

# Citrus for Southern and Coastal Alabama

With proper attention given to selection of the more cold hardy varieties, along with recommended care, citrus fruits can be successfully grown around homes in the coastal and extreme southern areas of Alabama. Citrus plants are very versatile around the home and can be used as individual specimen trees, hedges, or container plants. Their natural beauty and ripe fruits make them very attractive additions to the South Alabama home scene.

The most significant limiting factor to citrus culture in these areas is damage from low winter temperature. The brief history of citrus culture in the United States given below vividly illustrates the devastating effect of winter freezes.

## Historical Background of Citrus in the United States

Citrus was first introduced into the continental United States by the early Spanish explorers at Saint Augustine, Florida, in 1565. Considerable time elapsed before citrus was introduced into Arizona (1707) and California (1769).

History also indicates that citrus plants have been grown in gardens for many years in states that border the Gulf of Mexico and even as far north as Charleston, South Carolina. Small satsuma plantings developed in the Gulf states as early as the 1890s. The freezes of 1894–95 and 1899 largely destroyed this early attempt.

Plantings again resumed until the freeze of 1916–17 struck, killing thousands of acres of citrus crops. By the early 1940s, the hardy satsuma had again made a comeback, when some 12,000 acres of plants were growing in the Gulf Coast areas of Louisiana, Alabama, and northern Florida. But freezes in the two decades following World War II all but eliminated these plantings. The only commercial citrus remaining in these areas (about 1,000 acres) is located in the delta area south of New Orleans.

Alabama now has a small but emerging commercial satsuma industry in the Mobile Bay area.



## Selecting Varieties

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

If the producer grows citrus “outside” in South Alabama and wishes to harvest the fruit, varieties should be selected that can be harvested early (September through November). Beginning in December (sometimes late November), freezing temperatures are often severe enough to freeze fruits while not damaging the trees. Freeze protection methods available to producers may be inadequate to keep fruit from freezing during December. Table 1 lists season of ripening along with seed content and pollination characteristics for a number of citrus varieties.

**Table 1.** Characteristics of Citrus Varieties

<b>Fruit Type</b>	<b>Harvest Season<sup>a</sup></b>	<b>Seeds Per Fruit<sup>d</sup></b>	<b>Fruiting Behavior<sup>e</sup></b>
<b>SWEET FRUIT</b>			
<b>Satsuma</b>			
Armstrong Early	extremely early	very few	self-fruitful
Brown's Select	very early	very few	self-fruitful
Port Neches	very early	essentially none	self-fruitful
Owari	early	very few	self-fruitful
Kimbrough	early	very few	self-fruitful
<b>Tangerine</b>			
Clementine <sup>b</sup>	early	few to many	cross-pollination
Ponkan	early midseason	few to many	self-fruitful
Dancy	midseason	few to many	self-fruitful
<b>Tangerine Hybrids</b>			
Tangelos—Orlando <sup>b</sup>	early midseason	varies	cross-pollination
Other Tangerine hybrids			
Robinson <sup>b</sup>	very early	varies	cross-pollination
Sunburst	very early	varies	cross-pollination
Lee	early	varies	self-fruitful
Nova	early midseason	varies	cross-pollination
Page	early midseason	varies	cross-pollination
Osceola	midseason	varies	cross-pollination
<b>Sweet Orange</b>			
Navel—Washington	early	very few	self-fruitful
Navel-Cara Cara (blood orange)	early	very few	self-fruitful
Hamlin	early	few	self-fruitful
Ambersweet	early	very few	self-fruitful
<b>Grapefruit</b>			
Duncan	early midseason	many	self-fruitful
Triumph	early midseason	many	self-fruitful
Royal	midseason	many	self-fruitful
Redblush (Ruby)	midseason	few	self-fruitful
Thompson	midseason	few	self-fruitful
Star Ruby	midseason	few	self-fruitful
Ray Ruby	midseason	few	self-fruitful
Rio Red	midseason	few	self-fruitful
Marsh	late midseason	few	self-fruitful
<b>ACID FRUIT<sup>c</sup></b>			
<b>Kumquat</b>			
Nagami	early midseason	few	self-fruitful
Marumi	early midseason	few	self-fruitful
Meiwa	early midseason	few	self-fruitful
<b>Calamondin</b>	all year	few	self-fruitful
<b>Lemon</b>	mostly early, some		
Meyer	all year	very few	self-fruitful
<b>Lime</b>			
Key (Mexican)	early midseason	few to many	self-fruitful
Persian	early midseason	essentially none	self-fruitful
<b>Lime Hybrids</b>			
Eustis	all year	few	self-fruitful
Lakeland	all year	few	self-fruitful
Tavares	all year	few	self-fruitful

