted to young, tender shoots and can severely deform emerging growth in the spring. They are usually associated with ants (as are scale insects), which "farm" aphids and feed on the sticky secretions called honeydew. Controlling ants would go a long way toward controlling aphids, but because controlling ants in the Southeast is about as easy as herding cats, your best bet is going to be controlling aphids. The most effective method is also the most environmentally friendly: insects such as ladybugs find aphids particularly toothsome and are the best method of control.

Asian leaf miner is a recent introduction to the United States, but it has spread quickly. This pest is a small caterpillar about 3 millimeters long that feeds on the undersides of young citrus leaves. The biting parts leave a squiggly, shiny trail as the caterpillar moves along the leaf. (The trail is snakelike, apparently to avoid the spider mites which are also sucking on the leaves.) This activity can severely deform new leaves, but otherwise does not seem to affect fruiting, and once leaves are mature they are immune to attack. Again, horticultural oil applied to the undersides of the leaves can control the Asian leaf miner to some degree. However, outbreaks seem to be sporadic; in some years there are few miners at all, whereas in other years infestations are high.

Whiteflies are a particularly noisome pest because the damage they cause shows up long after they have gone. Mature whiteflies live and breed on the undersides of citrus leaves, and the leaves of many other species, and feed on the juices of the leaves. If you shake a branch and a cloud of whiteflies tumble out, the plant is badly infested. Unless there is a very heavy infestation, whiteflies often don't cause too much damage to the trees, but the honeydew that they produce causes sooty mold to form on leaves. When heavy enough, the mold can completely cover leaves, twigs, and fruit. Two applications of horticultural oil about 10 days apart in late fall will remove the mold from the tree.

Provado, a new product from Bayer, is very effective at controlling white fly, leaf miner and aphids, and appears to be relatively safe to use. Two caveats: Provado must be applied every seven to ten days on new growth for maximum efficacy, and it is expensive.

The good news is that while these pests all plague citrus at one time or another, rarely do all attack at once. It seems a wet year will be rank with whitefly, followed by next year's dry summer and spider mite infestation. (It's good to look at the bright side of these things.) While there are a number of diseases and pests that do attack citrus, as a class they are of much easier cultivation than most other fruit trees. Most of the time a little preventive maintenance will go a long way.

# Pruning Citrus

Hard freezes can damage citrus trees. How much damage any particular freeze causes not only depends on the severity and duration of low temperatures, but also on actions taken afterward. While it may be tempting to lop off frozen and apparently dead wood immediately after a freeze, the best time to prune cold-damaged citrus plants is after the first flush of spring growth. Though dead or damaged wood is unsightly, pruning too early causes even more damage and may retard new growth. Researchers in Florida have found that trees pruned after the first flush of growth recovered more quickly and grew more vigorously than those pruned immediately after a freeze.

Many types of citrus send out rapidly growing water sprouts in mid-summer after heavy rains. Water sprouts are particularly common on seed-grown trees. While water sprouts are the bane of most fruit growers, they often will mature normally on citrus and seem to present no problems. Unless these limbs cross other limbs and prevent otherwise normal growth, it's probably best to leave them. Juvenile citrus must grow to a certain point before they begin blooming, and excessive pruning of young limbs can keep them in a

# The Sex Life of Citrus

### Citrus Hybridization

Early hybridizers in the citrus industry included Dr. Walter T. Swingle, responsible for developing the original trifoliate hybrids and for classifying and clarifying so many other citrus types and species. A huge debt in the field of hybridization is also owed to Dr. John Brown of Texas. Dr. Brown is a doctor by profession but a citrus breeder by avocation, and it was through his efforts that many of the interesting hybrids presented here were developed. Among his contributions are the Clem-Yuz 3-3, ten-degree kumquat, CiClem #10, SanCitChang, Yuzuquat, and a host of others.

*He gave us this eternal spring,*
*Which here enamels everything,*
*And sends the fowls to us in care,*
*On daily visits through the air;*
*He hangs in shades the orange bright,*
*Like golden lamps in a green night.*

—From *Bermudas*, by English poet Andrew Marvell (1621-1678)

Citrus are very easy to grow from seed, and in some cases this may be the only way to obtain a variety you are looking for. It's possible simply to take the seeds from a grocery store citrus, push them into the soil of a houseplant, and watch them come up. As a class, citrus have low heat requirements for germination, though bottom heat will hasten this process and help the seeds germinate more evenly.

But how do you know that the seedling that springs up is true to type with the original? In a word, you don't. All citrus can, at least theoretically, produce hybrids, and even flowers that are self-pollinated can vary somewhat from the original. But there are some unique features about the sex life of citrus that make this less of a guessing game than you might imagine.

Most flowering plants reproduce sexually. That is, a flower is pollinated and the resulting seed will produce a plant that is a combination of the two parents. A seed from most plants will contain a single embryo that will develop into a plant, and as a result, most plants are called *monoembryonic*.

Citrus are different. Many types will fertilize regularly, but instead of a seed with just one embryo, citrus seeds often have two: one produced by normal sexual reproduction and a second that is produced wholly from genetic material of the mother plant. The asexually produced embryo will dominate and the resulting plant will be genetically identical to the mother. In a sense, the plant has cloned itself, though the resulting seedling reverts to a juvenile type complete with heavy thorns and a fairly long period before flowering. Citrus that reproduce in this manner are called *polyembryonic*, and most citrus fall into this category.

However, there are some notable exceptions. Many true species of citrus are monoembryonic, including the Ichang Papeda (*Citrus ichangensis*), kumquats (*Fortunella japonica* in particular) and most pummelos (*Citrus maxima*). Several known and suspected hybrids are also monoembryonic, including the Clementine tangerine (*Citrus reticulata*), Persian lime (*Citrus aurantifolia*), and the temple orange (really a tangor, a cross between an orange and a mandarin).

Most common citrus such as oranges, grapefruit, lemons and most mandarins are polyembryonic and will come true to type. Because most citrus have this trait, hybridization can be very difficult to achieve. In the late 19th Century, when the first attempts at controlled hybridization were attempted by the United States Department of Agriculture in Florida, Walter T. Swingle reported that more than 1,100 sweet orange seeds pollinated with trifoliate orange pollen were required to produce the first citranges, and seven of these came from a single fruit. The good news is that polyembryony helps stabilize varieties, which allows seeds to be passed around with little chance of spreading diseases such as viruses. This unique characteristic allows amateurs to grow citrus from seed, something you can't do with, say, apples.

If you decide to grow citrus from seed, it's worth knowing that seed-

ling citrus can be very thorny, especially as juveniles. Many types lose this thorny tendency as they grow and mature, and flowering branches will have fewer thorns. Also, all seedling citrus will take some time before blooming. How much time is required depends upon the type; grapefruit can take up to 10 years before blooming, whereas procimequats (a cross between a Eustis limequat and the wild Hong Kong kumquat) can bloom in less than a year from seed. As a general rule, citrus require four to seven years before blooming.

# Grafted Trees Versus Own Roots

Many citrus varieties are remarkably compatible with each other, and there is a wealth of rootstocks to choose from for grafting. Sweet orange can be grafted onto sour orange, kumquats onto trifoliate orange, and so on. However, all of them have their problems. Some are too dwarfing, others are disease-prone, and still others have delayed failure of the graft. There is an old saying among Florida citrus growers that you choose a rootstock based upon how you want your tree to die.

Having said this, an important decision to make is what rootstock to choose, or whether you should grow the citrus on its own roots. Our advice is to grow cit- rus on their own roots where feasible simply because if the tree is knocked back to the roots by bitter cold but survives, it will return true to type the next year. Most trifoliate hybrids are used as rootstocks and tolerate diverse soils very well, so they are a logical choice to grow on their own roots.

Other species and cultivars cannot grow on our soils on their own roots and must have a rootstock. Kumquats in particular do not grow well on their own roots in most Southeastern soils. And some cultivars, most notably hybrids that involve *Citrus ichangensis* as a parent, seem to flower and fruit more reliably on a rootstock. In these cases, we unequivocally recommend the trifoliate orange (*Poncirus trifoliata*). Trifoliate rootstock is extremely cold hardy and dwarfs the tree while ensuring exceptional fruit quality.

# About Cold Hardiness

A question which everyone has but is the hardest to answer is: “How hardy is *my* plant?” With citrus, this can be even more difficult to answer than for other plants. Although citrus, like all plants, have definite limits to how much cold they can take, where that line is drawn depends upon not only the lowest temperature reached but also the duration of the freeze, the size and health of the plant, how well watered the plant is preceding the freeze, microclimates, and what mechanical protection is used in the landscape.

The hardier types of citrus (*Poncirus trifoliata* hybrids and *Citrus ichangensis* hybrids) are surprisingly hardy during short freezes during which the temperature does not fall below 15°F. Hardy citrus will be essentially unaffected by these types of freezes, which are the most frequent types of freezes throughout the Southeast. The real killers are those freezes that bring temperatures which can plummet to 10°F or lower and remain below freezing for one or more days. During these freezes, most of the hardier types will defoliate and some may experience minor twig damage. The hardiest will bounce back readily in the spring.

One of the easiest methods of cold protection for citrus is to choose a variety that is well adapted for your area. It’s always easier to care for a plant that is thriving to begin with. The good news about citrus and the Southeast is that for most areas, there will be at least one type of citrus that you can grow. Edibility, however, may be a challenge, but our advice for most of the Southeast inland from the immediate coast is to grow citrus for their ornamental and culinary qualities and to buy dessert-quality fruit at the grocery store or local farmer’s market.

