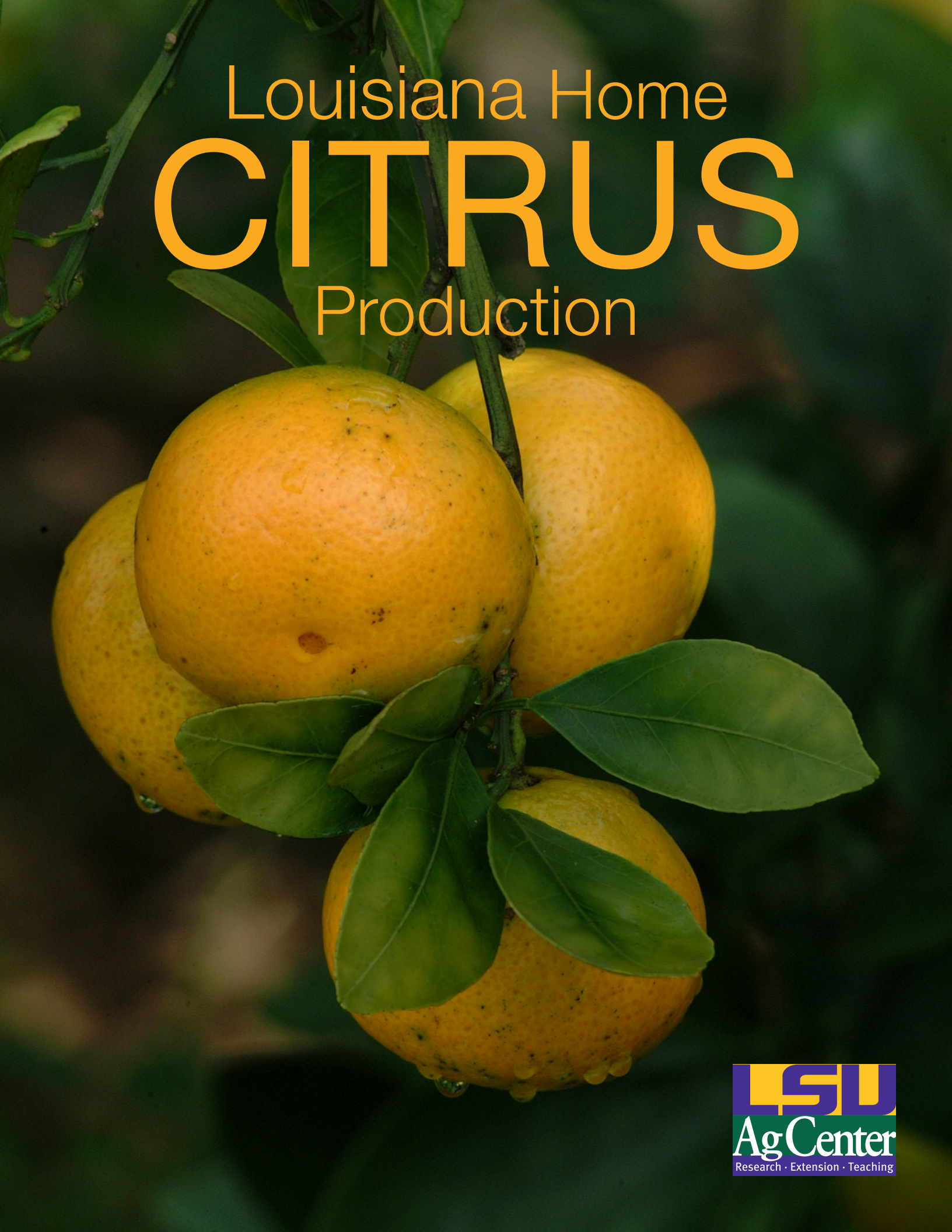
Louisiana Home CITRUS Production



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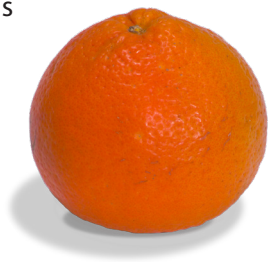
Lousiana Home Citrus Production Guide

Citrus trees should be included in all home orchards and landscapes where it can be successfully grown. The different types of leaves, abundance of blooms, aroma of the flowers and the color of the mature fruit of different types of citrus add to the aesthetic value of the landscape and provide an excellent quality, nutritional fruit for consumption. It is the ideal fruit for homeowners. The fruit is easy to grow and, once mature, stores well on trees.

Citrus fruits can be picked over a period of several months. The major problem for home gardeners is the survival of trees after hard freezes. The production of citrus is not without its insect and disease problems; however, these pests and diseases can be successfully managed with timely spraying and good cultural practices.

Recommended Varieties of Citrus

Satsuma



The satsuma is the traditional citrus grown by Louisiana homeowners. The fruit is easy to peel, has few seeds and separates easily into segments. The fruit turns from green to yellow as it ripens and to orange at full maturity. The fruit is edible when it shows some yellow color. This allows homeowners to harvest and eat the fruit for a long period.

Owari Satsuma

Owari is the most widely grown satsuma. The fruit is medium to small, seedless, has excellent quality and matures from early to mid-November, but can be harvested through early December. The trees are vigorous and have a willowy growth habit. An Owari satsuma is recommended for home orchards in Zones I, II and the southern part of Zone III.

Armstrong Early Satsuma

Fruit reaches maturity in late September and October. The fruit is large but has only fair quality. It becomes puffy quickly and will split badly during heavy rainfall. Armstrong satsumas should be harvested by early November for best quality. The trees are dwarfed and have an upright growth habit. Armstrong Early is recommended for home orchards in Zones I and II.

Brown's Select Satsuma

This variety produces medium to large fruit. The fruit matures mid-October to early November, several weeks ahead of Owari satsuma. The fruit keeps well on the trees without becoming puffy. The trees are large and have an open spreading branching pattern. Brown's Select is recommended for home orchards in Zones I and II.

Kimbrough Satsuma

Kimbrough was released as a cold-hardy Satsuma. Unfortunately, its cold hardiness is no better than that of Owari. The trees of Kimbrough are large, strong, spreading and very productive. The fruit is generally larger than Owari and matures in early to mid-November. The fruit stores well on the tree after maturity. Kimbrough may be hard to find in the nursery trade. This variety is recommended for Zones I and II.

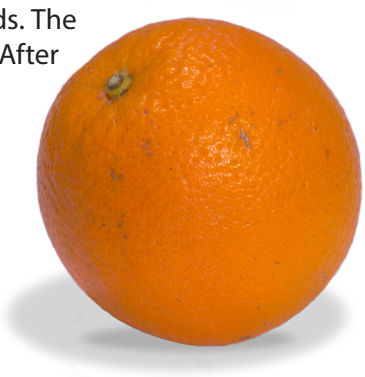
Louisiana Early and Early St. Ann Satsuma

Louisiana Early and Early St. Ann are two recently released satsuma varieties from the LSU AgCenter. They produce medium to large fruit that mature in early September through mid-October. The overall quality and productivity are better than Early Armstrong. Fruit puffiness ranges from none to slight on both varieties. The fruit does not hold well on the tree for an extended period. The medium-size trees have a spreading growth pattern. The availability of both of these varieties may be limited in the nursery trade. Louisiana Early and Early St. Ann are recommended for trials in home orchards in Zones I and II.

Sweet Oranges

Louisiana Sweet

Louisiana Sweet is the traditional round orange grown in South Louisiana. It is a medium to large fruit with a rich flavor and lots of seeds. The fruit matures in December. After reaching maturity, the fruit splits badly and drops. It is the most cold hardy of the sweet oranges. The trees are very vigorous and have thorns. This variety is recommended for home orchards in Zone I and the southern part of Zone II.



Washington Navels

The most distinctive feature of this orange is the presence of a navel, a small rudimentary, secondary fruit embedded in the end of the fruit. The fruit is large, has excellent quality and matures in late November and December. Distinctive characteristics of navel oranges include deep orange color, thin skin, ease of peeling, separation of the segments, high sugars, abundance of juice and seedlessness. The fruit will drop after full maturity, so it's best to harvest navels by end of January. The juice often becomes bitter when stored and should be consumed shortly after squeezing. Navel orange trees are usually less productive than other sweet oranges. The navel orange should be included in home orchards in Zone I and the southern part of Zone II.

Hamlin Sweet

This is the most widely grown of the early round oranges. It matures in early December, but it can hold on the tree through February. The fruit is medium to small and has few or no seeds. Trees are medium large, moderately vigorous and fairly cold tolerant. Hamlin is recommended for home orchards in Zone I.

Pineapple Sweet
Pineapple Sweet is a medium orange that matures in early December and has a pineapple flavor. The fruit is very seedy. The trees are vigorous good annual producers. Pineapple Sweets are recommended for home planting in Zone I.

Plaquemines
Plaquemines is a seedless, low-acid, round orange. It is a bud sport of Pineapple found at Magnolia Orange Grove, Port Sulphur, La., and released as a variety by LSU in 1948. The fruit of Plaquemines is medium, seedless and matures in January. The trees are vigorous good annual producers. Plaquemines is recommended for home orchards in Zone I.

Valencia
Valencia is the most widely planted orange in the world. The fruit is medium-large with few or no seeds. It ripens in April and has excellent quality through June. Juice is abundant and flavor is excellent. Trees are vigorous, upright and prolific. It is subject to heavy fruit drop after a freeze. This variety is recommended for home plantings only in the southernmost parts of Zone I.

