UF IFAS Extension UNIVERSITY of FLORIDA

HS1153

Lemon Growing in the Florida Home Landscape[1]

Jonathan H. Crane[2]

Scientific name: *Citrus limon* Burm. f.

Common names: lemon, limone (Italian), limon (Spanish), limonen (German), citronnier (French), citroen (Dutch), limon France (Haitian), limon amaraillo (Puerto Rico).

Family: Rutaceae

Origin: The lemon is thought to have evolved on the lower slopes of the Himalayan Mountains in eastern India (Davies and Albrigo 1994; Morton 1987). Molecular research indicates lemon originated from a cross of citron (*C. medica*) and sour orange (*C. aurantium*) (Moore 2001).

History: The lemon was introduced into southern Italy as early as 200 C.E. and spread to Iraq and Egypt by 700 C.E. (Morton 1987). Lemon was widely distributed throughout the Mediterranean region by 1000–1150 C.E. and was cultivated in China between 760–1297 C.E. Lemon was introduced by the Spanish to the island of Hispaniola in 1493 and later during the first settlement of St. Augustine, Florida (Jackson 1991). Sometime during 1751–1768 lemon was introduced into California.

Distribution: Today lemons are grown commercially throughout the Mediterranean region including Spain, Italy, Morocco, Greece, Turkey, Cyprus, Lebanon, and Israel. They are also grown in areas of the world with Mediterranean climates such as California and Chile and tropical areas such as Belize.

Importance: Lemons are grown commercially in Guatemala, southern Mexico, Argentina, Chile, and China. The top five lemon-producing countries are India, Argentina, Spain, Iran, and the United States (Anonymous 2004) In the United States, lemons are grown primarily in California (45,000 acres) and Arizona (13,500 acres) (Perez and Pollack 2007) with only a small amount of acreage (less than 600 acres) in south Florida (Anonymous 2004).

Lemon imports into the United States generally peak during the summer when domestic crop availability is lowest (Anonymous 2004). Imports make up only 9 percent of lemon consumption in the United States. Fortunately, lemon consumption has been growing since the early 1980s, ranking eighth in per capita consumption among consumed fresh fruits.

Invasive potential: Lemon (*Citrus limon*) has not yet been assessed by the UF/IFAS Invasive Plant Working Group on Non-Native Plants in Florida's Natural Areas. Lemon is not considered a problem species at this time, and may be recommended by UF/IFAS faculty for planting.

Caution: Two diseases may limit or eliminate the potential for successful lemon growing in the home landscape. Citrus canker, caused by *Xanthomonas campestris* pv. *citri*, infects leaves causing defoliation and reducing tree vigor and production and disfiguring the peel (Spann et al. 2008a). Citrus greening (Huanglongbing/yellow shoot disease), caused by the bacterium *Candidatus* Liberibacter spp. and transmitted by the citrus psyllid (*Diaphorina citri*), infects a

1. This document is HS1153, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date December 2010. Revised November 2016. Reviewed December 2019. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Jonathan H. Crane, professor, tropical fruit crop specialist; UF/IFAS Tropical Research and Education Center, Homestead, FL 33031.

tree's phloem conducting tissues, killing sections of the tree and causing general decline, loss of fruit production, and eventually the death of the tree (Spann et al. 2008b).

Description

Tree

The lemon tree is vigorous, upright, and spreading, with an open growth habit (Tucker and Wardowski 1976). Trees may reach 10–20 ft (3.1–6.1 m) in height (Morton 1987).

Leaves

The leaves are alternate, elliptic or long-ovate, 2.5–4.5 inches (6.25–11.25 cm) long with serrated margins and slender winged petioles. Reddish at first, they turn green as they grow (Morton 1987; Tucker and Wardowski 1976). Mature leaves are a paler green than orange leaves.

Flowers

The flowers are solitary or in clusters in the leaf axils (Morton 1987; Tucker and Wardowski 1976). Flower buds are reddish; the opened flowers have 4–5 petals and are 0.75 inch (2 cm long), white on the upper surface, and purplish on the under surface. Flowers have 20–40 stamens with yellow anthers. Many flowers are sterile due to pistil abortion; fertility of flowers varies greatly from bloom to bloom and from season to season (Tucker and Wardowski 1976).