A statement such as “hardy to 10 degrees” is helpful, but only tells part of the story. It’s a fact that no two freeze events are alike. Not only do slight variations in temperature make a difference, but also conditions before and during a freeze can dramatically affect the damage to citrus. A daytime high of 45°F followed by a quick dip to 10°F, with a freeze duration of less than 24 hours, will damage citrus far less than a daytime high of 70°F followed by a lengthy freeze of 48 or 72 hours. So weather conditions before a freeze can determine success or failure.

### USDA Hardiness Zones

The United States Department of Agriculture has assigned hardiness zones based on average annual minimum temperatures. Here are the zones used in the southeastern United States and northern Florida.

| USDA Zone | Temperature °Fahrenheit | °Celsius |
|---|---|---|
| 6a | -10 to -5 | -23 to -21 |
| 6b | -5 to 0 | -21 to -18 |
| 7a | 0 to 5 | -18 to -15 |
| 7b | 5 to 10 | -15 to -12 |
| 8a | 10 to 15 | -12 to -9 |
| 8b | 15 to 20 | -9 to -7 |
| 9a | 20 to 25 | -7 to -4 |

Fahrenheit to Celsius for Freezing Temperatures

| °F | °C |
|---|---|
| -10 to -9 | -23 |
| -8 to -7 | -22 |
| -6 to -5 | -21 |
| -4 to -3 | -20 |
| -2 | -19 |
| -1 to 0 | -18 |
| 1 to 2 | -17 |
| 3 to 4 | -16 |
| 5 | -15 |
| 6 to 7 | -14 |
| 8 to 9 | -13 |
| 10 to 11 | -12 |
| 12 to 13 | -11 |
| 14 | -10 |
| 15 to 16 | -9 |
| 17 to 18 | -8 |
| 19 to 20 | -7 |
| 21 to 22 | -6 |
| 23 | -5 |
| 24 to 25 | -4 |
| 26 to 27 | -3 |
| 28 to 29 | -2 |
| 30 to 31 | -1 |
| 32 | 0 |

For example, the terrible freeze of 1989 dropped temperatures to about 17°F in the Orlando, Florida area and wreaked havoc on citrus, killing some trees outright and knocking others to the ground. The same temperature in Aiken, South Carolina will scarcely cause citrus to drop a leaf. Why? In part, it is because different cultivars are grown, but even the same types of citrus will be damaged far less by cold in areas where the freeze is preceded by cooler air and soil temperatures. Excessively warm temperatures before a freeze can induce citrus to break dormancy and make them vulnerable to temperatures that would leave them otherwise unaffected.

Of course, all plants have a threshold temperature, below which they will die. Citrus are no exception. But before that limit is reached, it is best to keep things cool and quiet during the winter.

Aside from extreme cold, wind is perhaps the greatest enemy of citrus in winter. Cold accompanied by high winds will rapidly desiccate citrus leaves and will result in leaf drop after the weather warms. While this is not a total disaster for the hardiest hybrids, which possess the ability to bloom after defoliation, part of the charm of citrus is the fact that they are evergreen. A bare citrus tree is no more attractive than a maple or oak in winter.

It's best to keep citrus well watered in the winter months. This is not usually a problem in areas away from the immediate coast, where winter cold fronts are typically preceded by plenty of rain during the winter. Along the Southeastern coasts, however, cold fronts typically weaken and winter is often the dry season. This situation becomes more pronounced the farther south you go.

If you want a citrus cultivar that is marginal for your area, you will need to consider planting it in a favorable microclimate and count on protecting it during extreme cold spells. The easiest type of protection is heavy mulch around the base and perhaps a mound of earth to protect the main trunk, or in the case of grafted trees, the bud union. If you decide to do this, be sure to remove the soil after the weather warms.

Frost cloth draped over the whole of a tree and touching the ground can add up to 6°F to the inside. A very effective low-tech approach is to place 50-gallon plastic barrels full of water around the tree and then cover the whole thing with frost cloth.

Some people have decided that it's worth the trouble to build a PVC frame around the citrus and cover the whole thing with plastic, heating the temporary greenhouse with light bulbs or portable heaters. Most people who do this are interested in overwintering the fruit rather than merely protecting the tree. Two important considerations here are to remember that the plastic should not come into contact with the leaves, and that the enclosure should be vented on warm days. Even on a relatively cool day when temperatures outside are in the 50s, the inside of a greenhouse can soar into the 80s or even higher. Exposure to high temperatures such as these can stress the tree or at the very least induce it to break dormancy, making it even less hardy than otherwise.

# How Hardy Are They?

Citrus hardiness is harder to predict than palm hardiness. Factors affecting hardiness are minimum temperature, freeze duration, conditions before the freeze, soil moisture and wind protection. Citrus are usually hardier if they're healthy, well watered and fully dormant when cold arrives. Temperatures listed here and with the descriptions of each variety are approximate, and indicate where fully dormant plants begin to experience significant damage.

| Page | Hardy to about -15°F (-26°C) | |
|---|---|---|
| 16 | Trifoliate Orange | *Poncirus trifoliata* |

| Page | Hardy to about 0°F (-18°C) | |
|---|---|---|
| 23 | Ichang Papeda | *Citrus ichangensis* |

| Page | Hardy to about 5°F (-15°C) | |
|---|---|---|
| 20–21 | Citrandarins | *Poncirus trifoliata* x *Citrus reticulata* |
| 17 | Citranges | *Poncirus trifoliata* x *Citrus sinensis* |
| 20 | Citrumelos | *Poncirus trifoliata* x *Citrus paradisi* |
| 30 | Nansho Daidai Sour Orange | *Citrus taiwanica* |

| Page | Hardy to about 10°F (-12°C) | |
|---|---|---|
| 32 | Bloomsweet (Kinkoji) Grapefruit | *Citrus paradisi* hybrid |
| 21 | Citrangequats | (*Poncirus trifoliata* x *Citrus sinensis*) x *Fortunella spp.* |
| 22 | Complex *Poncirus trifoliata* hybrids: Glen Citrangedin, US 119, SanCitChang #10, Roundleaf | |
| 23 | ClemYuz hybrids | *Citrus ichangensis* x *Citrus reticulata* |
| 23 | Ichang Lemon | *Citrus ichangensis* x *Citrus maxima* |
| 23 | Yuzu | *Citrus ichangensis* x *Citrus reticulata* |
| 24 | Yuzuquat | (*Citrus ichangensis* x *Citrus reticulata)* x *Fortunella margarita* |
| 24 | Yuzvange | *Citrus ichangensis hybrid* |
| 25 | Tendegree Kumquat | *Fortunella japonica* hybrid |
| 26 | Nippon Orangequat | *Fortunella crassifolia* x *Citrus reticulata* |
| 27 | Changsha Mandarin | *Citrus reticulata* |
| 28 | Juanita Tangerine | *Citrus reticulata* |

| Page | Hardy to the low teens (-11°C) | |
|---|---|---|
| 28 | Keraji Mandarin | *Citrus reticulata* |
| 29 | Seville Sour Orange | *Citrus aurantium* |
| 30 | Smooth Flat Seville Sour Orange | *Citrus aurantium* |

| Page | Hardy to about 15°F (-9°C) | |
|---|---|---|
| 25–26 | Kumquats | *Fortunella spp.* |
| 26 | Procimequat | *Fortunella hindsii* x Eustace limequat |
| 27 | Sunquat and Marmaladequat | *Fortunella crassifolia* hybrids |
| 27 | Calamandarin | *Citrus reticulata* hybrid |
| 29–30 | Sour Oranges | *Citrus aurantium* |
| 32 | Sanbokan Grapefruit | *Citrus paradisi* hybrid or *Citrus sulcata* |

# It's a Matter of Taste

At the end of each citrus cultivar's description in the following section, a few comments are made about its relative merits. To give some consistency of comparison, the author has evaluated the flavor of each cultivar according to the chart below.

Each fruit was judged according to its most logical use, ranging from "dessert," meaning edible out-of-hand, to "only good for throwing at people." To give an example, if a fruit such as key lime were evaluated, it should not be judged as a sweet fruit but rather as a sour fruit. It would be classed as sour lime, no off-flavors, excellent quality, and useful for cooking and juice. Someone attempting to eat it as a dessert fruit, however, probably would be disappointed at best.

Taste is highly subjective. If you are someone who demands the very sweetest of fruit, then many of the cultivars listed in this publication will be unsatisfactory. The author enjoys many different flavors and doesn't mind even a few off-notes, drinks coffee without sugar, eats muscadines—skin, seeds and all—and holds Goody's powder under the tongue when a headache strikes.

The reader is encouraged to use the chart below to complete his or her own analysis.

VARIETY _____

CHECK A DESCRIPTOR

TYPE ☐ sweet ☐ semi-sweet ☐ sour ☐ bitter

TASTES LIKE ☐ orange ☐ tangerine ☐ grapefruit ☐ kumquat ☐ lemon ☐ lime

OFF FLAVORS ☐ none ☐ insignificant ☐ moderate ☐ strong ☐ persistent

QUALITY ☐ excellent ☐ good ☐ fair ☐ poor

USES ☐ dessert ☐ juices ☐ cooking ☐ preserves ☐ target practice

# Hardiest of All: The Trifoliate Orange and Its Hybrids

**Trifoliate Orange** (*Poncirus trifoliata*) is the hardiest true citrus, easily withstanding temperatures well below 0°F and thriving as far north as Cape Cod, Massachusetts and as far inland as St. Louis, Missouri. Unlike any other citrus, it has a marked winter dormancy and resumes growth in the spring only after days are greater in length than nights. It is native to river floodplains in China, and as a result can tolerate a variety of soil types and conditions as long as the soil is well drained. The trifoliate orange has widely naturalized in many areas of the Southeast, mainly in old pastures and along the banks of streams and rivers.