Ambersweet
Ambersweet is a sweet orange hybrid released in 1989 by the USDA Horticultural Research Station in Orlando. It is a hybrid of Clementine tangerine by Orlando tangelo crossed with a seedling mid-season sweet orange. Moderately cold tolerant, this early-season orange is of peak harvesting quality from October through December. Ambersweet fruit are medium-size, slightly pear-shaped, low in acid with good juice and flesh quality. Fruit in a home planting can have up to 30 more seeds in mixed plantings. Homeowners are encouraged to ask local nursery and garden centers to obtain trees of Ambersweet. It is recommended for trial in home planting in Zone I.

Moro Blood Oranges
This is a medium to medium-large, round, sweet orange with very few seeds. It is characterized by red coloration in the flesh and peel. It reaches maturity in late December and holds on the tree very well. The riper the fruit, the redder the fruit's pigment. The trees are of medium vigor and size with a spreading round topped shape. Homeowners are encouraged to ask local nurseries and garden centers to obtain trees of Moro Blood oranges. Moro Blood oranges are recommended for trial in home orchards in Zone I.

Grapefruit
Ruby Red
Ruby Red is the most widely planted grapefruit variety in Louisiana. It matures in December and holds wells on the tree through May. The fruit is medium to large and has only a few seeds, light yellow skin at maturity with a red blush, especially where fruit touch one another. It is recommended for home orchards in Zone I and southern part of Zone II.

Rio Red
Rio Red produces larger fruit than Ruby Red. The fruit is yellow at maturity with a red blush. This variety is earlier than Ruby Red and can be harvested from early November through May. It is recommended for trials in home orchards in Zone I and southern part of Zone II.

Kumquats

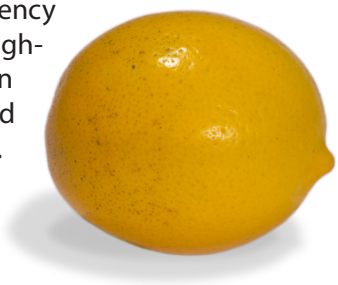
Nagami Kumquats
The Nagami kumquat produces oblong fruit with a smooth rind, deep orange color and acid juice. It ripens from mid-October to February. The fruit contains seeds. The Nagami trees are vigorous with a round, bushy top. Its growth pattern makes it adaptable to hedge and corner plantings. Nagami kumquats are cold-hardy and recommended for home orchards in Zones I, II and the southern part of Zone III.

Meiwa Kumquats
The Meiwa kumquats produce round fruit with sweet pulp. The trees are less vigorous than Nagami. Meiwa kumquats are cold-hardy and recommended for home orchards in Zones I, II and the southern part of Zone III.

Lemons

Meyers Lemons

Meyers is the only lemon recommended for Louisiana since it does possess a small degree of cold hardiness. It ripens in mid-October and holds on the tree until December. It is better when grown from a rooted cutting. It has a strong tendency to bloom and set fruit throughout the year. This makes it an excellent tree for a protected area near a window or door. It is recommended for homeowners in Zone I and in protected areas in the southern part of Zone II.



Other Citrus

Ponkan Mandarin

The fruit of Ponkan mandarin is medium to large and develops a deep orange color when mature. It matures in mid-December and should be harvested by mid-January. It has few seeds and a honey-type mandarin flavor. If left on the tree too long, it tends to become puffy. The tree is moderately vigorous and has a very upright growth habit and weak crotches. It has a tendency to bear alternately and suffers from limb breakage in heavy crop years. Ponkan mandarin is recommended for home orchards in Zone I.

Orlando Tangelo

Orlando tangelo is a hybrid between a Duncan grapefruit and Dancy tangerine. The fruit is medium in size and has high juice content. Fruit has deep orange color in late December with good quality until mid-January. Orlando tangelo is recommended for home orchards in Zone I.

Dancy Tangerine

The most extensively planted tangerine variety; the fruit ripens in mid-December to February. Fruit is medium in size and has a slightly flattened shape. The fruit color is deep orange-red at maturity. The fruit dries out when left on the tree for a long time after becoming ripe. Dancy tends to overbear and has brittle wood, resulting in frequent limb breakage. This variety is recommended for planting only in Zone I.

Robinson Tangerine

Robinson tangerine is a cross between Clementine mandarin and Orlando tangelo. This variety produces medium to large fruit with deep orange-red flesh of excellent quality. It peels easily. It matures in mid-October. It produces best when planted with Orlando tangelo or Sunburst tangerine since it will not set fruit with its own pollen. It has brittle wood and a tendency to set fruit near the end of its limbs, resulting in limb breakage with large crops. This variety is recommended for home planting in Zone I.

Sunburst Tangerine

Sunburst tangerine is a cross between Robinson and Osceola tangerine. The fruit ripens in late November and December and holds well on the tree. Fruit are reddish-orange and are high-quality with good flavor. It requires cross pollination with Orlando tangelo for good fruit set. It is very susceptible to rust mite injury. Sunburst tangerine is recommended for trial plantings in home orchards in Zone I.

Citrus in Zone III would freeze regularly. Home growers may risk planting satsumas and kumquats in Zone III. Citrus in Zone III should be grafted on a trifoliata rootstock and be protected in winter.

Zone II is a marginal area where only the cold-hardy satsuma and kumquats should be grown. Certainly, any plantings of citrus in Zone II should be undertaken only after realizing the risk of freezing. Success with citrus planted in Zone II can be enhanced with the trifoliata rootstocks and use of cold protection practices.

Zone I, the coastal area, is the primary area of commercial citrus production. Generally, all citrus types can be grown in this zone.

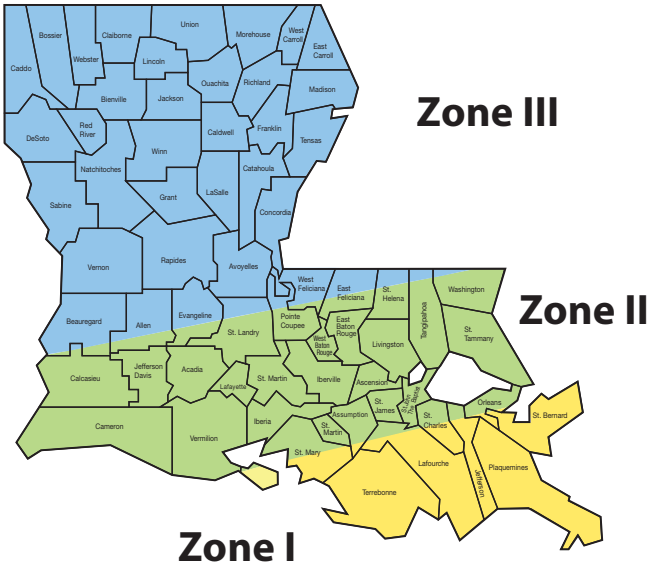


Figure 1. Louisiana climatic zones

kumquats satsumas sweet oranges grapefruit tangerine tangelos lemons limes

Kumquats	Satsumas	Sweet Oranges	Grapefruit	Other Citrus	Lemons
Nagami (sour)	Owari	Louisiana Sweet	Ruby Red	Ponkan Mandarin	Meyer
Meiwa (sweet)	Brown's Select	Washington Navel	Rio Red	Dancy Tangerine	
	Louisiana Early	Hamlin Sweet		Robinson Tangarine	
	Early St. Ann	Amber Sweet		Orlando Tangarine	
	Kimbrough	Moro Blood Orange		Sunburst Tangerine	

Areas of Citrus Production

Because of potential freezes, citrus can be produced in only a limited area of our state. Louisiana can be divided into three general climatic zones (Figure 1). Only two of these zones are suitable for citrus production. Zone I, the coastal area, is the primary area of commercial citrus production. Generally, all citrus types can be grown in this zone. Zone II is a marginal area where only the cold-hardy satsuma and kumquats should be grown. Certainly any plantings of citrus in Zone II should be undertaken only after realizing the risk of freeze-outs. Success with citrus planted in Zone II can be enhanced with the use of trifoliata rootstocks and cold-protection practices.

Citrus in Zone III would freeze-out regularly. Homeowners may risk planting satsumas and kumquats in Zone III. Citrus in Zone III should be grafted on a trifoliata rootstock and be protected in winter.

Rootstocks

The best citrus rootstock for the Louisiana home citrus orchard is trifoliata (*Poncirus trifoliata* Rubidoux). It is the most-cold hardy of the citrus rootstock, resistant to rots and tolerant of wet soils. Homeowners should ask nurseries to obtain trees on trifoliata, but they are at the mercy of the nurseries on the rootstocks of the citrus trees they buy.

One of the major rootstocks used in the Louisiana citrus nursery trade is *Swingle citrumelo*. This very vigorous rootstock produces a large budded tree in one year. Trees budded on Swingle rootstocks are vigorous and produce good crops of high quality citrus. The main drawback of using Swingle rootstock is that it is not as cold hardy as trifoliata.

In the last several years, several nurseries have been grafting citrus trees on a dwarf rootstock known as Flying Dragon Trifoliata. Dwarf trees are ideal for homeowners with limited space. Good crops of oranges and satsuma can be made in a circle only 10 feet in diameter. Ask your local garden centers and nurseries to obtain trees budded on the dwarf Flying Dragon Trifoliata rootstocks.