<sup>a</sup>Harvest seasons are as follows: early (September to November); midseason (December to January), and late (February to June).

<sup>b</sup>These varieties can be interplanted to ensure cross-pollination, which usually results in larger fruit with more seeds and higher tree yields.

<sup>c</sup>Acid-type fruits may have fruits all year but produce the largest crop from the spring bloom.

<sup>d</sup>Citrus fruits that have five to six seeds or fewer are considered “commercially seedless.” Selections above listed with “few” or “very few” are considered seedless.

<sup>e</sup>If self-fruitful, the variety can be planted by itself; if cross-pollination is indicated, a second variety must be used with this variety for best fruiting.

## Mandarins

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

### Satsuma

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

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

When grown under warmer climatic conditions (such as Florida), fruit often retain their peak quality for not much longer than 2 to 4 weeks, after which they may become puffy and rough in appearance and lose flavor and juice content. However, under the cooler climatic conditions of the South Alabama area, fruits tend to remain in good condition on the tree, retaining their juice and flavor for 1 to 2 months or longer after reaching full maturity.

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

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

### Tangerines (Mandarin)

The next best type of citrus to plant from the standpoint of cropping and cold hardiness is the tangerine. Because of their earlier ripening, satsuma and some tangerine fruit will escape damage from many freezes that will severely damage midseason varieties of grapefruit and sweet oranges.

Dancy and Ponkan are exceptionally good tangerine varieties that produce quality fruits. However, their fruits may not develop good flavor before early to mid-December, which means fruits may be exposed to freezing temperatures before attaining optimum ripeness. The Ponkan variety reportedly is less cold resistant than most mandarins; fruits lose quality and the rind puffs if not picked when ripe. Earlier ripening selections such as Clementine (Algerian) tangerine should be planted where possible. Sunburst was recently introduced by the USDA and is being grown extensively in Florida. It ripens very early and has reasonably good quality. Dancy, Ponkan, and Sunburst are self-fruitful, but Clementine requires cross-pollination from another tangerine or tangerine hybrid. The tangerine hybrids described below provide some exceptionally good early maturing varieties that should be of interest to the homeowner.

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

### Tangerine Hybrids

Tangelos are tangerine-grapefruit hybrids that produce loose-skinned, tangerinelike fruits. The Orlando variety is an ideal selection for homeowner use. It is cold hardy and produces excellent quality fruits that ripen early (October to December). Dancy, Clementine, or some other variety should be planted with Orlando for cross-pollination. If a second variety is not planted with Orlando tangelo, fruiting can be enhanced by scoring the trunk with a knife (cut through bark to wood but do not remove any bark) or spraying the tree with 10 to 20 parts per million (ppm) of gib-

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

## Sweet Oranges

This citrus can be grown along the lower coastal area with a fair degree of success if adequate cold protection is provided each year. However, hard freezes (20°F and lower) will severely damage trees (fruit is damaged at 26° to 28°F or colder). Hamlin may well be the best orange variety for Alabama (for fresh fruit and for juice). Fruits are commercially seedless (6 or fewer seeds per fruit) and ripen early (October to November). The cold hardiness of Hamlin is equal to or superior to other sweet orange varieties. All non-navel sweet oranges are self-fruitful.