*Poncirus trifoliata* is an upright tree with a strong central leader and branches that grow at narrow angles to the trunk. With spines as long as 4 inches, it's one of the thorniest cultivated plants, and can be used as a formidable security hedge. Still, *Poncirus trifoliata* and its variants, 'English Large', named for its larger blossoms, and the contorted cultivar 'Flying Dragon', make handsome ornamentals.

The trifoliate orange differs from other citrus in several important ways. It is deciduous, has three leaflets (technically called trifoliolate), and produces bud scales that protect the next year's growth and flowers. The fruit are yellow to orange and have a typical citrus hesperidium shape, meaning that they're divided into sections. The fruit are edible, meaning that you won't die from eating them, but they are exceedingly bitter and gummy.
*Flavor:* Bitter lemon, persistent off-flavors, poor quality.
*Uses:* Hybridization, target practice, ornamental.

**Dragon Lime** (*Poncirus trifoliata* hybrid) is a cultivar that arose as a chance seedling in a planting of Flying Dragon trifoliate orange seeds. It is remarkable in a number of respects, the foremost being that trifoliate orange was the seed parent. The trifoliate orange as a rule is highly polyembryonic and is usually used only for pollen. The pollen donor of the dragon lime is unknown, but probably was a sweet orange. This cultivar strongly resembles a standard Flying Dragon, with twisted stems and curved thorns, though the thorns are not as heavy as the trifoliate parent. Fruit are quite large for a trifoliate hybrid, almost as large as a sweet orange, and reportedly have a sweet limeade-like taste. There is some trifoliate odor but almost no trifoliate aftertaste. If the fruit lives up to initial reports, it may turn out to be the best trifoliate hybrid yet developed. It also suggests that there are monoembryonic forms of the trifoliate orange out there, and that hybrids using the trifoliate orange as

## Trifoliate Orange Hybrids

After the great freezes of the late 1890s in Florida, hybridizers from the United States Department of Agriculture bred the trifoliate orange with sweet and sour oranges, grapefruit, mandarins and kumquats to produce a bewildering array of hybrids. In most of its hybrids, *Poncirus trifoliata* tends to dominate, with its progeny usually having trifoliate leaves that are more or less evergreen, and small, sour fruit that is dominated by the bitter taste of the trifoliate parent. There are a few exceptions, but the rule holds. The silver lining is that trifoliate hybrids are the hardiest of the lot.

There are hundreds of hybrids between the trifoliate orange and just about any other known citrus. The few listed here are representative rather than inclusive, and discussion does not include some of the rarer forms.

## More Trifoliate Orange Hybrids

Citradia (*Poncirus trifoliata* x *Citrus aurantium*)
Citraldin (*Poncirus trifoliata* x Calamondin)
Citremon (*Poncirus trifoliata* x Meyer Lemon)
Tai-Tri (*Poncirus trifoliata* x *Citrus taiwanica*)

## Citranges

Citranges are crosses between the trifoliate orange and the sweet orange (*Poncirus trifoliata* x *Citrus sinen- sis*). None of the early hybrids pro- duced a commercial-quality fruit, and subsequent crosses made in the 20th Century have produced a diz- zying array of hybrids, almost all with bad-tasting fruit. Apparently, *Poncirus trifoliata* is a true species, while most cultivated citrus are combinations of several forms. True species tend to dominate hybrids, and the bad flavors and leaf characteristics of the trifoliate orange tend to persist.

If none of the trifoliate hybrids produce a dessert-quality fruit, all make handsome ornamental trees with attractive fruit that can be used for a variety of culinary purposes. Cooking and dilution of the juice tends to eliminate the undesirable flavors of the trifoliate orange parent. One cultivar worth seeking out is CiTemple Edible, a cross with a Temple orange that reportedly has almost no trifoliate off flavors. To our knowledge it is not currently being grown anywhere in the Southeast. Citranges are hardy to around 5°F.

### More Citrange Varieties

#1416
C-32
C-35
CiTemple Edible
Cunningham
Cup Leaf
Sanford
Savage
Uvalde
Willits
Yuma
Trifoliate x Spanish sweet orange
Hamelin x Flying Dragon

the seed parent may result in better-tasting hybrids. Hardiness of this cultivar is unknown, but should be comparable to other trifoliate hybrids.

*Flavor:* Sweet lime, no or very little off-flavor, good quality.

*Uses:* Dessert fruit.

**Morton Citrange** is one of the best of the early hybrids developed more than a century ago by the United States Department of Agriculture. It makes a large, upright tree that looks much like a sweet orange. Morton citrange leaves are quite large and tend to be more evergreen than some of the other citranges, making the tree very ornamental. It also has the largest fruit of any of the citranges, fully the size of an orange and just as brightly colored, with a thick peel that adheres tightly to the flesh. The fruit does have a fair amount of sweet, but like almost all of the trifoliate hybrids still has an off flavor. The fruit is large enough to eat like a grapefruit and with some sugar it is quite edible.

*Flavor:* Sour grapefruit, some off-flavors, fair quality.

*Uses:* Dessert, juices, preserves.

**Troyer Citrange and Carrizo Citrange** are crosses between the trifoliate orange and a navel orange. And the navel orange parent shows through in its highly attractive fruits, which do indeed resemble miniature navel oranges. The tree looks much like Morton citrange, though somewhat spreading, and even in the lower Piedmont Plateau will grow as large as a Natchez crape myrtle. Troyer has one of the largest flowers of any hardy citrus, which can be as much as an inch in diameter. The cultivar Carrizo is indeed a different type, but the fruit produced by both are identical and so they are included here together. Both produce attractive, sour, extremely juicy fruits that make a good orangeade drink if you have a large bag of sugar. The juice also can be used to make excellent "lemon" pies.

*Flavor:* Sour orange, much off-flavor, fair quality.

*Uses:* Juice, cooking.

*Note:* Cooking drives away the cloying and persistent trifoliate taste, as does dilution 2:1 with water—and lots of sugar.

**Benton Citrange** was developed in Australia as a rootstock. It produces a somewhat spreading tree with medium-sized, mostly evergreen trifoliate leaves. The fruit resembles Troyer citrange, but lacks much of the trifoliate bitterness, being merely sour. Fruit are fairly large, up to 2 inches in diameter, and are highly colored, looking like small sweet oranges.

*Flavor:* Sour orange, some off-flavors, fair quality.

*Uses:* Juice.

**Rusk Citrange** is a trifoliate cross with Ruby blood orange. Rusk makes a strongly upright tree, looking much like the trifoliate orange,

though taller and not quite as thorny. It tends to be semi-deciduous in the open and will lose about half its leaves each winter, and in exposed locations can totally defoliate. This does not seem to affect the fruiting habit of the plant, however. Rusk produces fruits about two inches in diameter that ripen to a rich orange color. The fruits are thin-skinned and as brightly colored as some mandarins. Inside, the fruit is golden yellow with up to 6 seeds. It is perhaps the sweetest citrange, though again the off-flavor of the trifoliate parent persists. The fruit reportedly makes a good marmalade.

*Flavor:* Semi-sweet orange, some off-flavors, fair quality.

*Uses:* Juice, preserves.

**Dunstan Citrumelo** may be the best overall hybrid with 50 percent trifoliate parentage. The tree is initially upright but becomes more spreading as it matures, much like its parent the grapefruit. This grapefruit hybrid produces 4-inch yellow fruit, which if sprinkled with sugar, smell and taste like an ordinary grapefruit, harvested perhaps a bit too early. Unfortunately, this cultivar is extremely hard to find, but worth seeking out. Dunstan citrumelo appears to be extremely hardy. A specimen in Mt. Olive, North Carolina endured the below-zero temperatures of the 1980s that wiped out all other citrus in the area.

*Flavor:* Sour grapefruit, some off-flavors, fair to good quality.

*Use:* Dessert.

**Swingle Citrumelo** is a more common citrumelo. It is more commonly found not because it tastes better, but because it is more often used as a rootstock on which other more desirable citrus are grafted. When the graft is killed back by cold or otherwise succumbs, Swingle will often grow to tree form. The fruit is more pear-shaped than Dunstan but is of a comparable size, much seedier, and far less edible. Both Dunstan and Swingle are very hardy, enduring temperatures in the low single digits Fahrenheit without permanent injury as long as these temperatures are not prolonged.

*Flavor:* Bitter grapefruit, persistent off-flavors, poor quality.
*Uses:* Ornamental. Large size and grenade shape make it excellent for throwing.

Changsha x English Large Citrandarin is reportedly the hardiest citrus hybrid of all. It seems to be hardy to 5°F and specimens growing in areas completely exposed to wind and cold partially defoliate but are otherwise unharmed. The tree is large and upright, much like the trifoliate parent, and fruit is variable in size and texture. Some are large and smooth, others are smaller and somewhat fuzzy. All are nearly round and universally sour, though the trifoliate taste is blunted.
*Flavor:* Sour lemon, some off-flavors, fair quality.
*Uses:* Ornamental, cooking.