Under subtropical conditions in Florida, flower bud initiation occurs in November, and blooming may occur from late December into March (Tucker and Wardowski 1976). Trees may bloom again in June and November.

Fruit

The fruit is oval, typically with a nipple-like apex at the stylar end, and ranges from 2.0–4.8 inches (5–12 cm) long (Morton 1987; Tucker and Wardowski 1976) (Figure 1). Fruit shape is influenced by temperatures, with fruit produced during summer and autumn relatively round, whereas winter and early spring fruit are oval (Davies and Albrigo 1994; Monselise et al. 1981). The peel is light-yellow to yellow, 0.25–0.38 inch (6–10 mm) thick, smooth to rough, and dotted with oil glands (Davies and Albrigo 1994; Jackson 1991). The pulp is divided into 8–10 segments, pale-yellow, juicy, and acid. Some fruits are seedless, most have a few seeds; seeds are small (0.38 inch; 9.5 mm long).

The time from flowering to fruit harvest ranges from 4 to 12 months depending upon cultivar, crop load, ambient temperatures, and cultural practices (Morton 1987; Tucker and Wardowski 1976). Fruit produced under more tropical climates tends to be larger and juicier and to contain more acid and peel oil compared to fruit produced under more Mediterranean (dry) conditions.

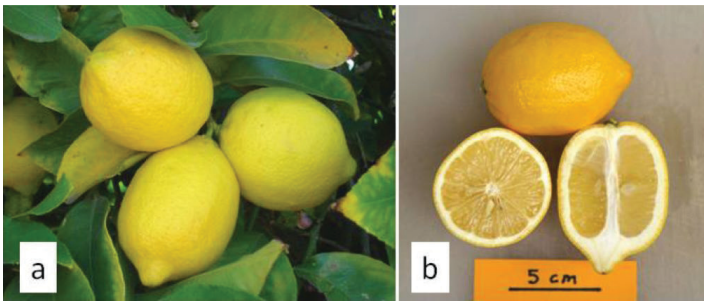

Figure 1. Photograph 1. (a) 'Lisbon' lemon fruit and (b) lemon fruit size, pulp, and seeds.
Credits: Jonathan H. Crane, UF/IFAS

Pollination

Lemon does not require cross pollination to set fruit although honey bees and other insects frequently visit the open flowers.

Lemon Types and Varieties

There are numerous lemon selections and cultivars that vary in tree vigor, thorniness, and fruit quality. In general, lemon fruit are high in total acidity (5–8%) and low in total soluble solids (7–9%) and may be seedy to seedless (Davies and Albrigo 1994; Jackson 1991).

There are two ways to classify lemons, one based on species and the other on types of true lemons. There are 3 major types of true lemons: Femminello, Verna, and Sicilian (Davies and Albrigo 1994). Femminello and Verna types are primarily grown in North Africa and Europe while Sicilian types are grown in the United States and South Africa (Davies and Albrigo 1994). Sicilian types include 'Eureka' and 'Lisbon'. There are also several species and hybrids of fruit typically called lemon. These include 'Ponderosa' lemon (*C. limon* x *C. medica*), 'Meyer' lemon (*C. limon* x *C. reticulata*), rough lemon (*C. jambhiri*), and sweet lime (*C. limetta*) (Jackson 1991; Morton 1987). True lemon varieties include:

- 'Bearrs'. Selected in 1952 from a seedling planted in 1892 from the Bearrs Grove in Lutz, Florida (Morton 1987). Originally called 'Sicily', the tree is vigorous, thornless to nearly thornless, and tends to produce many water sprouts (Jackson 1991). The fruit is elliptical to oblong and prominently nippled at the apex, with a yellow, slightly rough peel (Morton 1987). The pulp is pale greenish-yellow and high in juice content. 'Bearrs' lemons have very acid, good quality juice, and few or no seeds. The peel is rich in oil (Morton 1987). The fruit may be

marketed for fresh fruit and used in juice production. Leaves, stems, and fruit are highly susceptible to scab and greasy spot. The fruit is susceptible to oil spotting. Some clones of 'Bearrs' may have few to no thorns (Adams 1991).