Growth of Citrus

Growth in citrus tends to be in flushes with periods of shoot inactivity between the flushes. In Louisiana, there are three flushes of growth a year. The first flush occurs in late February and March. This is usually the time of greatest shoot extension because more buds elongate. The second flush occurs in August, and the last takes place in October. During growth flushes, the shoots elongate in between the flushes, the leaves expand to full size and root growth occurs

Flowering of Citrus

Oranges, grapefruit, mandarin, tangelo and tangerines tend to bloom in March, while satsumas and kumquats bloom in late March and April. Lemons and limes tend to blossom continuously, but the heaviest blossoms are in the spring. Citrus flowers tend to be borne in small clusters in the axils of leaves on last year's wood and as single flowers in the axils of leaves of a growth flush that is just completed.

Pollination

Citrus flowers have both male and female parts in the same flower (complete perfect flowers) and will pollinate themselves and produce fruit (self-compatible and self-fruitful). Pollination is seldom a problem in citrus. There are, however, a few special cases with tangelo and tangerines where a pollinator is required for good fruit set.

Citrus trees produce an abundance of flowers. Citrus has a natural tendency to drop its fruit, and most of the fruit set at bloom will not hold on until maturity. A good crop may be borne if only 3 percent to 7 percent of the flowers that are set turn in to mature fruits. The Washington navel and satsuma do not have viable pollen. They set fruit without pollination and have no seeds. The few seeds in a satsuma are from viable pollen from another variety.

Site Selection

A well-drained soil, high in organic matter and slightly acid to neutral, is desirable for citrus. The site should provide full sunlight. In most cases, homeowners are limited to sites in the yard where citrus can be planted. Sites with the most sun should be selected for a citrus planting. Citrus trees require good drainage. Trees planted on heavy clay soils with poor internal drainage should be planted on a mound or row 8 to 12 inches high.

Planting

The best time to plant citrus trees is in January or February. Trees planted after December can withstand a freeze in February better than earlier-planted trees. A 2- to 4-foot tree with three to four well-developed upward-growing side branches, 18 to 24 inches above the ground, is the ideal tree for home plantings.

The root system of young trees should be inspected before planting. Trees that have bent or circled root systems will be stunted and grow poorly. Nurserymen and growers often called this condition "J rooted." Prune any damaged roots back beyond the damaged area. If container-grown trees have a tap root curled in the bottom of the container, cut this root off at the point where it begins to curl. The tree will grow a new tap root. Separate and trim the roots of container trees that are root-bound.

Dig a hole slightly larger than the container. Place the tree in the hole at the same depth it was previously growing. If holes are dug too deep, trees may settle after watering. Trees set too deep may die. Container trees should have the top of the soil flush with the top of the hole.

Bare-rooted trees should have soil placed underneath them in a manner to allow the spreading of the roots in a natural position with no bending or crimping.

Before completion of backfilling, add water to settle the soil and eliminate air pockets around the roots. After watering, fill the hole to completion and water again. Construct a ridge around the complete circumference of the tree to hold water during subsequent watering.

Spacing

Different types of citrus require different spacing. In most cases, homeowners are limited to the space in their yards for citrus trees. The site that will provide the most space should be selected. Trees planted too close together or against buildings will have limited sunlight and air movement that will restrict the growth and yield of the tree and enhance the development of pests. Spraying for pests, pruning and harvesting the fruit are difficult on trees planted too closely together.

Navel oranges, grapefruit and other oranges are the most vigorous citrus trees. They require at least a 30- to 40-foot diameter circle. (Example: Allow at least 15 to 20 feet from any building or large tree on each side of the navel orange, grapefruit or other round oranges). A satsuma is not as vigorous as oranges or grapefruit and requires a 20- to 30-foot diameter circle; kumquats and lemons need only a 15- to 20-foot diameter circle.

Fertilizer

Citrus trees require annual fertilization for good growth and high yields of good size, high-quality fruit.

Newly set trees should not be fertilized until they show signs of growth, usually six weeks after they are set in the spring (mid-March). On newly planted trees, apply ½ pound of 8-8-8 or 13-13-13 per tree in mid-March.

After the second year, fertilize citrus trees in late January or early February. Apply 1 to 1 ½ pounds of 8-8-8 or 13-13-13 per year of tree age up to 12 years. Increase the rate of fertilizer 1 to 1 ½ pound per year as the tree gets older. A 1-year-old tree gets 1 to 1 ½ pounds of 8-8-8 or 13-13-13, and a 5-year-old tree gets from 5 to 7 ½ pounds. The fertilizer rate is increased each year until the tree is 12 years old. Trees 12 years old and older are at the top limit of fertilizer and should receive 12 to 18 pounds of 8-8-8 or 13-13-13 per tree.

A simple fact to remember is that 1 pint of 13-13-13 weighs about 1 pound and a quart weighs 2 pounds. (Example: A 1-year-old tree will require 1 pound or 1 pint of 13-13-13, and a 4-year-old tree will require 4 to 6 pounds or 2 to 3 quarts of 13-13-13.) Table 1 shows the fertility schedule for citrus trees.

Table 1. Fertility Schedule for Homeowners Citrus Trees

Tree Age	Time of Year	Amount of Fertilizer per Tree
Year of transplanting	Mid-March 6 weeks after transplanting	½ lb of 8-8-8 or 13-13-13
First year	Late January-early February	1-1 ½ lb of 8-8-8 or 13-13-13
Second year	Late January-early February	2-3 lb of 8-8-8 or 13-13-13
Third year	Late January-early February	3-4 ½ lb of 8-8-8 or 13-13-13
Fourth year	Late January-early February	4-6 lb of 8-8-8 or 13-13-13
Fifth year	Late January-early February	5-7 ½ lb of 8-8-8 or 13-13-13
Sixth year	Late January-early February	6-9 lb 8-8-8 or 13-13-13
Increase the rate of fertilizer 1 - 1 ½ lb of 8-8-8 or 13-13-13 per year as the tree gets older.		
Twelfth year and older	Late January-early February	12-18 lb of 8-8-8 or 13-13-13

Table 2. Summer Nitrogen Fertilizer for Homeowners Citrus Trees

Tree Age	Time of Year	Amount of Fertilizer per Tree
Fourth year Bearing age	Late May or June	1 lb $AmNO_3$ or $AmSO_4$ or 2 lb $CaNO_3$
Fifth Year	Late May or June	1 ¼ lb $AmNO_3$ or $AmSO_4$ or 2½ lb $CaNO_3$
Sixth Year	Late May or June	1 ½ lb $AmNO_3$ or $AmSO_4$ or 3 lb $CaNO_3$
Seventh Year	Late May or June	1 ¾ lb $AmNO_3$ or $AmSO_4$ or 3 ½ lb $CaNO_3$
Increase the rate of $AmNO^3$ or $AmSO^4$ ¼ lb ($CaNO3$ ½ lb) per year age of tree as the tree gets older		
Twelfth Year and Older	Late May or June	3 lbs $AmNO_3$ or $AmSO_4$ or 6 lb $CaNO_3$

A small amount of nitrogen fertilizer (¼ pound of Ammonium Nitrate or Ammonium Sulfate/year/age of tree or ½ pound of Calcium Nitrate/year/age of tree) should be applied to bearing trees (trees 4 years and older) in late May or June. The rate of fertilizer is increased each year until the tree is 12 years old. This helps the tree make adequate vegetative growth and appropriate sized fruit. The additional nitrogen also will encourage the tree to set a crop the following year. Nitrogen fertilizer should not be applied after the end of June. Fertilizer applied after the end of June will decrease cold hardiness and delay fruit from ripening. Table 2 shows the summer nitrogen fertilizer schedule for citrus trees.

Broadcast the fertilizer beyond the spread of the limbs where most of the feeder roots occur. A general rule when fertilizing trees is to put your left shoulder near the outer branches and hold the can of fertilizer in your right hand. You can simply walk around the tree and evenly spread the fertilizer in a 12- to 18-inch band on the outer branches of the tree. This technique will ensure that the fertilizer is placed a safe distance from the tree.

Avoid fertilizing citrus trees after the end of June. Late fertilization will encourage vigorous growth, delay fruit maturity and decrease the cold hardiness of the tree. Homeowners are also encouraged to pay strict attention to the amounts of fertilizer applied to citrus trees. Amounts above those recommended will encourage vigorous growth, delay fruit maturity and decrease cold hardiness. Vigorous growth can result in extensive freeze damage or death of the trees, even in a moderate freeze.

Pruning Trees

Good nursery trees usually have a framework already developed when purchased.

Homeowners should try to select a 2- to 4-foot tree. Trees should be pruned after planting and before growth starts in the spring. The top of the tree should be removed 18 to 24 inches from the ground at a site where there are three or four evenly spaced wide-angle lateral branches with an upward-growing pattern that has developed. All growth developing below this framework should be removed.

The primary purpose of pruning young nonbearing trees is to shape the tree so that scaffold branches will be well-distributed. This initial pruning helps bring the tops of the plants and the root system into balance. It also stimulates good scaffold branch development. If scaffold branches are selected properly, the weak narrow crotches and downward growing branches can be eliminated and future breakage under heavy fruit loads can be avoided. Proper selection of scaffold branches also will reduce the large pruning cuts in the future years.

After the selection of the scaffold branches, only limited pruning is needed on citrus. All pruning on older trees should be done in January and February. Pruning trees of bearing age is practiced to thin out thick growth to spray and harvest easily. The removal of long vigorous growing shoots that stick up at the top of the tree will help to control the size of the tree. These long shoots should be traced to where they originate on larger branches and cut off flush at the point of attachment. Dead branches, branches crossing over each other, water sprouts arising from the center of the tree and branches touching the ground should be removed. When pruning, cut all limbs flush at the point of attachment.