### A Rare Citrange Hybrid

TroyerCitrange x Rangpur Lime

*The fruit should carry a warning label: Caution, you are not really being poisoned—it just tastes that way.*

—Stewart Nagle, in *Citrus for the Gulf Coast*, describing Phelps cup-leaf citrange

### Citrumelos

Citrumelos are crosses between the trifoliate orange and grapefruit (*Poncirus trifoliata* x *Citrus paradisi*). Like most hybrids, citrumelos are intermediate between the parents, but the trifoliate leaves persist, as does the thorny nature of the tree. They are commonly used as rootstocks for other citrus in Florida and are hardy to about 5°F.

### More Citrumelos

Sacator
US 80-5 (a 10-foot specimen planted against a home in Athens, Tennessee easily survived 2°F in 2003)

### Citrandarins

As the name suggests, this is a class of hybrids between the trifoliate orange and mandarins, or tangerines as they are commonly known in the United States (Poncirus trifoliata x Citrus reticulata). Most were bred for use as rootstocks, but the cultivars listed below have merit as ornamentals and for their various culinary uses.

More Citrandarins
Trifoliata x Minneola
Trifoliata x Cleopatra Mandarin

**CiClem #10 Citrandarin** was developed by Dr. John Brown of Texas. As the CiClem name implies, it was one of a number of crosses with Clementine mandarin, which readily sets hybrids. This particular cultivar has fruit the size of an egg with light orange flesh and is sometimes called the golden lime. When diluted with an equal amount of water the juice makes a good limeade drink. The tree is spreading and large with few thorns on bearing wood.

*Flavor:* Sour lime, some off-flavors, fair to good quality.
*Uses:* Juice.

**Citsuma Citrandarin** is probably a hybrid with Satsuma. It makes a fairly large, spreading tree with large, very dark green trifoliate leaves that are almost totally evergreen. One tree owned by the author produces wildly divergent fruit; some are rounded but slightly flattened at the top and bottom and nearly as large as a typical grocery store tangerine. Others are smaller and more rounded, and still others are heavily fingered, almost as much so as Buddha's Hand citron. All are richly colored inside and out, with a deep orange peel and golden flesh. The juice is sweet, though unmistakably tinged with trifoliate orange, but it takes very little dilution to remove the unpleasant trifoliate aftertaste. The tree appears to be very hardy, tolerating brief dips to the upper single digits Fahrenheit with no loss to foliage or wood.

*Flavor:* Semi-sweet orange-tangerine, some off-flavors, fair quality.
*Uses:* Juice.

## Citrangequats

Citrangequats probably should be considered kumquat hybrids as the genus *Fortunella* accounts for half their parentage [(*Poncirus trifoliata* x *Citrus sinensis*) x *Fortunella* spp.]. They are included here because they do have trifoliate orange in their background, and are interesting because these hybrids suggest the possibility of removing the bad flavors of trifoliate orange without sacrificing cold hardiness. Citrangequats were developed in an attempt to combine the vigor of the citranges with the extreme tendency toward winter dormancy of the kumquat. A number have been developed over the years, but all of them tend to be vigorous, hardy trees with egg-shaped fruit. Notably, the addition of kumquat blood apparently removes much of the trifoliate taint, and in some of the citrangequats it is almost wholly absent. The cultivars here were named for the location they first fruited in the 1920s. Thomasville was named for the southwestern Georgia town, and Sinton for Sinton, Texas. Both cultivars are reliably hardy to 10°F and have recovered from even lower temperatures.

**Thomasville Citrangequat** is a very old cultivar developed by the USDA that crossed a Willits citrange with Nagami kumquat. It is the best citrangequat yet developed, with egg-shaped, egg-sized fruit that make a good lime substitute in summer and become edible out-of-hand by Christmas. By then the fruit taste like a slightly unripe orange. Because the fruit have a thin, sweet albedo (the white inner peel), they make excellent marmalade. The tree is very upright, usually with several leaders that shoot for the sky before branching. Juvenile plants have characteristic trifoliate foliage and wicked thorns, but leaves on bearing wood are usually unifoliate, with thorns much reduced. Thomasville citrangequat is among the most precocious of citrus; individual plants have been known to flower in four years from seed.

*Flavor:* Sweet orange-lime, no off-flavors, good quality.
*Uses:* Dessert, juice, preserves.
*Note:* Thomasville citrangequat makes an excellent lime substitute from mid-July onward, but isn't sufficiently sweet to eat out of hand until December.

**Sinton Citrangequat** is a cultivar arising from the same parentage as Thomasville, but Sinton is markedly different in a number of ways. For one thing, Sinton always has unifoliate leaves, even as a seedling. The

fruit are very different from Thomasville in that they are usually much more oblate (though there are trees that have more oblong fruit) and a bright orange color, almost red. Unlike Thomasville, Sinton fruit never become remotely sweet, and the peel has a spicy taste. Like most other citrangequats, however, the trees are strongly upright and very spiny.

*Flavor:* Sour lime, little off-flavor, fair quality.

*Uses:* Preserves, juices.

**Glen Citrangedin** is an interesting cross is between a citrange and a calamondin, itself believed to be a kumquat–mandarin hybrid. If the calamondin is a hybrid, this would make the citrangedin a combination of four different species of citrus representing three different genera (*Poncirus trifoliata, Citrus reticulata, Citrus sinensis* and *Fortunella* sp.). Glen
citrangedin is interesting as well because it carries a mixture of unifoliate, bifoliate, and trifoliate leaves. The fruit is orange and about the size of a Calamondin, and reportedly just as sour, though most of the trifoliate taste is gone. This cultivar should be hardy to about 10°F.

*Flavor:* Sour lime, no off-flavors, good quality.
*Uses:* Juice, preserves.

**SanCitChang #10 Roundleaf** it is a very attractive plant with an un- usual leaf shape unlike any other citrus listed here. Instead of the usual elliptical leaf with a pointed tip, this hybrid between the Sanford
citrange and Changsha mandarin has a leaf that is nearly round. It produces a bumpy orange fruit that looks like a tangerine and is reputed to be sweet. It has proven hardy as far north as Dallas, Texas but there are no fruiting specimens yet in the Southeast. There are several other SanCitChang cultivars, but the #10 appears to be the best tasting. All should be hardy in Zone 8.

*Flavor:* Sweet tangerine, no off-flavors, good quality.

*Uses:* Dessert.
*Note:* The other SanCitChang cultivars differ widely in taste. One form with a large yellow fruit has an aftertaste that is strongly reminiscent of ketchup.

**U.S. 119** is a citrumelo crossed with a sweet orange cross [(*Poncirus trifoliata* x *Citrus paradisi*) x *Citrus sinensis*] with large grapefruit-like leaves and orange fruit. The tree has a mixture of unifoliate, bifoliate, and trifoliate leaves, with trifoliate dominating. The fruit is very attractive, with a deep orange color and smooth peel. Inside, the fruit is very attractive with a rich orange color and few to no seeds. The taste is sweet with just a touch of trifoliate aftertaste. While U.S. 119 has been touted as hardy to 10°F, it remains to be seen if this is true. Young plants have been injured by temperatures in the lows 20s.

*Flavor:* Sweet orange, few off-flavors, good quality.

*Uses:* Dessert.

### More Citrangequats

19-15-7
Telfair

### Complex Hybrids of the Trifoliate Orange

There havebeennumerous crosses with the first generation of trifoliate hybrids with other more common citrus in an attempt to make the fruit more palatable without sacrificing cold hardiness. Unfortunately, the opposite seems to occur: cold-hardiness leaves long before flavor returns. However, the forms listed below do represent important breakthroughs and suggest that with further work, it could be possible to have a sweet Zone 7 citrus...maybe.

# The Very Hardy: The Ichang Papeda and Its Hybrids

## Ichang Papeda Hybrids

Unlike hybrids between the trifoliate orange and other citrus, Ichang papeda (*Citrus ichangensis*) hybrids tend to have a better balance of the two parents. When hybridized with more desirable citrus, fruit quality vastly improves. For example, the Yuzu, which is an Ichang papeda and mandarin (*Citrus reticulata*) cross, has a sour but not bitter fruit that makes a very acceptable lemon substitute. Second-generation hybrids have even better fruit, with some of the Yuzu hybrids producing fruit of tangerine quality with little loss of cold-hardiness. So there is hope yet for a hardy, tasty citrus hybrid.

A characteristic of nearly all hybrids involving *Citrus ichangensis* is the prevalence of large, pointed seeds. Nearly all of the hybrids have them, though not always in the quantity of the parent. A few other cold-hardy citrus (notably Keraji and Changsha mandarins) also have these large seeds, which indicates that they too may be a hybrid of some kind involving *Citrus ichangensis*.

Hybrids using *Citrus ichangensis* tend to be very hardy even into the second and third generation. Like the trifoliate orange and its hybrids, *Citrus ichangensis* hybrids can still flower and fruit after being defoliated. One peculiarity of Citrus ichangensis and its hybrids is that they all seem to flower and fruit more freely if grafted onto the trifoliate orange rather than grown on their own roots.

**Ichang Papeda** (*Citrus ichangensis*) is the most cold-hardy *evergreen* citrus, withstanding temperatures down to 0°F. In shape and character this species is much like the trifoliate orange, and like the trifoliate orange it produces a fruit that is essentially inedible. *Citrus ichangensis* has long, straight thorns. Its leaves are uniquely shaped, with a flared petiole base that is so wide that the leaf often appears to be a double leaf. The leaves have pointed "drip tips" that are typical of plants from high-rainfall areas. This wild species is grown only as a curiosity because its fruit is bumpy, dry, and filled with huge, thick seeds. The Ichang papeda is adapted to steep hillsides and prefers well-drained soil to thrive. Like the trifoliate orange, *Citrus ichangensis* makes a handsome ornamental tree.