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

The navel orange is recommended to the homeowner who wants to raise seedless fruit for

eating fresh. However, navel oranges often produce light crops and are generally not as fruitful as regular sweet orange varieties (non-navel types) such as Hamlin. The Washington variety is recommended. Another variety of navel orange of interest to some is Cara Cara. It is similar to the Washington variety but has red flesh. Dream and Summerfield should not be used because of virus problems. Navels make a mediocre dooryard tree, even in Florida. Fruits sometimes begin drying out internally before reaching full maturity. All ripen their fruits relatively early (October to December).

## Grapefruit

Because of a lack of outstanding cold hardiness, grapefruit will need cold protection more than oranges. Although numerous selections are available, the Marsh (white seedless) and Redblush or Ruby (red seedless) varieties are the most frequently planted. Both produce excellent-quality fruit and have few or no seeds. Royal and Triumph are lower in acidity, although not necessarily of better quality. Marsh and Redblush are quite acid because of Alabama's colder winters. Fruits of Marsh or Ruby can be harvested as early as late September and October, but, if allowed to remain on trees until November and December, eating quality significantly improves. The Star variety lacks cold hardiness. All of these varieties are self-fruitful.

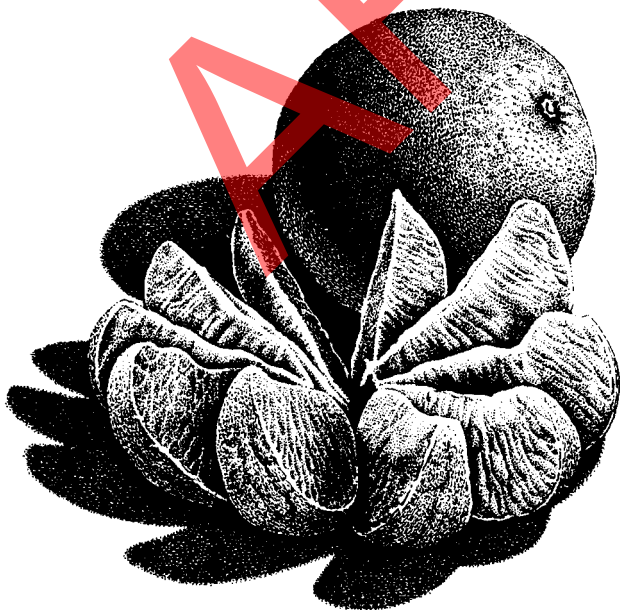
Several grapefruit varieties have been introduced during the past 20 years from Texas. Among these are the Star Ruby, Ray Ruby, and, most recently, the Rio Red (discovered as a limb sport on Ruby Red). Producers who wish to try some of the newer grapefruit selections may want to plant one or more of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

## Acid-Type Citrus Fruits

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

### *Kumquats*

The kumquat tree (not the fruit) is the most cold hardy of the commonly grown acid citrus fruits (it withstands temperatures of 15°F to 17°F). It resumes growth late in the spring, which helps prevent late freeze damage. The kumquat is one of the most widely used citrus plants around the home; it develops into an attractive shrublike tree that bears small orangelike fruit about 1 inch in diameter. Fruits can be eaten fresh, peel and all, or



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

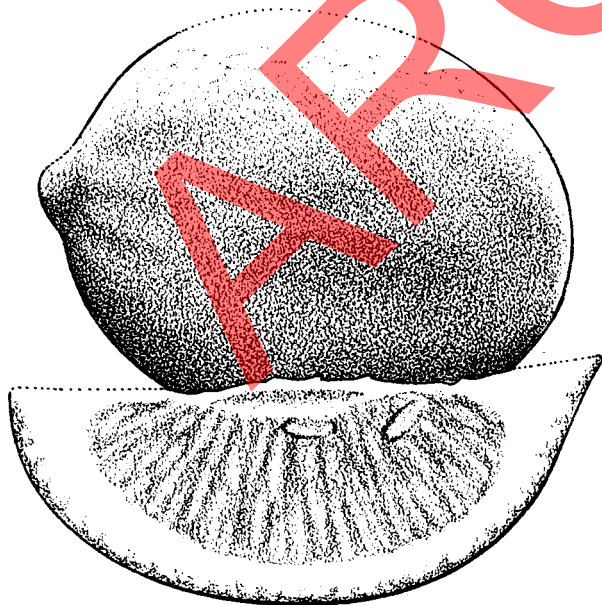
### **Calamondins**

The small, round fruit called calamondins look somewhat like a tangerine and have very acid pulp. It makes an attractive plant for use around the home as well as an indoor or container plant. Fruits are beautifully yellow to orange in color and are readily used as a substitute for limes and lemons. The tree has good cold hardiness (hardy to the low 20s).