Freeze-damaged trees should not be pruned until the extent of cold damage has been determined. Normally, the damage is not evident until July and August after the second flush of growth. Pruning a freeze-damaged tree consists of removing the dead wood to the point where the live wood starts.Picking

Citrus is the ideal fruit for the home grower because it can remain on the tree in a good state for a number of months. Satsumas can be harvested in the green-yellow stage as early as late September early October, while oranges, grapefruit and other citrus are not ready to harvest until they reach the full color stage – starting in late November through early December.

Harvest

Home growers can start picking satsumas and kumquats as soon as the fruit starts turning from yellow to green. A good rule is to taste a satsuma or kumquat; and if you like the taste, start picking a few of the fruit each week. The fruit left on the tree will turn from yellow to orange, develop a loose skin and become sweeter. Just be aware that satsumas will not separate cleanly from the stem. They should be clipped from the stem to prevent tearing the skin of the fruit.

Citrus fruit left on the tree will develop more color and improve in quality with exposure to low temperatures. It takes temperatures in the mid- to low 20s five to 10 hours to freeze the fruit. All fruit should be picked by the end of January or early February. Fruit left on trees after this time will reduce the blooms and fruit set for next year.

Citrus Insects and Mites

Backyard citrus groves can be attacked by a large number of insects and mites. These include insects that attack only foliage or fruit or pests that go for both foliage and fruit. Insects also can indirectly decrease the quality of citrus by producing a sticky substance called honeydew on which sooty mold grows. Honeydew is the black material you may find covering your citrus leaves and fruits.

The primary pest of citrus in Louisiana is the rust mite. Two other mite pests, the citrus red mite and two-spotted spider mites, are not as significant. Mites are arachnids rather than insects. Mites are related to spiders and have eight legs and two body parts.

Insects have three distinct body parts (head, abdomen and thorax) and six legs. Adults also may have a pair of wings. Sometimes it can be hard to see the three body parts, and wings may not be present in all insects. The most common insects that attack citrus in Louisiana include armored scales, soft scales, white flies, blackflies, mealybugs, leaf-footed bugs, stinkbugs, orange dogs and aphids. Most recently, the Asian citrus psyllid has been found in Louisiana. This pest transmits citrus greening disease, the most important disease of citrus worldwide.

Beneficial mites, insects and fungi also may be found on your citrus trees. So it is important to use a management approach that will kill the damaging insects while preserving beneficial insects on your citrus. This guide will teach you to identify mites and insects on your citrus trees. It also includes information about the biology of these pests and how to manage them using an integrated pest management plan.

Citrus Rust Mites

Phyllocopturta oleivora

Rust mites are very small, deep yellow and wedge-shaped. A generation may be completed in one to 32 weeks.

Figure 2. Citrus rust mite. Photo: Natalie Hummel

Rust mites feed on the outside exposed surface of fruit that is 1/2 inch or larger. The feeding destroys rind cells and causes browning on mature oranges and blackening on green fruit (Figure 2). Most damage occurs in early spring to early summer, although damage is possible throughout the year in groves not treated for other pests.

These mites have no specific predators, but other mite predators will feed on them. In early spring, check leaves for mites and check fruit after it reaches 1/2 inch in size.

Citrus Red Mite

Panonychus citri

The citrus red mite has a small red body with several white hairs (setae) rising from the back and sides of the abdomen. Each female can lay two to three eggs a day and may lay 20 to 50 eggs in her lifetime. The mite eggs are red with white setae in the top center. They can complete a generation from egg to adult in 12 days

Populations increase in spring, late summer and early fall in response to new growth of the tree, because these pests prefer young leaves. But be aware they also will infest fruit. Citrus red mites feed on the cells of leaves and fruit. Damage to foliage produces a pale stippling that is visible on the upper leaf surface (Figure 3). Stippling of the green fruit disappears when the fruit changes color. When large populations feed on fruit, the silvering may persist.

These mites have multiple generations and are fed on by predatory mites, lady beetles, lace wings, mantispids and six-spotted thrips.

Figure 3. Citrus Red mite. Photo by Natalie Hummel

Two-spotted Spider Mites

Tetranychus urticae

The two-spotted spider mite has a small, pale yellow body with dark spots on each side of its body. All stages overwinter on the trees and fruit. If winter is mild, they will feed through the season and increase normally.

Heavy infestations produce a web that may cover several fruit and foliage. Eggs are clear and become opaque before hatching. The mites molt three times after hatching. If conditions are optimum, they can complete development in seven days.

Damage from feeding results in yellowing or stippling, producing a grayish cast on the foliage. Mites, eggs, cast skins and egg shells can be observed along the veins on the underside of the leaves.

Predators help reduce populations of two-spotted spider mites. Predatory mites, lady beetles, six-spotted thrips and the minute pirate bug are effective in keeping populations small. Remember, however, that repeated spraying of pesticides will reduce predators and create mite problems.

Mealybugs

Mealybugs are soft, flat, oval, distinctly segmented and covered with white or mealy wax that extends into spikes along the abdomen and posterior end (Figure 4). The citrus mealybug has a yellow-orange body covered with a powdery wax. The waxy spikes are not very long on the abdomen or posterior.

The Comstock mealybug has a thicker wax covering, and the wax spikes on the abdomen and posterior are prominent. The female lays several hundred eggs within 10 to 20 days in waxy egg sacks attached to the plant and fruit. There are two to three overlapping generations a year. They overwinter as eggs or in various stages, weather permitting.

Since they feed continuously, they excrete the excess sugary plant fluids onto the plant. This creates an ideal food for bees and wasps and an excellent medium for the growth of several species of fungi that develop into a black mat-like growth on the plants known as sooty mold.

Figure 4. Mealy bug. Photo: Natalie Hummel

Armored Scales

Florida Red Scale *Chrysomphalus aonidum*

Armored scales are called armored because they are a soft-bodied insect that is covered by a shell or scale. The adult female scale is circular, about 1/12 inch in diameter, dark reddish-brown with a conspicuous light yellow center. The female lays bright yellow eggs that hatch into lemon yellow, oval-shaped crawlers. Crawlers are the immature stage of armored scales and are able to move around on the plant. Once they mature, adult female scales deposit eggs under their shell-like cover. There are four to five generations a year.

Scales feed on the exposed surfaces of the leaves and fruit. Injury appears as yellow spots on the leaves and fruit, which can be followed by heavy leaf and fruit drop with dense populations of scales. These exposed branches can be killed by cold weather in winter and early spring. Inspections in orchards should be made from late spring through fall.

Yellow Scale *Aonidiella citrine*

The yellow scale can be distinguished from the red scale by the light yellow color of its armored shell. Like the red scale, it has a circular shell, but is yellow to light orange and much flatter than the red scale. The scale's body is visible through the armor and is yellow and kidney shaped. The female gives birth to live young. Injury and feeding locations and preferences are similar to the red scale. The yellow scale also has multiple generations each year.

Purple Scale *Lepidosaphes beckii*

Glover Scale *Lepidosaphes gloverii*

The female purple scale lays grayish eggs in a sac-like enclosure under her shell. Glover scale eggs are pink and are found in two rows. Crawlers of both are off-white and oval with a posterior brown tip. There usually are three generations a year with peaks in March-April, June-July and September-October.

Purple scales feed on the foliage, fruit and wood of the trees and are often overlooked because they live primarily on the inside of the tree. They like the shady areas such as the undersurface of leaves and collect along the mid-rib on the underside of the foliage. Yellow, chlorotic areas on the foliage can cause defoliation and twig death. Injury to the fruit may cause fruit drop as well as green spots that cannot be removed.

Females of both the purple and the Glover scale are long and tapered. The purple scale is wider, somewhat larger and darker. The Glover scale is very slender and elongated and is lighter or tan in color.

Soft Scales

Cottony Cushion Scale *Icerya purchasi*

This scale is easily recognized. The mature female has a bright orange-red, yellow or brown body that is practically or entirely covered with yellowish or white wax. They produce a fluted egg sac that usually is about two to two-and-a-half times longer than the body. This sac may contain up to 1,000 red eggs. Depending upon the temperature, they may hatch in a few days or over two months. Newly hatched nymphs are bright red with dark antennae and thin brown legs. This is the primary dispersal stage, and these pests can be blown by the wind or they can crawl or hitchhike on other animals.

The cottony cushion scale can severely damage trees and nursery stock. Decreased vitality, fruit drop and defoliation result from scale feeding. Most damage is caused by the feeding of the immature stages on the foliage. Older nymphs migrate to the larger twigs and the adults to the larger branches and trunk. This scale has been known to inject toxins, which can cause tree death, into the tree, while feeding. Damage also may result from the excretion of honeydew and the development of sooty mold on the foliage and fruit, reducing photosynthesis.

Florida Wax Scale *Ceroplastes floridensis*

These soft scales are covered with a dense layer of wax. The female beneath is bright pink. They feed on all parts of the plant and excrete large amounts of honeydew. They have three generations each year, and each female can lay 80 pink oval eggs at maturity. Upon hatching, the pink crawlers move about the plant and, once settled, begin to secrete the white wax. Young instars have a reddish body with white wax rays extending from the margins and dorsal areas of the body. The wax completely covers the body by the late third instar.

On the foliage, the scales appear to collect along the main veins of the leaf and cover the leaf in dense populations. They are not known to cause any appreciable damage but, with the honeydew excretions, can cause the plant to look bad and grow erratically.

Adults killed by sprays will not easily fall from the plant, because the wax will hold them to the surface. Dead scales will fall off with time, and heavy rainfall will assist in removal. Control is noted by reduced numbers and no movement to new growth.