*Flavor:* Bitter lemon, some off-flavors, poor quality.
*Uses:* Hybridization, ornamental.

**Ichang Lemon** is an Ichang papeda crossed with a pummelo (*Citrus ichangensis* x *Citrus maxima*). It originated in China, where it is called Shangjuan, which means "fragrant ball." This vigorous, spreading tree is very ornamental, resembling a grapefruit with large, wide leaves with a flared petiole. It produces clusters of large, bumpy, seedy, yellow grapefruit-like fruits, which can be used like lemons. The fruit are extremely juicy with each one producing as much as a half-cup of juice. When overripe, it tastes like a grapefruit and is quite edible with sugar. The Ichang lemon also is very hardy, enduring temperatures down to 10°F and below with no permanent damage as long as it is protected from wind.
*Flavor:* Sour grapefruit, some off-flavors, fair quality.
*Uses:* Dessert, cooking, juice.

**Yuzu** is an ancient, natural hybrid (*Citrus ichangensis* x *Citrus reticulata*) that originated in Japan, where it was often used as a rootstock for Satsuma. Yuzu produces a narrow, upright, thorny tree, similar to a trifoliate orange. The fruit is yellow and the size of a medium-sized tangerine with a lemon-like taste and an easily-peeled but rough skin. It's used in Japan like a lemon and the peel is used in spicy dishes. It's very resistant to cold, and like many *Citrus ichangensis* hybrids, can go deciduous during
cold spells with no loss to fruiting wood. When fully dormant it can tolerate temperatures as low as 10°F and perhaps lower.

*Flavor:* Sour lemon, some off-flavors, good to excellent quality.
*Uses:* Cooking, juice.
*Note:* Yuzu peel is edible, and the albedo is distinctly sweet, much like a kumquat.

**Clementine-Yuzu hybrids** were developed by Dr. John Brown, and are only one-quarter *Citrus ichangensis*, with the other three-quarters be-

ing a mandarin (*Citrus reticulata*) of one type or another. They are included here because they illustrate the fact that hybrids with *Citrus ichangensis* can be quite tasty without sacrificing cold-hardiness. Both of the hybrids described here are better than any trifoliate orange hybrid. **ClemYuz 3-3** produces small, bright-orange tangerines of market quality. Best of all, it's marketed in Texas as the ten-degree tangerine because the original Texas plant withstood temperatures below 10°F and more than 60 consecutive hours below freezing in 1989. One drawback is that the fruit doesn't ripen until mid-December, making it susceptible to early freezes. The cultivar **ClemYuz 2-2**, a sister hybrid, produces very attractive fruit of a large tangerine size that peel very easily. The fruit are sweet and moderately juicy, with no unpleasant aftertaste. Fruit of ClemYuz 2-2 ripen in October, a distinct advantage over ClemYuz 3-3. This cultivar has the unfortunate tendency toward alternate bearing.

*Flavor:* Sweet tangerine, no off-flavors, good quality.
*Uses:* Dessert.
*Note:* Clem-Yuz 3-3 can be used as a lime substitute before it fully ripens in late December.

**Yuzuquat** is a Yuzu and Nagami kumquat (*Fortunella margarita*) hybrid, one of many cultivars developed by Dr. John Brown in Texas. This attractive citrus, one of the best *Citrus ichangensis* hybrids, has large, deep-green leaves and produces lemon-like, smooth-skinned fruit that's edible, skin and all. Yuzuquat is ripe by late September, before fruits color, and tends to be a little tastier early in the season. The fruit are very soft and while they hold well on the tree, they become progressively softer as the season progresses. This cultivar is also extremely hardy, enduring 7°F in Texas and being completely unaffected by temperatures in the lower teens in Georgia.

*Flavor:* Sour lemon, no off-flavors, good quality.
*Uses:* Cooking, juice.

**Yuzvange** is another hybrid developed by Dr. John Brown and is a cross between Yuzu and the Savage citrange, making it one-quarter mandarin, one-quarter *Citrus ichangensis*, one-quarter trifoliate orange and one-quarter sweet orange. Talk about complex! This hybrid is remarkable because the crossing of Yuzu with the citrange almost totally cancels the off-flavors of the trifoliate orange, leaving a fruit with a nice lemon flavor. Trees are slow and make small shrubs. Leaves are unifoliate, intermediate between mandarin and Yuzu types with a prominent "drip-tip." The yellow fruit are globose, about 2 inches in diameter, and have a good lemon flavor and no trifoliate aftertaste. If there is a drawback, it is that they are excessively seedy with fruit commonly having 10 to 20 seeds. It should do well throughout Zone 8.

*Flavor:* Sour lemon, no off-flavors, good quality.
*Uses:* Cooking, juice.

### The Trendy Yuzu

In the search for novel flavors, the West has often turned to the East. The Yuzu, until recently unknown in the West, has found its place among trendy ingredients in high-end restaurants from the Napa Valley to New York. One enthusiastic chef describes the flavor as lemon with a hint of tangerine, grapefruit and pine. Yuzu juice and rind are used as a flavoring in cocktails, marinades and desserts.

Yuzu prices are high. In some American cities a single fruit sells for up to $2.50. Legal budwood, meaning certified disease-free, is now available, and new Yuzu groves are being planted in California.

The Yuzu may be new to the West, but the peoples of eastern Asia have used it time out of mind. It has become a symbol of the winter solstice in Japan. The golden globes are floated in a hot bath taken on solstice day.

### Another Yuzu Hybrid

Yuzu x Sweet Orange

# Hardy Kumquats and Their Hybrids

## Kumquats and Dormancy

While not as hardy as the trifoliate orange (*Poncirus trifoliata*) or the Ichang papeda (*Citrus ichangensis*), kumquats (*Fortunella* spp.) go completely dormant in the winter and are slow to resume growth in the spring, waiting until temperatures consistently reach 65°F. This gives them an enormous advantage during the roller-coaster winters of the Southeast. If they are frozen back, they can also bloom on old wood, a helpful trait after severe freezes.

Kumquats differ from most other citrus in that the peel is sweet, whereas the juice is often sour or bitter. Because of their sour juice, the best kumquats are those with the least juice.

Most kumquats are difficult to grow on their own roots but are excellent shrubs or small trees on trifoliate orange rootstock.

All kumquats make shrubs or small trees that rarely exceed 15 feet in height, and they can be kept smaller by budding onto Flying Dragon trifoliate rootstock, and by judicious pruning. Kumquats are generally hardy to about 15°F.

**Meiwa Kumquat** (*Fortunella crassifolia*) is probably a hybrid between Nagami and Marumi kumquats. Fruit are nearly globose, about 1.5 inches in diameter, with a tender peel and very little juice. It is one of the better kumquats for eating out of hand. There are seedling selections available that do well on their own roots, and these seedling trees will sometimes grow to about 15 feet tall, almost twice the size of a Meiwa on trifoliate orange rootstock.

*Flavor:* Sweet kumquat, no off-flavors, excellent quality.
*Uses:* Dessert.

**Nagami Kumquat** (*Fortunella margarita*) appears to be a true species as it readily sets hybrids when used as a female. This is the kumquat most often found in grocery stores, having a very attractive oval fruit about an inch wide and two inches long. Each fruit usually has about four seeds. Even though it is the most commonly grown commercial kumquat, Nagami is quite sour and there are other selections that are better. However, it pickles exceptionally well and makes an excellent marmalade.

*Flavor:* Sour kumquat, no off-flavors, good quality.
*Uses:* Dessert, preserves.

**Ten-Degree Kumquat** (*Fortunella margarita* hybrid) is an open- pollinated form from Dr. John Brown of Texas. It makes an exceptionally handsome ornamental tree, with deep green leaves. The leaves are typical kumquat shape, small and pointed, but the ten-degree kumquat has leaves that have a distinctive wavy shape. Fruit are essentially seedless and small kumquat size, about 1 inch long and oblong, with a spicy taste with little juice. The tree is so named because the original survived 7°F and more than 60 hours below freezing in Texas. When grafted on trifo- liate orange rootstock it eventually grows to about 12 feet tall, making a large globose shrub or small tree.

*Flavor:* Semi-sweet kumquat, no off-flavors, good quality.

*Uses:* Dessert, preserves.

**Chang Shou Kumquat** (*Fortunella obovata*) is rather obscure and found only in nurseries that specialize in citrus. However, it is worth seeking out because it has a tender, almost melting peel, in contrast with most other kumquats which have rather tough peels. Chang Shou has very tasty, semi-sweet flesh with little juice. Fruit are a medium-orange color about the shape and size of a ping-pong ball. Fruit have from 1 to 3 seeds per fruit, and the seeds are generally monoembryonic. Unlike most kumquats, which have long, pointed leaves, Chang Shou has medium-sized, rounded leaves. The tree otherwise is typical for kumquats, with a shrubby habit and small stature, which is accentuated when the plant is grafted onto trifoliate orange rootstock. Hardiness is unknown under

Southeastern conditions, but the plant should be reliably hardy to 15°F.
*Flavor:* Sweet kumquat, excellent quality.
*Uses:* Dessert.

**Hong Kong Kumquat** (*Fortunella hindsii*) also called the golden bean kumquat is grown mostly as a novelty or as a parent for hybrids; the fruit are a mere one-half inch in diameter and are essentially inedible, with very little juice and large seeds. It does make a handsome ornamental or container plant. This species apparently grows wild on the sides of volcanic mountains in China. In the United States it must be grafted.