- 'Eureka'. From a seedling planted in Los Angeles, California in 1858; selected in 1878 (Jackson 1991; Morton 1987). The tree is non-vigorous and has a spreading, open growth habit. It is nearly thornless, cold sensitive, and relatively short-lived (Davies and Albrigo 1994; Tucker and Wardowski 1976). The tree bears fruit year-round but the main season is in late winter, spring, and early summer. Fruit is often borne in large terminal clusters not protected by foliage. The fruit is elliptical to oblong, with a moderate nipple at the apex, usually 10 segments, and a yellow, smooth or slightly rough peel (due to sunken oil glands) (Morton 1987; Tucker and Wardowski 1976). The pulp is greenish-yellow, high in juice content, and very acid. Fruit usually have 9 seeds or fewer (Davies and Albrigo 1994). The fruit is mainly marketed for fresh fruit.
- 'Lisbon'. 'Lisbon' originated in Australia and was introduced from Portugal into the United States several times (Jackson 1991; Morton 1987; Sauls and Jackson 1990). The tree is large, vigorous, densely foliated, thorny, prolific, and tolerant of cold and high temperatures and wind conditions (Davies and Albrigo 1994; Morton 1987). Short thorn clones are commonly grown (Tucker and Wardowski 1976). Fruit characteristics are very similar to those of 'Eureka', however the fruit is often borne on the inside of the tree canopy. The fruit is elliptical to oblong with a moderate nipple at the apex. It usually has 10 segments. The peel is yellow and very slightly rough due to sunken oil glands (Morton 1987; Tucker and Wardowski 1976). The pulp is greenish-yellow, high in juice content, and very acid. Fruit usually has fewer than 9 seeds (Davies and Albrigo 1994).

A number of other varieties have been propagated and grown to a small extent. 'Avon' is of unknown origin and was selected in 1934 (Jackson 1991; Tucker and Wardowski 1987). Trees are very productive and produce high quality fruit. 'Harvey', also of unknown origin, was selected in 1940. Fruit characteristics are similar to those of 'Eureka'. 'Villafranca' was introduced from Sicily in 1875 and produces high quality fruit.

Climatic Adaptation

Lemons are best adapted to semiarid to arid subtropical or Mediterranean climates and are more tolerant of cold temperatures than lime trees (Davies and Albrigo 1994; Morton 1987; Sauls and Jackson 1990). The best fruit quality usually occurs along cool summer coastal areas. However, trees are susceptible to freezing temperatures: defoliated at 22–24°F (-4.4 to -5.6°C), severe wood damaged at 20°F (-6.7°C), flowers and young fruit are killed at 29°F (-1.7°C), and mature fruit damaged at 28°F to 31°F (-2.2°C to -1.8°C) (Castle 1983; Tucker and Wardowski 1987). Fruit scarring is a problem in windy sites and fruit quality is improved with the use of wind breaks.

Hot, humid production areas have more plant diseases (especially scab and red algae) and problems with fruit curing and storage than dry production areas. Furthermore, fruit peel texture may be coarser or more puffy in humid production areas than in Mediterranean-type climates, and fruit grown in humid areas may lack bright color (Davies and Albrigo 1994; Jackson 1991).

Propagation

Lemons are typically propagated by grafting or budding onto rootstocks. Recommended rootstocks vary with soil type (Castle 1983). Trees planted on acid to neutral sandy soils do well on Swingle citrumelo and Changgsha mandarin. Trees to be planted in the high-pH, calcareous soils of south Miami-Dade County should be grafted onto rough lemon (*C. jamhiri*) or macrophylla (*C. macrophylla*) (Tucker and Wardowski 1987). To reduce problems with phytophthora foot rot, trees should be grafted at 6 to 12 inches (15–20 cm) above the soil line. In areas where foot rot is not of major concern, trees may be propagated by large cuttings. Several selections or clones free of important diseases are available to nurserymen through the Florida Department of Agriculture Citrus Budwood Program. These are sold in nurseries as registered trees and we highly recommend them over any other type for growing a lemon tree in the home landscape.