Asian Citrus Psyllid

Diaphorina citri

Figure 5. New growth infested with Asian citrus psylid adults and nymphs. Photo: Raj Singh

Figure 6. Adult Asian citrus psylid. Photo: Raj Singh

Asian citrus psyllid vectors a bacterial disease called citrus greening. Adults are very small and measure 3-4 mm in length.

Female psyllids lay bright orange eggs in the whorls of newest growth. The eggs hatch and yellow immature psyllid feed on new growth and suck cell sap. Immature psyllids go through five nymphal stars and excrete white wax from their hind ends (Figure 5).

Adult psyllids have piercing and sucking mouth parts and feed on citrus leaves at a 45 degree angle position (Figure 6). Under favorable conditions, Asian citrus psyllid may complete up to 30 generations.

Diaprepes Root Weevil

Diaprepes abbreviates

Diaprepes root weevil, also known as sugarcane root-stock borer or West Indian weevil, is an important pest of citrus.

Adult beetles feed on leaves and notch leaves in a semicircular fashion (Figure 7). The feeding from adult beetle does not do any harm to mature trees but feeding from weevil larvae on the roots can kill the tree. Root injury caused by larvae of citrus root weevil, Diaprepes abbreviatus provides infection sites for foot rot caused by Phytophthora spp.

Female weevils lay eggs between two leaves and glue them together with a gelatinous material. Newly emerged larvae do not feed on the leaves and drop to the soil where they burrow and feed on the roots. Larvae are grub shaped and creamy white in color (Figure 8). As larvae molt and grow, they become aggressive feeders and can damage the entire root system of mature trees. Mature larvae pupate in the soil for two to four weeks before the adults emerge.

Figure 7. Citrus root weevil adult. Photo: Raj Singh

Figure 8. Citrus root weevil grub. Photo: Raj Singh

Whiteflies/ Citrus Blackflies

The citrus whitefly, the woolly whitefly, the cloudy-winged whitefly and the citrus blackfly (Figure 9) all are present in Louisiana. These are piercing, sucking feeders in both the nymph and adult stages.

Figure 9. Citrus blackfly. Photo: Natalie Hummel

The eggs are laid individually by the whiteflies are usually yellow when laid and turn dark before hatching. The citrus blackfly lays its eggs in a spiral fashion, making them easy to detect (Figure 10).

Figure 10. Citrus blackfly eggs. Photo: Natalie Hummel

The nymphs are clear when they first hatch and gradually change color as they mature, depending on species. The eggs usually are placed on the underside of the leaf surface, and the nymphs develop there. The nymphs develop through three instars and then pupate. The empty clear shells left behind often are mistaken for developing nymphs.

Large populations of whiteflies occur in March-April, June-July and September-October. Populations are easily managed when caught early—before multiple generations can develop. The citrus whitefly and cloudy-winged whitefly often are attacked by a red-colored, beneficial fungus, *Aschersonia aleyrodis* (Figure 11). Whiteflies also are consumed by ladybugs.

Figure 11. Citrus whitefly and cloudy-winged whitefly attacked by red-clored, beneficial fungus. Photo: Natalie Hummel

Leafminers

These small pests affect the foliage of each flush of growth. The moths deposit their eggs on the underside of the foliage and, upon emerging, larvae tunnel into the leaf and create winding tunnels between the upper and lower surfaces as they develop and feed (Figure 13).

At maturity, the larvae move to the edge of the leaf, causing it to curl. This protected area is where the larvae pupate. The larval stage lasts from five to 20 days; pupation lasts six to 22 days.

Adult females emerge in the morning and lay their eggs at night. Total development time takes from 13 to 52 days, depending on weather and temperature. Adults are short lived. But there are multiple generations each year, which can occur every three weeks, depending on the environmental conditions.

Figure 13. Leafminer in new flush. Photo: Natalie Hummel

Giant Swallow Tail/ Orange-dog Caterpillar

Papilio cresphontes

The orange-dog caterpillar often is a pest of young trees, and one or two of these caterpillars can completely strip a young tree of its foliage. The larva appears as bird droppings on the foliage and stems when small (Figure 14).

When disturbed, they evert a pair of orange glands from the base of the head (Figure 15). This is caused by blood pressure, and these hornlike glands have a very pungent odor. The odor is used as a defense mechanism against predators.

The adult butterfly is called the giant swallowtail. It is black with a series of yellow spots that form bands in both the fore and hind wings.

Figure 14. Giant swallow tail/orange-dog caterpillar. Photo: Natalie Hummel

Figure 15. Giant swallow tail/ orange-dog caterpillar with hornlike glands displayed. Photo: Natalie Hummel

Leaf-footed Bugs

The western leaf-footed bug is widespread and a pest of many crops including fruits, vegetables, grains, nuts and ornamentals. It is a major pest of citrus, and its feeding on ripening fruit causes premature color break and fruit drop (Figure 16).

Adults will fly considerable distances and enter orange groves at bloom time to feed on buds and young shoots. Later, adult bugs will attack the ripening fruit, causing drop. Leaf-footed bugs transmit a yeast, Nematospora coryli, that causes dry rot.

Leaf-footed bugs primarily attack Satsuma mandarins. Injury usually occurs as the fruit matures in the fall.

The leaf-footed bugs will aggregate in large colonies on individual trees while neighboring trees are completely free of bugs. Leaf-footed bugs are parasitized by a Tachinid fly, which lays eggs on adults and nymphs. Immature flies hatch from the eggs and consume the leaf-footed bug internally.

Figure 16. Leaf-footed bug on citrus. Photo: Natalie Hummel.

Southern Green Stinkbug

The southern green stink bug is a widespread pest of many crops (Figure 17). It is an occasional pest of citrus, and the feeding of adult southern green stinkbugs on ripening fruit causes premature color break and fruit drop.

Biology and damage of the southern green stinkbug are very similar to the leaf-footed bug.

Figure 17. Southern green stinkbug. Photo: Natalie Hummel

Aphids

Aphids or plant lice are injurious to young trees and can cause severe leaf curling to new growth on trees, particularly in the fall. Five different species of aphids are found on citrus: the green citrus aphid, the cotton aphid, the melon aphid, the black citrus aphid and the green peach aphid. All aphids feed with piercing, sucking mouthparts and excrete the excess sugars, honeydew, which promotes sooty mold development.

Aphids can be recognized by the pair of little tubes located on the rear of the abdomen. These are called cornicles, and only aphids have them. The feeding of aphids on foliage causes leaves to roll, curl up and become disfigured. This is usually observed on the young, tender growth, both in the spring and on the last flush of the trees in the fall.

Aphids are attacked by predators, mostly lady beetles, and by various parasites.

Insect Management Spray Schedule

Pest to Control	Pesticide and Formulation	Amount to use for:		Limitations
		50 gallons	1 gallon	
Post bloom spray: when 75% of petals have fallen				
Scales, Whiteflies, Mealybugs	Malathion 57EC Or	1 pint	2 teaspoons	Do not apply Malathion or Vendex fewer than 7 days before harvest. Do not apply Malathion to plants in full bloom. Do not use Vendex on tangerines, tangelos, Reed, or Red blush grapefruit. Do not apply Vendex when daily temperatures at application average below 70 °F. Make no more than 2 applications of Vendex/year and allow 60-day intervals between applications.
	Vendex 50 WP	4-6 ounces	1 - 1 ½ teaspoons	
Thrips, Leafminers	Spinosad	4-6 ounces	1 teaspoon	Allow a minimum of 7 days between last application and harvest; several formulations available for home gardens (i.e. Spinosad, Success, Conserve, Naturalyte, etc.); follow label recommendations.
Asian citrus psyllid	Bayer Advanced Fruit, Citrus & Vegetable Insect Control	Varies depending on size of tree		See product label for instructions and restrictions. 0.15 to 0.2 fluid ounce/inch of trunk diameter at breast height or/foot of tree height. Do not apply more than 5.9 fluid ounces of product/year.
Summer spray: July 15- August 15				
Scales, Whiteflies, Mealybugs	Vendex 50 WP +	4-6 ounces	1 - 1 ½ teaspoons	Same as above.
	Sun spray ultra fine oil or	½-1 gallons	2½-4 tablespoons	Use caution when applying oils; read the label; do not spray when temperatures exceed 85 °F; read footnotes.
	Summer oil emulsion or	½ gallons	5 tablespoons	
	Malathion 57EC	1 pint	2 teaspoons	Same as above.
Asian citrus psyllid	Bayer Advanced Fruit, Citrus & Vegetable Insect Control	Varies depending on size of tree		See product label for instructions and restrictions.
Thrips, Leafminers	Spinosad	4-6 ounces	1 teaspoon	See limitations above; read the label.
Fall spray: October 15- November 15				
Scales, Whiteflies, Mealybugs, Leaf-footed bugs	Malathion 57EC	1 pint	2 teaspoons	Same as above.
Asian citrus psyllid	Bayer Advanced Fruit, Citrus & Vegetable Insect Control or	Varies depending on size of tree		See product label for instructions and restrictions.
	Vendex 50WP or	4-6 ounces	1-1 ½ teaspoons	
	Spinosad			See limitations above; read the label.

Integrated Pest Management

The LSU AgCenter recommends developing and following an integrated pest management plan to control insects and mites that attack your backyard citrus. Integrated pest management is a concept that includes using a variety of cultural, biological and chemical control tactics to control insects and mites.

The first step in an effective integrated pest management plan is the proper identification of the insect or mite that is attacking your citrus. The second step is to determine the best approach for managing this pest or preventing infestation of your citrus tree(s).

Depending on your preference and your tolerance for damage to your fruit, you can choose to use chemical or nonchemical means to control insects and mites on citrus. The specific guidelines vary depending on the pest.