### **Lemons**

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

Lisbon, Villafranca, and Eureka, the commercial varieties of lemon commonly produced in California, can be satisfactorily grown in containers. Ponderosa, a minor variety grown in Florida that



produces exceedingly large fruits, can also be grown as a container plant.

### **Lime Hybrids**

The Eustis limequat is a cold hardy lime-kumquat hybrid that makes a very attractive small plant. It is popular as a container plant. Limequats produce fruit resembling the lime in appearance and quality and may serve as an excellent lime substitute. Cold hardiness is about equivalent to the tangerine (low 20s). Lakeland and Tavares are two less-popular varieties occasionally found in retail outlets. Fruits tend to be especially sensitive to cold injury.

### **Limes**

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

Kaffir lime (*Citrus hystrix*) is a rather unusual selection that Asians think has medicinal properties. The leaves are used in preparing foods. Fruits are small and green, with a rough, wrinkled appearance. They have a slightly off-bitter flavor but may be used in tea. This selection makes a very attractive and satisfactory container plant.

### **Rootstock Selection**

Selection of rootstock is another factor to be considered. Scions\* must be free of exocortis virus. Trifoliate orange (*Poncirus trifoliata*) is a superior rootstock for satsumas and tangerines and is strongly recommended. It induces good cold hardiness in the scion variety and results in favorable yields and high fruit quality. About the only other rootstocks that are of value are sour orange, Cleopatra mandarin, and certain of the citranges (cross of sweet orange and trifoliate orange). Avoid the Rusk citrange. This stock has a weak root system, and the tree is more susceptible to cold injury. The Carrizo citrange does not impart enough cold hardiness to the scion and is not recommended.

Flying Dragon is a dwarf selection of trifoliate orange that has been evaluated as a rootstock in California, Louisiana, and Florida since the late 1970s. When sweet oranges or other types of citrus are budded onto this rootstock, the trees produced are about 1/5 to 1/3 normal size. Trees can be planted every 6 to 8 feet in rows, with rows 7 to 15 feet

\* Know the scion and rootstock to avoid combinations that are not cold hardy enough for Alabama.

apart. This rootstock has not been evaluated in Alabama. Researchers are concerned that tree size and yields may be too small for commercial use, but limited grower trials look promising. However, Flying Dragon is suggested to home producers who would like to grow citrus trees that may never become taller than 6 to 7 feet. It would also add variety to the landscape.

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

## **Pollination**

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

## **Establishment and Care of Young Citrus Plants**

### ***Site Selection and Spacing***

Citrus thrives in full sun. Even partial shade tends to result in weak tree development. However, planting citrus under the canopy of a tree such as pine that does not have dense canopy can prevent frost from forming on the citrus tree.

Avoid planting trees near septic tanks or drain fields. Tree roots may clog the drain, and soaps and other cleaning products used in the home may prove toxic to the trees.

Citrus trees do best on well-drained sandy loam soils but will grow on many soil types if good water drainage is provided. Citrus plants that develop into trees, such as satsumas, kumquats, and tangerines, can be planted as close as 10 to 15 feet apart, although a spacing of 15 feet in the row and 20 feet between rows is ideal. Smaller citrus plants such as kumquats and lemons can be spaced as close as 8 to 10 feet if desired. Satsumas and other citrus propagated onto dwarf Flying Dragon rootstock can be planted 6 to 8 feet apart in rows 15 to 18 feet apart.