Fruit Production

Fruit production may occur throughout the year, but depending upon cultivar, climate, and cultural practices, the major harvest season may be during summer, autumn, or winter (Davies and Albrigo 1994; Morton 1987). Young trees usually begin fruit production in the third year, yielding approximately 38 lbs/tree (about 17 kg/tree) but quickly increase to over yields of 100 lbs by the fourth or fifth year (Takele and Mauk 1998). Typically, yields for mature trees range from 100 to 200 lbs (45–91 kg) per tree per year (Morton 1987).

Placement in the Landscape

Planting distances depend on soil type and fertility and the expertise of the homeowner. Lemon trees in the home landscape should be planted in full sun, 15 to 25 feet or more (6.1 to 7.6 m) away from buildings and other trees. Trees planted too close to other trees or structures may not grow normally or produce much fruit due to shading. Lemon trees are more vigorous than most citrus species and crowding results in increased disease and insect problems, lower production, loss of lower productive canopy, and the necessity for repeated severe pruning (Tucker and Wardowski 1976). Production declines with repeated severe pruning.

Soils

Lemons are adapted to most well drained soils and prefer soils with a pH of 5.5 to 6.5 (Morton 1987). Rootstock selection for the soil type and conditions is critical. Rootstocks used include rough lemon (*C. jambhiri*), 'Cleopatra mandarin' (*C. reticulata*), Volkamer lemon (*C. volkameriana*), sour orange (*C. aurantium*) and macrophylla (*C. macrophylla*) (Tucker and Wardowski 1976). Trees on rough lemon rootstocks are extremely vigorous and susceptible to foot rot (phytophthora). Budding the tree high may help reduce the incidence of foot rot as scion infection appears to be important. Trees on macrophylla are also very vigorous and susceptible to tristeza, hence rootstock sprout removal is important to preclude infection. Lemons on Cleopatra mandarin are slower to come into bearing and fruit size appears smaller.

Planting a Lemon Tree

Proper planting is one of the most important steps in successfully establishing and growing a strong, productive lemon tree. The first step is to choose a healthy nursery tree. Purchase only disease-free certified trees propagated under the rules and regulations of the Florida Budwood Certification Program. Commonly, nursery lemon trees are grown in 3-gallon containers, and trees stand 2 to 4 feet from the soil media. Large trees in smaller containers should be avoided because their root systems may be "root bound." This means all the available space in the container has been filled with roots to the point that the tap root is growing along the edge of the container in a circular fashion. Root-bound trees may not grow properly once planted in the ground. Inspect the tree for insect pests and diseases, and inspect the trunk of the tree for wounds and constrictions. Select a healthy tree and water it regularly in preparation for planting in the ground. The preferred time to plant is late winter or early spring, although potted trees may be planted any time in warm locations.

Site Selection

In general, lemon trees should be planted in full sun for best growth and fruit production. Select a part of the landscape away from other trees, buildings and structures, and power lines. Select the warmest area of the landscape that does not flood (or remain wet) after typical summer rains. Make sure the site has good air circulation and is protected from cold north winds.

Planting in Sandy Soil

Many areas in Florida have sandy soils. Remove a 3- to 10-ft-diameter ring of grass sod. Dig a hole 3 to 4 times the diameter and 3 times as deep as the container the lemon tree came in. Making a large hole loosens the soil next to the new tree, making it easy for the roots to expand into the adjacent soil. It is not necessary to apply fertilizer, topsoil, or compost to the hole. In fact, placing topsoil or compost in the hole first and then planting on top of it is not desirable. If you wish to add topsoil or compost to the native soil, mix it with the excavated soil in no more than a 50-50 ratio.

Backfill the hole with some of the native soil removed to make the hole. Remove the tree from the container and place it in the hole so that the top of the soil media in the container is level with or slightly above the surrounding soil level. Fill soil in around the tree roots and tamp slightly to remove air pockets. Immediately water the soil around the tree and tree roots. Staking the tree with a wooden or bamboo stake is optional. However, do not use wire or nylon rope to tie the tree to the stake because they may eventually damage the tree trunk as it grows. Use a cotton or natural fiber string that will degrade slowly.