Cultural control strategies include managing weeds near your trees. Weeds often provide a harbor for insects that may attack your trees. It also is important to scout frequently for insects and mites attacking your tree(s) in order to attempt to control them before they are abundant on your tree(s).

Biological control is the use of predatory mites or insects, pathogens or other naturally occurring mechanisms to control insects and mites attacking your citrus.

Chemical control is the use of pesticides to control insects and mites on citrus. Please contact a county agent in your parish LSU AgCenter office for the latest in LSU AgCenter Citrus IPM recommendations. If you intend to use pesticides to control insects and mites in your citrus, please consult the latest version of LSU AgCenter publication 1838, which provides the latest pesticide recommendations to control citrus in backyards.

In general, be sure to carefully read any insecticide labels before applying them to your citrus trees. Before you spray your citrus with any insecticides, make sure citrus is included on the label. Also make sure the insects or mites you would like to control are listed on the label.

Oils can be used to control many insects that attack citrus, including whiteflies and scales. These products work by suffocating insects and causing them to die. But keep in mind it is important to discontinue use of oils after Aug. 1 to avoid damage to fruit and delay in fruit maturity.

Use Correct Water pH When Spraying Insecticide

It is very important to consider the pH of tank water when preparing pesticides to spray on citrus trees to control insects. pH is a factor of the acidity or alkalinity of your water. It is important for your water to be on the acid side (pH less than 7.0) when spraying insecticides. Most insecticides are acid-forming materials. If mixed in an alkaline water solution (pH greater than 7.0), they can break down before you spray them on your crop. If the pesticide breaks down, it will not kill the insects you are trying to control.

The average pH of water in Louisiana is 8.3, while the optimum range for most insecticides is between 5.5 and 6.5. It is best to check your water pH with a digital pH pen. pH can be adjusted by adding a buffer before adding the insecticide. Add buffer, check pH and repeat until the proper range is reached. Then add insecticide, mix solution and spray.

Using the correct pH allows the insecticide to give you the proper knockdown of the pest and extended residual for proper insect management. Spraying without adjusting pH can cause you to spray more and lead to development of insect tolerance or resistance to the insecticide used. Tolerance is the ability of an insect or mite to tolerate exposure to an insecticide. Resistance is an inherited condition in which the offspring of an insect or mite that survived an insecticide treatment also have the ability to survive subsequent insecticide treatments.

Spraying insecticides from a tank solution with the proper pH will give better control of the pest with fewer sprays – thus saving you time and money, as well as being safer for the environment.

Disease Identification and Management

Citrus trees and their fruit are subject to several diseases. Only the most common ones are described.

Citrus Canker

Citrus canker is a devastating disease of citrus caused by the bacterium, *Xanthomonas citri* subsp. *citri*. Citrus canker is a highly contagious disease and all citrus varieties are susceptible – although some varieties are less susceptible than others.

Listed from highly susceptible to less susceptible citrus varieties are: grapefruit, trifoliate orange, Mexican/Key lime, navel orange, sour orange, sweet orange, lemon, satsuma, tangerine, Mandarin orange, king orange and kumquats. Symptoms on leaves and fruits start as tiny raised blisters that expand and become tan to brown as the disease develops. Lesions are visible on both sides of the leaves with water-soaked margins surrounded by yellow halo (Figure 18).

The pathogen forms raised corky craterlike lesions on the fruits. Those fruit lesions often also have water-soaked margins surrounded by yellow halo (Figures 19 and 20). Similar lesions are present on the twigs and leaf petioles, except the water-soaked margins may be reduced and the yellow halos are absent. As the disease intensifies, defoliation and twig dieback occur, and severely blemished fruit drop prematurely. The pathogen prefers a temperature range from 68-86 degree Fahrenheit but is active over a wide temperature range. Lesions appear at about 10 days to two weeks after infection.

Natural infection requires free water on the leaf surface to permit bacterial access through stomates or wounds. It is not vectored by insects or other organisms, but the wounds caused by citrus leafminer may serve as infection sites (Figure 21). Bacteria survive in old cankers, and under wet and warm environmental conditions exude from these cankers and disperse short-distance via wind-borne rain, lawnmowers, other landscaping equipment and people carrying the infection on their hands, clothing or equipment. Long-distance dispersal of citrus canker generally is attributed to human movement of infected or exposed citrus material and storm events like hurricanes and tornadoes.

Figure 18. Citrus canker on leaves. Photo: Raj Singh

Figure 19. Citrus canker on sweet orange. Photo: Raj Singh

Figure 20. Citrus canker on Meyer lemon. Photo: Raj Singh

Figure 21. Citrus canker and citrus leafminer association. Photo: Raj Singh

Louisiana residents are urged not to move any infected citrus plant material within or out of the state. Homeowners must buy citrus trees from certified nurseries only. If you believe that your citrus trees have similar symptoms as shown in the pictures, please do not take any samples and contact U. S. Department of Agriculture at 225-298-5410 or the Horticulture and Quarantine Division of the Louisiana Department of Agriculture and Forestry at 225-952-8100. More information about citrus canker can be obtained by calling Dr. Raj Singh with the LSU AgCenter at 225-578-4562 or emailing rsingh@agcenter.lsu.edu.

Citrus Greening

Citrus greening, also known as yellow shoot disease or huanglongbing, is one of the most devastating diseases of citrus worldwide. It is a bacterial disease caused by *Candidatus* Liberibacter asiaticus (other strains of citrus greening bacteria also cause disease), that inhabits the phloem (or food conducting tissues) of the tree.

It affects all citrus varieties and certain other members of the citrus family. Sweet orange and mandarin orange are highly susceptible to the disease. Sour orange, grapefruit and lemons are moderately susceptible. The orange jasmine, *Murraya paniculata*, is also a host of both Asian citrus psyllid and citrus greening bacterium. The bacterium is transmitted from infected to healthy trees by an insect, Asian citrus psyllid (Figure 6 on page 10).

Figure 22. Blotchy Mottling caused by citrus greening. Photo: Raj Singh

Figure 23. Thickening of veins caused by citrus greening. Photo: Raj Singh

Citrus greening can also be transmitted by grafting diseased budwood. Once the tree is infected, it stays infected for rest of its life and there is no cure.

Citrus trees affected by citrus greening may not show symptoms for years. Symptoms include blotchy mottling of the leaves (Figure 22), thickening of the veins (Figure 23), yellowing of the shoots, twig dieback, stunted growth and lopsided fruits (Figures 24 and 25). Infected fruits do not ripe uniformly and some green color remains on the ripe fruits. Greening-affected fruit taste bitter, medicinal and sour. Seeds usually abort, and fruit set is poor.

There is no chemical control available for citrus greening. Once the tree is infected, it stays infected for rest of its life and there is no cure. Homeowners must buy citrus trees from certified nurseries only. The Asian citrus psyllid (vector of citrus greening) can be managed with insecticides (see insect pest management section on page 14).

Figure 24. Lop-sided grapefruit caused by citrus greening. Photo: Raj Singh

Figure 25. Lop-sided internal. Photo: Raj Singh

Citrus Scab and Sweet Orange Scab

Both citrus scab and sweet orange scab are fungal diseases.

Citrus scab is caused by *Elsinoë fawcettii* and occurs primarily on sour orange (used primarily as rootstocks), grapefruit, lemons, mandarins, satsumas, tangerines and tangerine hybrids. It rarely affects oranges or limes. Citrus scab affects fruit, leaves and young shoots, causing irregular raised corky, scabby wart-like outgrowths. Severely scabbed leaves and fruit become misshapen and distorted (Figure 26). The rind of scabbed fruit is thick and puffy.

Sweet orange scab is caused by *Elsinoë australis* and occurs on sweet oranges, limes, lemons, mandarins, satsumas, kumquat, grapefruit, tangerines and tangerine hybrids. In contrast to citrus scab, sweet orange scab produces circular, smoother and flatter pustules (Figures 27 and 28). These pustules give the fruit a corky or scurfy appearance (Figure 29).

Both citrus scab and sweet orange scab require moist conditions to reproduce and under optimal temperatures (68-75 F for citrus scab and 75-80 F for sweet orange scab), both diseases develop quite rapidly. The pathogens survive in older pustules on leaves and fruits and spread primarily with water splash and sometimes also with wind driven rain. Removal of infected leaves and fruits from the trees and/or the ground help reduce fungal spores. Minimize disease infection and spread by avoiding overhead irrigation and watering early in the morning to reduce extended periods of leaf wetness.

Figure 26. Common citrus scab. Photo: Raj Singh

Figure 27. Sweet orange scab on leaves. Photo: USDA APHIS

Figure 28. Sweet orange scab on ripened fruits. Photo: Raj Singh

Figure 29. Sweet ornage scab on green fruit. Photo: USDA APHIS

Fruit Rots

Fruit rots usually are not a problem in home orchards. However, green mold caused by *Penicillium* spp. and brown rot caused by *Phytophthora* spp. can cause problems in wet seasons or if the fruit remains on the tree too long. These pathogens easily invade overripe or bruised or injured fruit.

Fruit rots can be controlled by following good sanitation practices, pruning low limbs to prevent fruit from touching the ground and drying fruit immediately after harvesting.

Foot Rot/Root Rot/Gummosis

Foot rot or root rot is the most frequently encountered disease on the trunks and roots of citrus trees in Louisiana. The disease is caused by a soil-borne water mold known as *Phytophthora* spp., a fungal-like organism. The pathogen produces motile spores called zoospores that splash with irrigation or rain water and invade the trunk at the bud union resulting in foot rot. Wounds or injuries caused to lower trunk near soil line provide entry sites for the pathogen.