*Flavor:* Bitter kumquat, persistent off-flavor, poor quality.

*Uses:* Ornamental only.

**Eustis Limequat** (*Fortunella japonica* x *Citrus aurantifolia*) was one of several limequats developed by Walter T. Swingle of the United States Department of Agriculture in the early 1920s in an effort to develop a more cold-hardy lime. In this, he succeeded admirably. Eustis makes a small, kumquat-sized yellow fruit that is very juicy with an excellent, powerful lime taste. The fruit looks like a key lime but is much more cold hardy, thriving in Southeastern coastal areas. It also makes an excellent container tree. Because it has the tendency to re-bloom during warm periods, over-wintered fruit can be especially appreciated the next summer.

*Flavor:* Sour lime, no off-flavors, excellent quality.

*Uses:* Juice.

**Procimequat** (*Fortunella hindsii* x Eustis limequat) produces tiny yellow to orange fruit on a dwarf tree. Procimequats are excellent ornamentals as they are precocious—seedlings as young as a year old have been known to bloom and fruit in a 4-inch container. The fruit are generally sour but have an interesting hint of lime. They are also very hardy for a citrus with no trifoliate parentage. Mature plants have taken upper single digits with minimal damage. The procimequat is hardy to 20°F and probably to 15°F or lower if hardened off.

*Flavor:* Sour lime-kumquat, a few off-flavors, fair quality.

*Uses:* Flavoring bottles of Mexican beer. The tiny fruit fit easily through the neck of the bottle.

**Nippon Orangequat** (*Fortunella crassifolia* x *Citrus reticulata*) is a cross between the Meiwa kumquat and the Satsuma mandarin orange. The resulting tree is very cold hardy and specimens in protected sites have easily withstood upper single digits with no protection. Characteristics are intermediate between the two parents; the egg-shaped fruits are bright orange inside and out with an edible peel. They're sour and juicy, making an excellent marmalade and drink. Nippon orangequat bears reliably and abundantly under Southeastern conditions and rarely fails to make a crop. The plant is fairly low and spreading, reminiscent of Sat-

### More Kumquats

Centennial Kumquat (variegation in both leaves and fruit)
Marumi or Round Kumquat (*Fortunella japonica*)
Malayan Kumquat (*Fortunella polyandra*)

### More Kumquat Hybrids

Lakeland Limequat
Tavares Limequat
Lemonquat ( *Citruslimon* x *Fortunella japonica*)
Razzlequat (Kumquat x *Eremocitrus glauca*)

*The oranges of the Island are like the blazing fire amongst the emerald boughs,*
*And the lemons are like the paleness of a lover who has spent the night crying.*

—11th Century poet Abd ur-Rahman Ibn Mohammed Ibn Omar, describing Sicily

### Best Citrus for Marmalade

The very best citrus for marmalade is the Seville type of sour orange, used so extensively in Great Britain to make the famous Dundee prod- ucts. A number of other citrus make very good marmalade, though. Some have a distinct advantage over sour oranges because they have a sweet albedo (kumquats and citrange-quats) or because they are easy to prepare (Rusk citrange). Below are some types that will make a very good, useful marmalade.

Rusk Citrange
Thomasville Citrangequat
Nippon Orangequat
Sunquat
Marmaladequat

suma, with large pointed kumquat-like leaves. It makes a very handsome ornamental plant and is hardy to at least 10°F.
*Flavor:* Sour tangerine, no off-flavors, good quality.
*Uses:* Juice, preserves.
*Note:* Becomes sweeter as season progresses but fruit must be over-wintered to become sufficiently sweet to enjoy out of hand.

**Sunquat and Marmaladequat** are among the more promising hybrids of the last decade, the chance seedlings between a Meiwa kumquat and either a Meyer lemon or a Clementine mandarin. (The seedlings were discovered underneath a Clementine tree.) The Marmaladequat is named for the ease in which marmalade is made from the fruit, having a peeling so soft that it doesn't need to be precooked. Both are thorny, upright trees that produce yellow fruit with a sweet juice and are completely edible, peel and all. Marmaladequat is reportedly more vigorous and comes back quickly from the roots if a freeze kills it to the ground. Both are probably hardy to 15°F.

*Flavor:* Sweet kumquat, no off-flavors, good quality.
*Uses:* Dessert, preserves.

# More Hardy Citrus

### The Most Familiar Citrus

These citrus comprise many of the varieties with which people are most familiar: oranges, lemons, grapefruit, and others. As a rule, they are not nearly as hardy as the *Citrus trifoliata* and *Citrus ichangensis* hybrids, though several are hardy in the upper parts of Zone 8 if given a good microclimate and/or protec-tion in winter.

**Calamandarin** (*Citrus reticulata* hybrid) is a cultivar that may be a hybrid with the Calamondin (itself purportedly a kumquat-mandarin hybrid) and another, unknown type of mandarin. The tree is large, vigorous and bushy, with the fruit held at the ends of the tips of twigs like all other mandarins. Consequently the tree produces an abundance of small, brightly-colored fruit. Fruit quality is only average, though. This variety is hardy at least to Aiken, South Carolina, so to 10°F to 15°F.

*Flavor:* Semi-sweet tangerine, some off-flavors, fair to good quality; varies with individual plants.
*Uses:* Dessert.

**Changsha Mandarin** (*Citrus reticulata*) is a very old Chinese cultivar. Such plant characteristics as a pointed leaf tip, extreme cold hardiness and a skunky odor to the fruit peel point to the possibility that Changsha is a hybrid of some sort with *Citrus ichangensis*. There is quite a bit of variability within the Changsha group, both in growth habit and fruit quality. Most specimens of Changsha have a very upright growth habit like other mandarins, but there are forms of Changsha that are spreading, like Satsuma. Leaves are medium-sized and similar to other mandarins with a prominent drip tip. Fruit, which ripen in late September, are medium tangerine size and very easy to peel. Inside, the flesh is bright orange and seedy, with four to six seeds per section. Some cultivars of Changsha are very good, almost as good as Satsuma, whereas others are

dry and bland. All tend to dry out quickly and must be harvested as soon as possible. The fruit must be clipped or the peel will tear, and if the peel is not injured the fruit will store very well in the refrigerator. Changsha is reported to be hardy to 5°F. In tests at the Bamboo Farm and Coastal Gardens in Savannah, Georgia, Changsha tolerated short freezes down to 13°F with no loss of foliage or fruiting. A newer hybrid of Changsha with Clementine mandarin produces a slightly smaller fruit but is much more flavorful. Hopefully it will be as hardy as Changsha.
*Flavor:* Sweet tangerine, some off-flavors, fair to good quality.
*Uses:* Dessert.
*Note:* Excessive seediness makes Changsha less desirable as does a tendency toward blandness in some individual trees. Especially sweet clones are worth seeking out.

**Juanita Tangerine** (*Citrus reticulata*) arose from a chance seedling from a supermarket tangerine planted by Juanita Barrineau of Barrineau, South Carolina. The original plant came from a seed planted in a pot with a houseplant. The houseplant died, but the seedling flourished and was planted outdoors. The resulting tree amazingly survived 0°F in 1985 and continues to bear about five bushels of fruit annually. The tree and fruit resemble Dancy tangerines. The tree is upright with numerous branches and twigs and few thorns, especially on bearing wood. Fruit is typical for Dancy; a rich orange tangerine about three inches in diameter, oblate and with small radial furrows at the stem end. The pulp is a rich orange color, tender, and very sweet. It also ripens in the Southeast by Thanksgiving, well ahead of Dancy, and is more desirable for that reason. This cultivar demonstrates the value of trying seedlings of more common fruit.

*Flavor:* Sweet tangerine, no off-flavors, excellent quality.
*Uses:* Dessert.

**Keraji Mandarin** (*Citrus reticulata*) produces a 2-inch fruit too small to be commercially viable, but nevertheless is an excellent tree for the garden. Growth is upright and narrow, with almost no thorns, even in seedlings. The fruit are small, yellow, flattened tangerines that have a sweet lemonade taste unlike any other citrus fruit. The peel is puffy and very easy to remove. Keraji may be almost as hardy as Changsha. A tree in Augusta, Georgia has performed very well since 1997, tolerating short drops to the upper teens with no leaf drop or twig damage.

*Flavor:* Sweet lemon-tangerine, no off-flavors, very good quality.
*Uses:* Dessert.

**Long Huang Kat Mandarin** (*Citrus reticulata*) is a Chinese cultivar and small tree similar to Changsha. Thorns are minimal, even on small plants. The growth habit is upright, like most other mandarins, with narrow leaves. Fruit is held singly at the end of branches, but because the habit

### Mandarins

Mandarins, or tangerines as they are commonly called in the United States (*Citrus reticulata*), cover a broad class of citrus, all of which appear to have originated from a common ancestor. Many are apparent hybrids or complexes with other citrus, and some, such as tangelos, are deliberate hybrids. All mandarins have brightly-colored skins, mild flesh that can be sweet or sour, and many threadlike veins that adhere to the outside of the sections when the fruit is peeled, hence the Latin binomial *Citrus reticulata*. As a class, mandarins are hardier than most commercial citrus. Hardiness varies widely.

### More Hardy Mandarins

Nasnaran
Ponkan
Shekwasha

of the tree is shrubby with many small branches, prodigious quantities of fruit can be produced. The fruit are small and seedy, about 2 inches in diameter, resembling miniature Dancy tangerines. They are easy to peel and have a very good sweet-tart taste. The Kat is probably about as hardy as Satsuma—around the upper teens.
*Flavor:* Sweet tangerine, no off-flavors, good quality.
*Uses:* Dessert.
*Note:* Too small to be of much use commercially, but an interesting citrus.