Planting in Rockland Soil

Many areas in Miami-Dade County have a very shallow soil with hard calcareous bedrock several inches below the soil surface. Remove a 3- to 10-ft-diameter ring of grass sod. Make a hole 3 to 4 times the diameter and 3 times as deep as the container the lemon tree has come in. To dig a hole, use a pick and digging bar to break up the rock or contract with a company that has augering equipment or a backhoe. Plant the tree as described for sandy soils.

Planting on a Mound

Many areas in Florida are within 7 ft or so of the water table and experience occasional flooding after heavy rainfall

events. To improve plant survival, consider planting the fruit tree on a 3- to 4-ft-high by 4- to 10-ft-diameter mound of native soil. After the mound is made, dig a hole 3 to 4 times the diameter and 3 times as deep as the container the tree came in. In areas where the bedrock nearly comes to the surface (rockland soil), follow the recommendations for the previous section. In areas with sandy soil, follow the recommendations from the section on planting in sandy soil.

Care of Lemon Trees in the Home Landscape

A chart outlining the suggested month-to-month cultural practices for lemon is shown in Chart 1.

Fertilization

Lemon is somewhat demanding in its fertilizer requirements. However, over-fertilization is associated with luxuriant growth at the expense of fruit production. After planting, when new growth begins, apply 1/4 lb (113 g) of a young tree fertilizer such as a 6-6-6-2 (6% nitrogen–6% phosphate–6% potash–2% magnesium) with minor elements. Twenty percent to 30% of the nitrogen in the fertilizer should come from organic sources (Table 1; Takele and Mauk 1998). Repeat this every 3 to 4 months for the first year, and as the tree grows, gradually increase the amount of fertilizer to 0.5, 0.75, and 1.0 lb (227 g, 341 g, 454 g). For mature trees, 3.0 to 4.0 lbs of fertilizer per application 2 to 3 times per year is recommended. Use 2 to 4 minor element (nutritional) foliar sprays per year from April to September.

Lemon trees may develop iron deficiency symptoms, especially when grown on the rocky, calcareous, high-pH soils of Miami-Dade County. If iron deficiency symptoms appear (chlorotic leaves with green veins), apply iron. For trees growing on acid to neutral soils, apply dry iron sulfate at 0.25 to 1 oz (7–28 g) per tree to the soil 2 to 3 times per year; water the iron into the ground. In alkaline soils with a high pH, drench the soil next to the tree trunk with 1 to 4 oz (28–113 g) of an EDDHA-form of iron chelate 1 to 2 times per year sometime from June through September.

Irrigation (Watering)

Lemons benefit from irrigation during flowering through the fruit development period, but irrigation water must be carefully controlled because wetting the foliage, flowers, and fruit increases disease problems. Newly planted lemon trees should be watered at planting and every other day for the first week or so and then 1 to 2 times a week for the first couple of months. During prolonged dry periods (e.g., 5 or more days of little to no rainfall) newly planted and young lemon trees (first 2 years) should be watered periodically. Once the rainy season arrives, watering frequency may be reduced or stopped. Watering lemon trees that are 4 or more years old will be beneficial to plant growth and crop yields only during very prolonged dry periods during the year. Mature lemon trees do not need frequent watering and over watering may cause trees to decline or be unthrifty.

Insect Pests

Asian citrus psyllid (*Diaphorina citri*). The Asian citrus psyllid attacks the young leaves and stems of lemon trees, severely weakening them (Mead 2007; Spann et al. 2008). The adult psyllid is 3 to 4 mm long with a brown mottled body and light brown head. The nymphs (young) are smaller and yellowish orange. The nymphs of this psyllid produce a characteristic white, waxy excretion with a ribbon-like shape. Foliage attacked by this psyllid is severely distorted. There are treatments to control the psyllid, but preventing infestation by the psyllid in a home landscape is difficult at best because of presence of alternative hosts (e.g., orange boxwood and orange jasmine) and lack of control in neighboring properties. Unfortunately this psyllid may transmit a deadly bacterial disease called citrus greening (Huanglongbing/yellow shoot disease) (Yates et al. 2008). See below for more information on citrus greening. Please contact your local Agricultural Extension Agent for current recommendations.