Locate citrus plants in a protected area if possible, such as near a house or some other structure, preferably on the south side. This location provides

some protection from severe freezes. Usually, the wind associated with cold weather comes from the north to northwest. Avoid areas where trees would be watered frequently by automatic lawn sprinklers.

### ***Tree Selection and Planting Procedure***

One very valuable characteristic of most citrus is that plants will begin fruiting the year following planting, especially those purchased in containers. Plants will also fruit quite effectively when left in containers and used as patio plants. Most citrus trees for home plantings are purchased in containers or as balled and burlapped plants. Healthy 1-year-old budded trees should be  $\frac{3}{8}$  to  $\frac{5}{8}$  inch in caliper, and 2-year-old trees usually measure  $\frac{5}{8}$  to 1 inch in caliper (caliper is trunk diameter measured 1 inch above bud union). These trees are the ideal size for home planting. Plants of the smaller acid-type fruits are usually purchased in smaller sizes. Plant citrus anytime during the year, although late winter or early spring (past the danger of freezing temperatures) is the ideal time. A planting site of 4 to 5 feet in diameter should be cleared of all weeds and grasses and the soil thoroughly spaded.

Dig a hole large enough to accommodate the root ball. Remove the plant from the container and place it in the hole, keeping the top of the root ball level with the soil surface. If the tree is pot-bound, make several vertical cuts around the ball to stimulate new root development. Fill the hole about one-half full with soil, and then add water and tramp firmly to settle the soil and remove air pockets. Allow the water to settle, and finish filling the hole with soil; apply water again. Pack the soil firmly around the trunk, adding additional soil if needed. Do not apply any fertilizer in the planting hole as root damage may result. Construct a water basin around the tree 30 to 36 inches in diameter and 4 inches high. Water twice weekly for the first 2 weeks unless rainfall is adequate (1 to 2 inches per week during growing season). Gradually reduce the number of waterings to once weekly during periods of little or no rainfall.

The first growing season is critical in the life of a citrus plant. Perhaps the most essential item is the water supply. During this first growing season, trees should be adequately watered every 7 to 10 days unless rainfall is sufficient. Keep an area at least 4 feet in diameter beneath the tree free of weeds and lawn grass to minimize competition for nutrients and water. If dense lawn grass is allowed to reestablish close to the tree trunk, the small tree will grow rather slowly because of intense competition. Keeping this area free of weeds and grasses

will also help reduce bark injury from mowers. Safe herbicides are available for effective weed control.

At the time of planting, cut the branches back to 6- to 12-inch stubs (this pruning is sometimes already completed when plants are purchased). This practice helps balance the top with the functional root system, stimulates vigorous regrowth, and should generally be used where plants are bare-root or ball and burlaped. Plants purchased in containers usually require less pruning unless they are somewhat pot-bound and require root pruning to correct the direction of growth. Very little pruning should be required during the first growing season except to remove any sprouts below the scaffold limbs (primary structural branches originating from tree trunk).

Ideally, scaffold branches should not be allowed to develop lower than 18 to 20 inches from the soil. The natural branching habit of citrus results in structurally sound trees without any special form of training or annual pruning; thus, the type of tree training as normally practiced with peaches and apples is unnecessary.

### Fertilization

Newly planted trees should not be fertilized until growth begins in the spring. If possible, use a complete fertilizer such as an 8-8-8 that contains micronutrients. A suggested fertilizer schedule for the first 3 years is given in Table 2. Fertilizer applications should not be made between August 1 and February 15 during the first 2 years to avoid inducing untimely growth flushes during the winter.

During the first year, spread fertilizer in a 30-inch circle, and avoid placing any against the trunk. In subsequent years, the fertilized area should be gradually increased. A good rule of thumb to follow is to fertilize an area twice the diameter of the tree canopy.

**Table 2.** Suggested Fertilizer Schedule for Young Citrus Trees<sup>a</sup>

Growing Season	(pounds of 8-8-8 fertilizer per tree)			
	March	April	June	July
	1	15-30	1-15	15-30
First	1/3 <sup>b</sup>	1/2	2/3	1
Second	1	1	1 1/4	1 1/2
Third	1 1/2	2	2	2

<sup>a</sup>This schedule is designed for citrus plants that develop into medium to large trees. Only half of these amounts or less will be needed for smaller, shrubby citrus plants such as kumquats, limequats, calamondins, etc.