Wet conditions during the spring favor foot rot development. Above ground symptoms include wilting, yellowing of the leaves followed by defoliation and twig dieback. Rapid defoliation may occur on severely infected trees under favorable environmental conditions.

Foot rot symptoms start with water soaking of the bark that appears as a dark spot on the trunk. At first, the bark appears firm, but with age it becomes cracked and may shred as it dries. Gummosis (gum exudates from the trunk) often accompanies advanced stages of foot rot (Figure 30).

Root rot interferes with the water and nutrient uptake resulting in the poor health of the trees. Infected roots become soft, brown or discolored and fibrous roots slough losing their cortex. Root injury caused by larvae of citrus root weevil, *Diaprepes abbreviatus* (Figures 7 and 8 on page 12), provides infection sites for *Phytophthora* spp. Maintaining adequate drainage by planting trees on raised beds and pruning lower limbs off the ground to allow air movement around the tree are the best controls for the homeowners.

Figure 30. Foot rot or gummosis. Photo: Raj Singh

Figure 31. Ganoderma heart rot. Photo: Raj Singh

Ganoderma Heart Rot

Several species of wood rotting fungi called Ganoderma can cause heart rot of citrus. Heart rot occurs when the fungus invades the tree trunk through wounds or injury at or near the soil line and kills the sapwood. The pathogen kills the tree from inside out. After some time, conks or mushrooms appear on the trunk of infected trees (Figure 31).

Other symptoms related to heart rot include, yellowing of leaves, defoliation, twig dieback and general decline of the trees. Infected trees eventually die and the tree trunks disintegrate and decompose over time.

There is no chemical control available for heart rot. Cultural practices including, complete removal of infected trees along with roots, avoiding planting in the same spot where an infected tree has been removed, avoiding injury to the tree trunk at or near soil line during and after planting and complete care of the trees help avoid infection and spread of heart rot.

Greasy Spot

Greasy spot of citrus is a fungal disease caused by *Mycosphaerella citri*. It is most severe on grapefruits, lemons and sweet oranges, but all citrus cultivars are susceptible to the disease. Extended periods of high humidity and high temperature favor disease development.

Figure 32. Greasy spot on lower leaf surface. Photo: Raj Singh

Symptoms start on the lower surface of mature leaves as yellow to dark brown lesions and corresponding slightly raised chlorotic spots appear on the upper surface of the leaves (Figures 32 and 33). As the disease progresses, the lesions on both surfaces become darker and turn greasy in appearance. Severely affected leaves turn yellow and defoliate prematurely.

Figure 33. Greasy spot on upper leaf surface. Photo: Raj Singh

Removal of leaf debris containing infected and decaying leaves from the ground is essential to reduce the fungal spores.

Anthracnose

Anthracnose is a fungal disease caused by *Colletotrichum* sp. The disease can cause symptoms on both leaves and fruits.

Anthracnose produces light tan spots with dark purple margins on the leaves. Dry, firm decay of fruits occur and the entire fruit rot under during wet weather (Figure 34). As the disease develops, the lesions on the fruit and leaves produce spores that may disperse with water splashed from rain or irrigation.

Figure 34. Anthracnose on Fruit. Photo: Raj Singh

Removal of infected fruits both from the ground and on the tree is crucial to reduce the fungal spores.

Botryodiplodia Stem Canker

Stem canker caused by *Botryodiplodia* sp. is a fungal disease. Symptoms start with wilting of the leaves and twig dieback occurs (Figure 35). Wilted leaves may remain on the tree for several days.

Infected stem tissue becomes lighter in color than the rest of the bark and black fruiting bodies of the fungus appear in the cankered area (Figure 36). The fungus may produce cankers on both lateral shoots and main trunk. Under favorable environmental conditions, canker can girdle the entire trunk resulting in a rapid decline and death of the tree.

Avoid unnecessary injury during pruning of trees. Remove and discard infected tissue. Clean pruning and cutting tools with disinfectant between cuts.

Figure 35. Twig dieback caused by Botryodiplodia stem canker. Photo: Raj Singh

Figure 36 Stem canker with black fruiting bodies. Photo: Raj Singh

Melanose

Melanose is a fungal disease caused by *Diaporthe citri*. The disease affects leaves, shoots and fruit and forms numerous dark brown dots or spots. These spots are at first sunken but later become slightly raised but not as much as scab. The spots may cover one side of the surface of the fruit, or they may run in streaks to form a tear stain-like pattern (Figure 37).

Melanose infection occurs on young, tender growth. The fruit becomes progressively resistant with age. The fungus produces spores on dead twigs and branches.

Pruning and burning the dead wood helps to control this disease by eliminating much of the source of infection.

Figure 37. Citrus melanose. Photo: J.O. Whiteside. Reprinted with permission from Compendium of Citrus Diseases, 1st edition, 1988, American Phytopathological Society, St. Paul, MN.

Puffy Fruits

Puffy and misshapen fruit are mostly a problem on young vigorous growing satsuma trees (Figure 38). As the tree becomes older, the occurrence of puffy fruit decreases.

Puffy fruit on older trees are the result of fruit set on late blooms during periods of warm weather.

Little can be done to prevent puffy fruit. Good growing conditions, proper fertility and pest control will help to reduce the amount of this condition.

Figure 38. Puffy fruit. Photo: Ken Whitham

Lichens

Lichens are not plant pathogens or parasites. Lichens do not invade the tissue of the bark and cause no damage to the tree (Figure 39). Growth of different kinds of lichens often occurs on trunks, branches and sometimes on leaves of citrus trees.

Lichen growth is less abundant on healthy, vigorous trees than on neglected, weakened trees that are growing poorly. The presence of lichens is often blamed for the unthrifty condition of the trees, but the reverse is true; the lichen's growth is abundant because the tree is unthrifty from some other cause.

Lichens generally are considered harmless and usually no control is warranted. Improving the tree health and vigor with cultural practices including, proper fertilization, proper pruning and avoiding any drought stress help minimize lichens.

In case of severe lichen problem, spraying with copper fungicides might help.

Figure 39. Lichens. Photo: Raj Singh

Figure 40. Sooty mold. Photo: Raj Singh

Sooty Mold

The sooty mold fungus is not a parasitic organism. It does not penetrate the tissue of the plant, but grows superficially on the honeydew excretions of whiteflies, aphids, mealy bugs and scale insect (Figure 40).

Sooty mold can cause damage by preventing the sunlight from reaching the leaf and by making the fruit black and unattractive. Fruit covered with sooty mold is smaller and does not color well.

Manage sooty mold indirectly by controlling the whiteflies, aphids, mealy bugs and scale insects that excrete the honeydew on which the sooty mold fungus grows. When the insects are controlled, the sooty mold disappears.

Figure 41. Yellowing of foliage caused by iron chlorisis. Photo: Ed Richards.

Figure 42. Magnesium deficiency. Photo: Raj Singh

Nutrient Deficiencies

Citrus is highly susceptible to symptoms caused by nutrient deficiencies. Nutrient deficiencies may cause symptoms similar to diseases and it is very crucial to distinguish between the symptoms caused by nutrient deficiency and those caused by diseases.

Some of the common nutrient deficiencies include iron chlorosis (Figure 41), magnesium (Figure 42) and zinc deficiency (Figure 43). Homeowners are recommended to get their soil tested before applying fertilizers.