**Satsuma** (*Citrus reticulata*) is really a class of mandarins, within which there are several cultivars. Among them are Kimbough, Owari, and Early St. Anne, which differ primarily in the time of ripening. As a class, Satsumas ripen very early, with most having best quality before the peel turns orange, and all nearly finished by Thanksgiving. Fruit do not hold well on the tree, becoming large and puffy. However, they do store well once picked. The fruit are easy to peel and have a rich tangerine flavor when fresh, though not so much as some other mandarins. Satsuma does very well along the coast in the Southeast, and commercial groves have existed, and still do, in southern Mississippi, Alabama and Georgia. While Satsuma has a reputation for being the most cold-hardy commercial citrus, it isn't hardy much below 18°F and anything below 15°F for prolonged periods will severely damage it.

*Flavor:* Sweet tangerine, no off-flavors, excellent quality.
*Uses:* Dessert.
*Note:* One of the best all-around cold-hardy citrus for the Southeast.

### The Sour Orange and Its Hybrids

Sour oranges (*Citrus aurantium* for the most part) greatly resemble sweet oranges, but are larger in most respects. Sour orange trees tend to be very large and somewhat spreading, with larger leaves than sweet oranges. Leaves on standard sour oranges have a winged petiole much like grapefruit, though not as large. Sour orange fruit are highly colored and are arguably one of the most beautiful citrus fruit. Their deep orange color is much prettier than most sweet oranges, which have a muted yellow-orange skin. It appears that most sour oranges are almost as hardy as the hardier mandarins, tolerating temperatures in the upper teens with no damage.

**Seville Sour Orange** (*Citrus aurantium*) is the standard sour orange. It produces a fruit that superficially resembles a common sweet orange. The peel is a brighter orange color and is thicker than a sweet orange, one reason why the sour orange is the very best fruit for marmalade, with Dundee marmalade being produced from sour oranges. Internally, the pulp of a sour orange is coarser than the pulp of a sweet orange, and is juicy and sour. Sour orange flowers are perhaps the most fragrant of all citrus. Standard sour oranges are hardy to around 15°F and will grow well on the Southern coasts and inland to Augusta, Georgia.
*Flavor:* Sour orange, no off-flavors, excellent quality.

*Uses:* Cooking, juice, preserves.
*Note:* Sour oranges are excellent used in cooking Cuban-style pork as well as in fajitas and other Latin dishes.

**Chinotto Sour Orange** (*Citrus aurantium* var. *myrtifolia*) is also called the myrtle-leaf orange for its tiny leaves that are densely packed on the twigs. Chinotto produces small fruit about the size of a grocery store tangerine. The fruit are moderately sweet and Chinotto is worth growing for the unusual foliage, fragrant flowers and thornless stems. Tests in Augusta indicate that this cultivar is about as hardy as Satsuma—to

15°F, perhaps a bit lower.

*Flavor:* Semi-sweet orange, no off-flavors, fair to good quality.
*Uses:* Dessert.
*Note:* Surprisingly sweet for a sour orange, in contrast with the rind, which is excessively bitter, as in all sour oranges.

**Smooth Flat Seville Sour Orange** (*Citrus aurantium* hybrid) is an Australian variety that may be a hybrid, possibly with grapefruit. Foliage is typically sour orange with large leaves and a smallish petiole base, but the yellow fruit is very large, up to 8 inches or more, in diameter. When fully ripe they make an excellent grapefruit substitute. Hardiness is unknown, but should be comparable to other sour oranges. A grafted plant in metropolitan Atlanta endured lower teens with minimal leaf damage.

*Flavor:* Semi-sweet grapefruit, no off-flavors, good quality.
*Uses:* Dessert.
*Note:* Surprisingly good grapefruit substitute when fully ripe.

**Nansho Daidai Sour Orange** (*Citrus taiwanica*) is a very hardy tree and an upright, vigorous grower with long, narrow leaves and huge spines. The fruit is large, oblate-spherical, and bright yellow. Over the years, Nansho Daidai has proven to be one of the hardiest evergreen citrus. A citrus pioneer in Montezuma, Georgia had a large Nansho Daidai that endured 0°F in 1985 without any noticeable leaf drop, and no loss of crop the next year. How much below zero this citrus can take is unknown, but it's certainly a hardy variety. Fruit quality is only mediocre, though the fruit can be used as a lemon substitute and for making very good -ade type drinks. Hardy to 5°F easily.

*Flavor:* Sour lemon, some off-flavors, fair quality.
*Uses:* Cooking, juice.

**Ambersweet Orange** (*Citrus sinensis* hybrid) is actually a tangelo and sweet orange cross, which makes it one-half sweet orange and one-quarter grapefruit and one-quarter mandarin. It was bred in Florida for cold-hardiness after the disastrous freezes of the 1980s. For marketing purposes, however, it is classed as an orange. The fruit is sweet but is tinged slightly with a pine taste, especially early in the season, but this is much diminished as the season progresses. Ambersweet juices well and makes a full, vigorous tree.

*Flavor:* Sweet orange, minor off-flavors, good quality.
*Uses:* Dessert, juices.

**Hamlin Orange** (*Citrus sinensis*) is an early-ripening variety that is edible in mid-October and is widely for juice in Florida. It has a typical orange size, three to four inches in diameter and is almost perfectly round. Inside, the flesh is a rich golden color, nearly seedless, and heavy with

*The count is neither sad, nor sick, nor merry, nor well; but civil count, civil as an orange, and something of that jealous complexion.*

—Beatrice, in Shakespeare's *Much Ado About Nothing*, employing the "bitter" Seville orange in a pun on Claudio's "civil" attempt to hide his unfounded jealousy of Don Pedro

### A Sour Orange Hybrid

Tai-Chang [ *Citrus taiwanica* × Ichang Lemon

### More Sour Oranges and Hybrids

Abers Narrowleaf
Bergamot
Bigaradier Apepu
Boquet des Fleurs
*Citrus neoaurantium*
Gou Tou Sauvage
Willowleaf
Zhu Luan

### Sweet Oranges

Sweet oranges (*Citrus sinensis*) are the most important citrus commercially and something of a Holy Grail to everyone from Jason and the Argonauts to the little old lady in Ocala. Everyone wants to grow the Golden Apples of folklore and myth. It is no myth that growing sweet oranges is possible along the immediate coastlines of the Lower South, particularly on barrier islands. Take care to obtain an early-ripening cultivar that is grafted onto trifoliate orange rootstock. For these reasons, only early oranges are listed here, and though it may be possible some years to ripen Valencia oranges in Charleston, we don't recommend trying it when other varieties are available. All sweet oranges are hardy to about 20°F.

*I thought it came from the Hesperides, for there they say the golden apples grow.*

—A young man in Antiphanes' *The Boeotina Girl*, upon presenting a citron to his mistress. The Hesperides, daughters of Herperis and Atlan, crossed the Mediterranean from Africa to Italy in a giant shell.

## The Grapefruit and Its Hybrids

Grapefruit (*Citrus paradisi*) originated in the Caribbean and are believed to be either hybrids of pummelo with another variety or a mutation of the pummelo. Most botanists do not distinguish between the two, but there are some pronounced differences. Like pummelos, grapefruit trees are large and spreading to accommodate the large fruit, with huge green leaves with a pronounced winged petiole. Grapefruit, also like pummelo, come in white, red, and pink forms. Grapefruit is much juicier than pummelo, however, and nearly all varieties have some bitterness that contrasts with the sweet flavor. And grapefruit are markedly poly-embryonic, but their cousins the pummelo are monoembryonic. Hardiness varies by cultivar. Most standard types are hardy to about 20°F, making them essentially a Zone 9 tree.

juice.Hamlin is relatively easy to find at large home improvement stores, though trees almost invariably are shipped in from Florida and on citrumelo or Carrizo citrange rootstock, which make excessively large trees that are more susceptible to cold. Better to find it on trifoliate orange rootstock if possible.

*Flavor:* Sweet orange, no off-flavors, excellent quality.

*Uses:* Dessert, juice.

**Parson Brown Orange** (*Citrus sinensis*), like Hamlin, is another old cultivar from Florida. Parson Brown oranges are somewhat larger than Hamlin, with a rougher peel and more seeds. They ripen a little after Hamlin but otherwise are excellent. Parson Brown is also used as a juice orange in Florida. Trees are similar to Hamlin and other sweet oranges.

*Flavor:* Sweet orange, no off-flavors, excellent quality.

*Uses:* Dessert, juice.

**Navel Orange** (*Citrus sinensis*) ripens around the end of October in the Southeast. They typically are not as rich tasting here as those grown in California, but fruit tend to be much larger than those found in the gro- cery store. Some fruit will be as large or larger than standard grapefruit. They are easy to peel and have a lower concentration of juice than other sweet oranges, which makes them better suited for eating out-of-hand. There is a cultivar called Cara-Cara or simply red navel that has red flesh. This cultivar appears to be as hardy as the standard and is becoming more widely available.

*Flavor:* Sweet orange, no off-flavors, excellent quality.

*Uses:* Dessert.