<sup>b</sup>Make this application after growth begins in the spring, usually 4 to 6 weeks after planting.

Ordinary lawn and shrub fertilizer can be used for citrus trees. However, this type of fertilizer may only contain the primary plant food elements nitrogen, phosphorus, and potassium. For best performance from citrus plants, a fertilizer that contains the secondary food and micronutrients—magnesium, manganese, and copper—is very beneficial. The latter two elements, plus zinc and boron as needed, may also be supplied through nutritional sprays.

### Cold Protection

Young citrus trees, even of the most cold hardy type, cannot withstand freezing temperatures as well as more mature, bearing trees can. Before the first freeze each fall, trees up to 4 years of age should be banked with clean soil to a height of about 15 inches. Soil banks should be removed after the last chance of a freeze in early spring. Only the portion of the tree under the bank will be protected. Wrapping material having good insulating properties, such as spun fiberglass or foam rubber, also make effective protectors and can be used in lieu of soil banks. Commercial trunk wraps are also available. On average, soil banks provide at least 10°F to 15°F protection, while the trunk wraps available afford 6°F to 10°F protection. These materials should be a minimum of 6 inches thick and must make good contact with the soil.

Under Alabama conditions and when small numbers of trees are involved, polypropylene covers provide the best protection for upper portions of trees. The use of microsprinklers positioned to protect lower and upper portions of tree trunks and scaffold branches is one of the better alternatives for freeze protection in commercial plantings. Although protecting the trunks and lower portions of scaffold branches is essential for tree survival during a freeze, no crop will be produced following a winter in which all leaves are frozen and drop. Therefore, protecting the leaves from freeze damage should be a major objective where possible (especially for home gardeners). Leaves will be killed if in contact with a plastic cover (and certain other types) during a freeze. For protection of an individual tree on extremely cold nights, placing one to three electric light bulbs beneath the cover provides a fair amount of protection. During a very severe freeze, using a small electric or propane heater beneath the cover provides substantial protection. *However, care should be exercised to avoid placing the heat source too close to the plant or the cover.*

## Cold Hardiness and Factors Affecting Freeze Damage

Among the citrus types that are most easily killed by freezing temperatures are citrons, lemons, and limes. Temperatures from the mid to high 20s will readily kill or severely damage these plants. Sweet oranges and grapefruit are somewhat more cold hardy and usually require temperatures in the low to mid-20s before incurring major damage to large branches. Tangerines and mandarins are quite cold hardy, usually withstanding temperatures as low as the low 20s before significant wood damage occurs. But among the edible types of sweet citrus, the satsuma (also called satsuma mandarin and satsuma orange), has the greatest degree of cold hardiness. Properly hardened bearing trees will withstand temperatures as low as 18°F to 20°F without appreciable wood damage. Temperatures at ground level can be several degrees colder than temperatures around the canopy of the tree, especially if there is no wind.

Keep in mind that the temperature ranges given above refer only to leaf or wood damage. Citrus fruits easily freeze at 26°F to 28°F when these temperatures last for several hours. Further, a longer duration of freezing temperatures is required to freeze fruits of grapefruit as compared with sweet oranges. And tangerines and satsuma fruits are the most easily frozen of the common citrus.

The particular temperature at which tissue of a given plant will freeze and the degree of the damage sustained are functions of a number of factors in addition to the species and variety involved. Some of the more important are the following:

- The freezing temperature reached
- The duration of the minimal temperature
- How well the plant became hardened or conditioned before freezing temperatures occurred (The freezing point of tissue of a hardened citrus plant may be 5 to 6 degrees lower than an unhardened plant.)
- Whether the plant is wet or dry (The killing temperature is 2°F to 4°F lower for a dry citrus plant.)
- Age of plant (A young plant cannot withstand as much cold as a more mature tree.)