Figure 43. Zinc Deficiency. Photo: Raj Singh

Disease Management Spray Schedule

Disease	Fungicide	Recommendations
Citrus Canker	Copper (Bonide Copper Spray or Dust, Bonide Dragoon Dust with Copper, Bonide Liquid Copper Fungicide[1], Concern Copper Soap Fungicide, Gordon's Bordeaux Mixture, Hi-Yield Bordeaux Mix Fungicide, Hi-Yield Copper Fungicide, Lilly Miller Cueva Copper Soap Fungicide, Natural Guard Copper Soap Liquid Fungicide, SA-50 Southern Ag Liquid Copper Fungicide).	For suppression only as preventative application. Coppers fungicides can be used for organic gardening. Do not mix with liquid fertilizers. Do not use in spray solutions with a pH of less than 6.5. May cause staining of masonry, concrete, etc.
Citrus Greening	No chemical control.	Buy certified citrus plants; manage Asian citrus psyllid (see insect management section).
Citrus Scab and Sweet Orange Scab	Copper (Bonide Copper Spray or Dust, Bonide Dragoon Dust with Copper, Bonide Liquid Copper Fungicide[1], Concern Copper Soap Fungicide, Gordon's Bordeaux Mixture, Hi-Yield Bordeaux Mix Fungicide, Hi-Yield Copper Fungicide, Lilly Miller Cueva Copper Soap Fungicide, Natural Guard Copper Soap Liquid Fungicide, SA-50 Southern Ag Liquid Copper Fungicide).	Spray after bloom when the fruit is pea-size. Coppers fungicides can be used for organic gardening. Do not mix with liquid fertilizers. Do not use in spray solutions with a pH of less than 6.5. May cause staining of masonry, concrete, etc.
	Sulfur (Bonide Sulfur Plant Fungicide, Ferti-lome Dusting Sulfur, Green Light Wettable Dusting Sulfur, Hi-Yield Wettable Dusting Sulfur, Lilly Miller Sulfur Dust, Safer Brand Garden Fungicide II).	Do not re-enter treated area for 24 hours after application. Do not use during periods of high temperatures (85 °F or higher) or within two to four weeks of using an oil spray.
Foot Rot/ Root Rot/ Gummosis	Monterey Agri-Fos Systemic Fungicide (soil treatment as a drench).	Avoid injury to the trunk near soil line during and after planting. Improve soil drainage and avoid water logging conditions.
Fruit Rots	No chemical control.	Follow cultural practices to reduce fruit rots.
Ganoderma Heart Rot	No chemical control.	Avoid injury to the trunk during and after planting. Completely remove any dead stumps.
Greasy Spot	Copper (Bonide Copper Spray or Dust, Bonide Dragoon Dust with Copper, Bonide Liquid Copper Fungicide[1], Concern Copper Soap Fungicide, Gordon's Bordeaux Mixture, Hi-Yield Bordeaux Mix Fungicide, Hi-Yield Copper Fungicide, Lilly Miller Cueva Copper Soap Fungicide, Natural Guard Copper Soap Liquid Fungicide, SA-50 Southern Ag Liquid Copper Fungicide).	Spray copper fungicides 2-3 weeks after petal fall followed by a second spray at 2-3 weeks interval. Coppers fungicides can be used for organic gardening. Do not mix with liquid fertilizers. Do not use in spray solutions with a pH of less than 6.5. May cause staining of masonry, concrete, etc.
Melanose	Copper (Bonide Copper Spray or Dust, Bonide Dragoon Dust with Copper, Bonide Liquid Copper Fungicide[1], Concern Copper Soap Fungicide, Gordon's Bordeaux Mixture, Hi-Yield Bordeaux Mix Fungicide, Hi-Yield Copper Fungicide, Lilly Miller Cueva Copper Soap Fungicide, Natural Guard Copper Soap Liquid Fungicide, SA-50 Southern Ag Liquid Copper Fungicide).	Manage melanose on the fruit with copper spray one to three weeks after bloom and fruit set when the fruit is pea-size. Coppers fungicides can be used for organic gardening. Do not mix with liquid fertilizers. Do not use in spray solutions with a pH of less than 6.5. May cause staining of masonry, concrete, etc.
Puffy Fruits	No chemical control.	Follow cultural practices to promote good tree health.
Lichens	No control is warranted. In case of severe lichens problem, copper fungicides may be used.	Improve plant vigor and keep trees healthy.
Sooty Mold	No control is warranted. Manage insect pests. In case of severe sooty mold problem, copper fungicides may be used. Mild soap solutions may be used to wash off sooty mold from leaves and fruits.	Manage insect pests such as aphids, scale insects, whiteflies and mealybugs (see insect management section).

[1]Follow the label when handling and spraying chemicals. Avoid over dose of chemicals. Copper and sulfur containing fungicides may cause phytotoxicity when not used properly.

Freeze Protection

The major problem for home citrus production is survival of trees after hard freezes.

Temperatures in the mid- to low teens for five or more hours is necessary to kill trees. Temperatures in the low 20s for more than five hours will damage the fruit. The best way to reduce freeze damage is to maintain healthy trees.

Weak trees that show diseases and insect damage or nutritional deficiencies are more susceptible to freeze damage than healthy trees. Cultural practices that induce and maintain dormancy in the winter will also help trees survive during freezes. They include no late summer or fall fertilization or pruning.

Maintaining bare ground free of mulch and grass under citrus trees is a practice often overlooked by homeowners. Bare ground under the trees is warmer during freezes than sod-covered or mulched ground. Grass and mulches prevent heat from entering the soil during the day, so less heat energy is stored in the soil for release during the night.

To protect a single tree, homeowners can construct a simple frame covered with clear plastic over the tree. Light bulbs placed near the trunk of the tree or an electric heater can raise the temperature in the frame a few degrees and protect the trees during the freeze. The structure needs to be opened by mid-morning during bright sunny days to prevent the development of high temperatures that can damage the tree.

Wrapping the trunk of a tree to cover the bud union with insulation or Styrofoam will help prevent cold damage to the trunks. The top of the tree may be killed during a freeze; a tree can recover if its trunk is intact. Tree wraps work best on young trees.

To prevent foot rot, treat the trunk of the trees with a copper fungicide before wrapping. The wrap should be removed in the spring to prevent the occurrence of foot rot.

Trees can also be protected from freeze injury by banking the trunk to cover the bud union of the tree with a mound of soil. A mound of soil 18 to 24 inches high extending 2 to 3 feet from the trunk of the tree is necessary to provide freeze protection. Banking needs to be done well ahead of the killing freeze. The soil must be removed from the tree in the spring to prevent foot rot. Banking and removing the soil from citrus trees are difficult tasks. It is often very difficult for homeowners to bank trees successfully. As with wrapping, the trunk of the trees should be treated with a copper fungicide before banking.

Salt Damage

In Louisiana's coastal parishes, saltwater intrusion into the groundwater has caused salinity problems for citrus trees. This is a serious problem that is difficult to correct.

Trees affected by salt have few leaves, bloom sparingly and bear small crops of small fruit. The first signs of salt damage are the shedding of the mature leaves with the petiole of the leaf still attached to the branches. A large amount of the leaves will fall to the ground after a rain. As the damage progresses, the branches become defoliated and die back, and the canopy of the tree becomes very thin. Flowering and fruit yields are decreased.

The best defense against salt problems for home growers is to plant on a mound of soil 12 inches to 18 inches high. The mound helps to improve the drainage around the tree.

The use of underground drainage tubes (4-6 inches in diameter) has helped to minimize the damage from salt. The tubes are buried 2-feet to 3-feet deep and 5 feet to 10 feet to the side of the tree. These tubes remove water and salt away from the tree, which means this underground drainage system lowers the water table and reduces the salt in the soil where the tree is growing.

Gypsum also can be applied to the soil before planting or to the soil surface under bearing trees at the rate of 3 pounds to 5 pounds per 100 square feet. Gypsum should be applied underneath trees every 2 to 3 years. The calcium in the gypsum combines with the salt and becomes soluble. The salt can then be leached throughout the soil by rainfall. This is a slow process, however. The calcium from the gypsum also helps combat the effects of the salt in the trees. The use of low-salt fertilizers also is recommended.

Low-salt fertilizers are made from materials with low-salt indexes such as potassium sulfate, diammonium phosphate and calcium nitrate. The use of calcium nitrate (low-salt index) is recommended for the May-June application of nitrogen. These low-salt fertilizers may be difficult to find for home growers, however, so

they are encouraged to ask their local feed and seed stores and garden centers to stock low-salt fertilizers. Splitting the amount of fertilizer applied to the trees into three applications – coming four weeks apart in February, March and April – instead of just one application in February also is recommended. These frequent applications provide the necessary nutrients with a minimum amount of salt added to the soil.

Control-released, low-salt fertilizers also can be used in February on citrus trees having problems with salt. These fertilizers release a small amount of nutrients over a period of several months. Most controlled-release fertilizers are liquid encased in a plastic coating. The coating is washed away, which then releases the liquid. The coating on the particles washes away at different rates, providing a continuous release of small amounts of fertilizer.

Keeping the soil moist under the trees by frequent light watering of the trees also will help to reduce the effects of salt on citrus trees.

Resources

Selected LSU AgCenter websites LSU.AgCenter.com

Local LSU AgCenter extension agents: go to **www.LSUAgCenter.com** select OUR OFFICES button

Soil Testing & Plant Analysis lab: **www.LSUAgCenter.com** search "soil testing lab"

Master Gardener information: **www.LSUAgCenter.com** search "local master gardener"

Plant Diagnostic Center: **www.LSUAgCenter.com** search "plant diagnosic center"

Pest Identification and Information (Entomology): **www.LSUAgCenter.com** search "insect identification"

Management Guides:

Insect and Disease Control Guides
www.LSUAgCenter.com search "management guides"

Louisiana Insect Pest Management store.LSUAgCenter.com
The guide includes regulations, precautions and suggestions for pest control in Louisiana. Detailed topics include drift of pesticides, hazards of pesticides to beneficial insects and wildlife, phytotoxicity and using beneficial insects to control pest populations. A section on organic gardening also is included. $12

Louisiana Plant Disease Management store.LSUAgCenter.com
The guide contains suggestions for management of the most important or more prevalent diseases of Louisiana plants. It includes information on fungicides, bactericides and nematicides, as well as safety precautions for using them. $12

Louisiana Suggested Chemical Weed store.LSUAgCenter.com
This guide includes helpful information on herbicides and weed control with detailed suggestions for aquatics, commercial nursery stock, field crops, forestry, fruit crops, home gardens, lawns and many other Louisiana crops. The guide was compiled by LSU AgCenter faculty. $12

Gardening Guides
Louisiana Home Vegetable Gardening store.LSUAgCenter.com
A comprehensive guidebook to vegetable gardening in Louisiana. 120 pages, $20

Louisiana Home Fruit and Nut Production store.LSUAgCenter.com
A resource for ayone interested in growing fruit or nuts in the area. 84 pages, $20

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Acknowledgments

The authors wish to acknowledge the following individuals for their contributions to this publication:

Wayne Bourgeois, professor, Citrus Research Station

Alan Vaughn, county agent (Plaquemines Parish – deceased)

Stuart Gauthier, county agent, Vermilion Parish

James Boudreaux, professor (School of Plant, Environmental and Soil Sciences - retired)

Don Ferrin, assistant professor (Plant Pathology and Crop Physiology Department - deceased)

Dale Pollet, professor (Entomology - retired)

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PUB1234 (2.5 M) 02/20 Rev.

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Louisiana State University Agricultural Center
Louisiana Agricultural Experiment Station
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$10.00
ISBN 978-1-936952-05-2
51000>
9 781936 952052