**Duncan Grapefruit** (*Citrus paradisi*) is the oldest variety of grapefruit, its name arising from Florida, where it was the standard for many years. A white grapefruit, Duncan is very seedy and sweet. Though one of the sweetest cultivars, it is not often found in grocery stores because of its seediness. It is still grown in Florida and is used for canning purposes. Commonly found in discount nurseries along the coast, it is a good choice there because it is one of the earliest ripening cultivars, edible as early as mid-October.

*Flavor:* Sweet grapefruit, no off-flavors, excellent quality.

*Uses:* Dessert, juice.

**Marsh Grapefruit and Pink Marsh Grapefruit** (*Citrus paradisi*) are two very closely related cultivars similar in form and taste to Duncan. The principal difference between them and Duncan is the lack of seediness. They are not as flavorful as Duncan, though they are still very sweet.

*Flavor:* Sweet grapefruit, no off-flavors, excellent quality.

*Uses:* Dessert, juice.

**Ruby Red Grapefruit** (*Citrus paradisi*) is the most highly colored grapefruit that can be grown in the Southeast. When fully ripe it is a clear gemstone red and beautiful to behold. One limitation of this type is that it does not reach full flavor until late December or early January. It can be eaten as early as October but the fruit has quite a bit of acidic bite at that time.

*Flavor:* Sweet grapefruit, no off-flavors, excellent quality.
*Uses:* Dessert.

**Bloomsweet or Kinkoji Grapefruit** (*Citrus paradisi* hybrid) is sometimes given the Latin binomial *Citrus obovoidea*, and is called Kinkoji in Japan. It resembles a sour orange in its upright growth habit, but the large, yellow fruit looks just like a grapefruit, though with a thinner peel. The brightly-colored fruit is easy to peel, much like a mandarin. Inside, the fruit is coarser and drier than grapefruit, but sweeter and with no bitterness. It's probably a hybrid of the pummelo with something (or somethings) else. Bloomsweet appears to be fully hardy to Zone 8a, enduring 14°F in Montezuma, Georgia with negligible leaf damage.
*Flavor:* Sweet grapefruit, no off-flavors, very good quality.
*Uses:* Dessert.

*There's more juice in a grapefruit than meets the eye.*

—Anonymous

**Sanbokan Grapefruit** (*Citrus paradisi* hybrid) has excellent grapefruit-type fruit and is sometimes given specific status as *Citrus sulcata*. The tree is large and spreading like a grapefruit, but the yellow fruit is oblong with a slight neck and shaped more like some of the tangelos. Sanbokan has juicy fruit with a delicious lemony-grapefruit flavor. It doesn't appear to be as hardy as Bloomsweet, but should be hardy in most areas of Zone 8b. A grafted unprotected plant withstood 14°F with no damage, but succumbed to 9°F the following winter.
*Flavor:* Sweet lemon-grapefruit, no off-flavors, excellent quality.
*Uses:* Dessert.

**Meyer Lemon** (*Citrus limon* hybrid or *Citrus meyeri*) was introduced to the United States about a century ago from China by the plant explorer Frank Meyer. It has a number of traits that point to lemon ancestry, such as lemon-scented foliage, a serrated leaf edge, reddish new growth and purple-tinged blossoms. The fruit, however, has characteristics that indicate that Meyer lemon may be a hybrid with a sweet orange. Fruit initially turn yellow but then continue changing color to a deep yellow and in some plants, a rich orange. Inside, the flesh is a pale orange color with a good lemon flavor, but the fruits tend to be a bit sweeter than typical lemons and not as highly flavored. Still, Meyer lemon makes a good lemon along coastal sections of the Southeast. It is only about as hardy as asweet orange but grows well on its own roots and recovers rapidly from a freeze.

### Lemons and Lemon Variants

Lemons (*Citrus limon*) are among the most cold-tender citrus, and true lemons grow well only in parts of California and central and southern Florida. However, the two "lemons" listed here grow well along the coastal sections of the Southeast. Lemons exhibit variable hardiness, and are generally the least hardy of citrus that can be grown in the Southeast. Meyer lemon and Ujukitsu may be hardy to about 20°F.

### An Unusual and Somewhat Hardy "Lime"

The Rangpur Lime, hardy to perhaps 15°F and sometimes listed as *Citrus limonia*, may be a mandarin–lime hybrid. It has orange fruit the size of a small mandarin and a unique sour flavor that is a blend of both supposed parents.

*Flavor*: Sour lemon-orange, some minor off-flavors, good quality.
*Uses:* Cooking, juice.

**Ujukitsu Lemon** (*Citrus limon* hybrid) is classified as a sweet lemon by most citrus enthusiasts, but has a range of characteristics that could confuse any botanist. Leaf shape is rather small and willowy like a sweet orange. The fruit is yellow, like a grapefruit, with a pronounced neck, like a Minneola tangelo, and a sweet lemony taste that is much like a cross between a lemon and sweet orange. This cultivar has been grown for many years in Texas but only recently has been "imported" into the Southeast.

*Flavor:* Sweet lemon, no off-flavors, good to excellent quality.
*Uses:* Dessert.

# RESOURCES

## The Southeastern Palm Society (and Subtropical Plants)

The Southeastern Palm Society's web site contains information about hardy citrus. You can find it online at www.sepalms.org.

Click on "Hardy Citrus" for
- Descriptions and photos of hardy citrus
- Links to online articles
- Sources of hardy citrus
- Southeastern Citrus Expo news.

The Southeastern Palm Society is the southeastern United States (north-of-Florida) chapter of the International Palm Society. The society provides information on how to select and grow hardy palms and subtropical plants, including hardy citrus, maintains public display gardens to promote the use of these plants in the landscape, and conducts horticultural research, including trials of new species and varieties.

Membership in the Southeastern Palm Society is open to all. Our members share an enthusiasm for growing palms and many other subtropical plants and include beginning gardeners, serious hobbyists, nursery owners and academics. Members enjoy quarterly meetings and a subscription to our quarterly journal *Southeastern Palms*.

## The Southeastern Citrus Exposition

The first annual Southeastern Citrus Exposition was held in November 2003 at Riverbanks Zoo and Garden in Columbia, South Carolina. Organized by Southeastern Palm Society member Stan McKenzie of Scranton, South Carolina, it featured a citrus fruit competition, expert speakers who explained how to choose and care for hardy citrus, and the opportunity to purchase hardy citrus trees and other subtropical plants.

Originally called the South Carolina Citrus Expo, the unexpectedly high attendance from both South Carolina and other states in the region inspired a name change to reflect the widening interest in growing citrus north of Florida.

The Expo may be the best source of rare species and cultivars for the home gardener.

# Hardy Citrus Sources

McKenzieFarms
2115 Olanta Highway
Scranton, SC 29591

Phone: 843.389.4831
E-mail: citrusman99@hotmail.com
Web site:
www.mckenzie-farms.com

*Hardy varieties*

Woodlanders,Inc.

1128 Colleton Avenue
Aiken, SC 29801

Phone: 803.648.7522
E-mail: woodland@scbn.net
Web site: www.woodlanders.net

*Seedlings of hardy varieties*

Just Fruits and Exotics
30 St. Francis Street
Crawfordville, FL 32327

Phone: 850.926.5644
E-mail: justfruits@hotmail.com
Web site:
www.justfruitsandexotics.com

*Commercial and hardy varieties grafted on Trifoliate rootstock*

PacificTree Farms
4301 Lynwood Drive
Chula Vista, CA 91910

Phone: 619.422.2400
Web site: www.kyburg.com/ptf
*Grafted commercial varieties*

FlyingDragonCitrusNursery
3973 Loretto Road
Jacksonville, FL 32223

Phone: 904.880.5026
E-mail: mbarwald@yahoo.com
*Commercial varieties grafted on Trifoliate rootstock*

Louisiana Nursery
5853 Highway 182
Opelousas, LA 70570

Phone: 337.948.3696
E-mail: dedurio@yahoo.com
Web site: www.durionursery.com

*Commercial and hardy varieties*

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Some of the additional hardy citrus varieties and hybrids listed were found at the Bureau of Citrus Budwood Registrat Winter Haven, Florida (www.doacs.state.fl.us/pi/budwood), and the Citrus Variety Collection of the University of California Riverside (www.citrusvariety.ucr.edu).


## Photo Credits

Photographs were contributed by Southeastern Palm Society members and were taken in the Southeast north of Florida.

**Front Cover**
Jeff Stevens

**Page 9**
Joe LeVert: *leaf miners and white flies*; Tom McClendon: *sooty mold*.


Key to back cover photo

**Pages18 & 19**
Keith Endres: *US 119*; Gary Hollar: *Dunstan citrumelo*; Joe LeVert: *Changsha mandarin, Flying Dragon trifoliate orange;* Tom McClendon: *Kinkoji grapefruit, Rusk citrange, procimequat, Meyer lemon, Benton citrange, Thomasville citrangequat (close-up of fruit), Sinton citrangequat, Meiwa kumquat, Hamlin sweet orange*; Stan McKenzie: *Juanita tangerine*; Ned Rahn: *Nagami kumquat*; Jeff Stevens: *Ichang lemon, yuzuquat, Chinotto sour orange, Ichang lemons (arrangement by JoAnn Inhulsen), citrumelo (tree with Dr. Christopher Inhulsen), Owari satsuma, Swingle citrumelo x Smooth Flat Seville*; Will Taylor: *Citrumelo USDA 80-5*; George Weaver: *Citrange in bloom*; Jim Wilkinson: *Grapefruit.*

**Back Cover**
Joe LeVert: *Yuzu*; Tom McClendon: *Seville Sour Orange*; Jeff Stevens: *Satsuma, citrus harvest from Montezuma, Georgia.*