Healthy trees are more hardy than diseased trees. Another complicating factor contributing to observations by some that citrus plants seem to freeze at higher temperatures in some years than others is the difference between air (ambient) temperatures and leaf (tissue) temperature. On a windy night with clear or cloudy skies, leaf temperature will be approximately the same as air temperature.

However, on a cold, clear night with little or no wind movement, leaf temperature can easily drop several degrees (3°F to 4°F) below air temperature because of radiation heat loss. Thus, under the latter circumstances, while the minimum air temperature on a given night may have only been 25°F, actual leaf temperature of the plants may have reached 21°F to 22°F. The critical temperature is that of the leaf or fruit and not the air temperature itself. Trees with a good fruit crop are less hardy than those with no fruit.

## Care of the Bearing Tree

The first 3 years should be devoted to developing a vigorous tree with strong scaffolds. Some fruit may be borne the second and third growing seasons, although the quality may not be too high. Trees should begin to make significant crops in the fourth growing season.

Continue using the same 8-8-8 fertilizer (or equivalent) for bearing trees. Two applications per year, March and June to July, are usually adequate. Fall applications (October to November) as practiced in Florida are generally not needed. Apply fertilizer from near the trunk to well beyond the leaf drip of the tree (on large trees this usually involves fertilizing about 4 to 6 feet beyond the leaf drip). A reasonable rate in each application to maintain healthy foliage and good fruiting is about  $\frac{3}{4}$  pound of the 8-8-8 fertilizer per year of age of the tree (these rates are for sandy soils; clay soils and others with greater inherent fertility would require less fertilizer). After a number of years, a fertilizer containing nitrogen and potassium or just nitrogen alone may prove adequate. A maximum of 1½ to 2 pounds actual nitrogen per tree per year should be adequate. If plants are remaining too vigorous in the fall and winter period, the fertilizer rate should be reduced.

As trees become older, problems may be encountered with micronutrient deficiencies. An annual nutritional spray applied in the spring usually corrects the deficiencies. There are usually prepackaged nutritional spray mixes that can be purchased from garden supply dealers. These mixes should contain manganese, zinc, and copper. Deficiencies of boron may be corrected with foliar sprays or soil applications. When iron deficiency symptoms develop, chelated forms of this element should be applied to the soil.

The pH (acidity or alkalinity) of the soil in which trees are growing should be maintained between 6.0 and 7.0. Apply dolomite, agricultural limestone, or basic slag as needed to prevent the pH from dropping below 6.0. Your county



Extension agent or garden supply dealer can assist in determining if a pH adjustment is needed.

Weed control around large bearing trees becomes somewhat less essential. However, it is generally beneficial to remove all weeds and lawn grass from beneath the canopy of the tree mechanically or by using safe herbicides. This approach also provides a more attractive landscape design. Of particular importance is the removal of weeds and grass from the area immediately around the tree trunk. This growth tends to create ideal conditions for fungal organisms such as those causing root rot at the base of the tree. Mulches are not necessary for best tree performance but may be used to reduce weed problems. Mulching material should not be placed within 12 inches of the trunk.

Watering of bearing citrus plants will not be necessary in some years. But adequate water should be provided as needed, particularly during flowering and fruit setting in early spring and the dry periods of mid to late summer. A slow application of water over a several-hour period is preferable to a rapid lawn-type irrigation.

Pruning citrus trees on an annual basis is not necessary. Actually, the only pruning usually required is for the removal of water sprouts (suckers) and dead, damaged, or diseased limbs. Leave short stubs when removing branches. This helps prevent entry of disease organisms into the trunk. Historically, there has been a recommendation to seal all cuts larger than 1 to 2 inches with a safe pruning paint, usually one with an asphalt base being preferred. However, studies over the past 20 years indicate that healing occurs just as readily or better when no pruning paint is used. Until this matter is resolved, growers may prefer to choose either option. Spring and summer are ideal times for pruning.

When citrus plants become too tall (above 12 to 13 feet), overall management, including freeze protection, becomes more difficult. It is suggested that selective pruning (thinning out type cuts rather than heading-back) be used in upper areas of trees. The ideal time for this pruning is in early to mid-spring after the potential for freezes has passed. Pruning in fall and winter could make plants more susceptible to freeze damage.

Citrus plants in Alabama are always subject to injury from cold weather. If trees are only slightly damaged, prune them as soon as new growth indicates the extent of injury. However, regardless of the amount of injury sustained, no pruning should be done until the danger of further freezes has passed. If trees incur major freeze damage, allow the first flush of growth to mature before pruning.

Such a tree will be less cold hardy than usual the following winter.

Alternate bearing (fruiting every other year) can become a problem for some types of citrus. Trees that alternately bear normally crop lightly (10 to 25 percent of normal crop) following years when crops are heavy.

As a group, mandarins have the worst tendency toward alternate bearing. Satsumas, as well as tangerines, exhibit varying tendencies to alternate bear following years of excessive cropping or other forms of stress. Leaving fruits on trees for long periods following peak harvest time can result in alternate bearing. Removing some excess fruit in heavy bearing years, properly harvesting fruit on time, maintaining adequate soil moisture and nutrition, and reducing other stresses will help reduce the tendency toward alternate bearing.

## **Other Cultural Problems**

### ***Fruit Shedding***

Homeowners frequently become concerned about the excessive shed of young blossoms and fruits in early spring. This natural shedding, or abscission, of blossoms and fruits is characteristic of all citrus. Another natural fruit shedding occurs in May and June when fruits are marble size. Keep in mind that only 1 or 2 percent (sometimes less than 1 percent) of the blossoms are needed for good crops. Natural abscission of flowers and fruits aids in preventing citrus from overproducing. However, navel oranges may drop throughout the growth period because of disease organisms in the navel of the fruit.

### ***Leaf Drop***

Occasionally, homeowners become alarmed when healthy trees lose large numbers of their leaves. In many cases, this is a natural drop (it may be most noticeable in early spring). Citrus leaves live for 18 to 24 months and then begin shedding, with some leaf dropping occurring throughout the year. However, the homeowner should always be alert to other possible causes of leaf shedding, including mite damage, excessive or insufficient soil moisture, cold damage, or root diseases.

### ***Fruit Splitting***

In late summer (August to September) fruit splitting may be a problem with certain oranges and tangerines. This is a physiological problem not adequately understood. It usually occurs when a period of fruit growth cessation (growth stops be-

cause of drought) is followed by a rapid increase in size as the result of a heavy rain. Other than alleviating moisture stress, little can be done about the problem. This problem is most common on varieties that produce seedless or nearly seedless fruit.

## **Insect and Disease Control**

Citrus fruits can be grown successfully in the home grounds with little or no control of insects and diseases. Fruits produced without pesticide sprays may be very poor in external quality as a result of damage by several mites, insects, and fungal diseases. Although these unattractive fruits may have little eye appeal, this external damage usually has no detrimental effect on internal fruit quality. And the appearance of the tree may suffer, but seldom will trees be critically damaged by most citrus pests. Natural biological control will assist in maintaining pests at low population levels.

For those who prefer to spray, three cover sprays during each season should be sufficient. A postbloom spray for scales, mites, and fungal diseases, a summer oil spray for scales and mites, and a fall mite spray usually are satisfactory. Commercial producers usually need to apply at least a postbloom spray to maintain fruit appearance adequate for the wholesale/retail market.

During the past 5 years, Alabama producers have had to apply insecticides to control the newly introduced citrus leaf minor, which causes major foliar damage. It is often very useful to apply a postbloom copper spray to control the fungal diseases scab and melanose. Controlling mites is also necessary at times, particularly in the fall.

Formulating a spray program can be somewhat difficult because of the many factors involved. Government regulations are constantly changing regarding the use of agricultural chemicals. Many household insect sprays should not be used on citrus trees because they contain petroleum carriers that injure the leaves or fruit. Consult your county Extension agent for information on developing a spray program for home citrus trees.

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**For more information**, call your county Extension office. Look in your telephone directory under your county's name to find the number.

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