Brown citrus aphid (*Toxoptera citricida*). Adult, wingless forms are shiny black and nymphs (young) are dark reddish-brown (Halbert and Browning 2008). This aphid may be confused with several other dark colored aphids. Wingless and winged forms of the brown citrus aphid feed on new growth causing distortion and, when populations are very high, stem dieback. The brown citrus aphid is a vector of citrus tristeza virus, which causes tree decline and death of citrus on susceptible rootstocks (e.g., sour orange, alemeow). Purchase and planting of certified disease-free citrus trees under the Florida Citrus Budwood Program will help reduce the spread or introduction of this disease into your landscape.

Citrus leafminer (*Phyllocnistis citrella*). The citrus leafminer adult moth is small (4 mm wingspan), with white and silvery colored wings with several black and tan markings (Heppner 2003). The larvae of this moth usually infest the lower leaf surface, forming meandering mines. Their mining causes leaf distortion which reduces the functional surface area of the leaf. The immature leaves of lemon trees in the home landscape are commonly attacked

by the citrus leafminer during the warmest time of the year and less so during the winter months (Browning et al. 1995). Their feeding may severely damage the leaves and this may weaken young, newly planted trees. Application of horticultural oil in a ½ to 1% solution to a new flush of leaves (when ½ to 1 inch in length) will usually protect them sufficiently as they mature. Once trees are 3 years old or more they can withstand the damage to the leaves by the citrus leafminer. In general, leaf flushes that develop during the cool temperatures of late fall and winter avoid attack by the citrus leafminer.

Mites. Several mites may attack lemon leaves, stems, and fruit.

Citrus red mite (*Panonychus citri*). The red mite usually attacks the upper leaf surface, causing brown necrotic areas. Severe infestations may cause leaf drop (Browning et al. 1995; Jackson 1991). The red mite is deep red to purple and has a round body. Red mite infestations are greatest during the dry winter months but may occur from November to June (Childers and Fasulo 2005). When heavy infestations occur, foliar applications of sulfur will control red mites. Caution: *never* apply a sulfur spray and an oil spray within three weeks of each other.

Rust mite (*Phylocoptruta oleivora*) and **Broad mite** (*Polyphagotarsonemus latus*). The rust and broad mites may attack leaves, fruit, and stems but are primarily a fruit pest (Pena and Campbell 2005). Rust mites are very hard to see because of their small size (0.1 mm long) and light yellow color (Jackson 1991). Broad mites are 0.2 mm long with color varying from light yellow to dark green (Fasulo 2007). Feeding by these mites results in russetting (browning) of the fruit peel but, unless severe, does not affect internal fruit quality. When heavy infestation occurs, foliar applications of sulfur will control red mites. Caution: *never* apply a sulfur spray and oil spray within three weeks of each other.

Scale insects. Various scale species may infest and damage bark, leaves, or fruit.

Florida red scale (*Chrysomphalus aonidum*). This armored scale is circular (1.5–2.2 mm in diameter) with a prominent central nipple. It varies in color from reddish-brown to reddish-purple (Browning et al. 1995; Fasulo and Brooks 2004; Jackson 1991). This pest mostly attacks leaves, but occasionally fruit as well. Leaf symptoms appear as reddish to reddish brown stippling, especially along the central main vein. Application of horticultural oil in a ½ to 1% solution to the leaves will usually control this pest.

Snow scale (*Uaspis citri*). The clustering of the white male scales along the limbs and tree trunk look like white flecking or snow (Browning et al. 1995; Fasulo and Brooks 2004). The female scales range from brown to purple. The scale feeding causes the bark to split and weakens the tree, sometimes killing limbs. Several applications of horticultural oil in a ½ to 1% solution to the affected limbs and trunk will usually control this pest.

Diseases

Algal disease (Red alga). Caused by *Cephaleuros virescens*, red alga infects leaves and bark, and can cause leaf drop and girdling of branches, which results in stem dieback. Algal disease may be controlled by 1 to 2 copper-based sprays during mid- to late summer.

Citrus canker (*Xanthomonas campestris* pv. *citri*). Lemon trees are highly susceptible to citrus canker (Spann et al. 2008a). Citrus canker is caused by bacteria, which may be spread by wind-driven rain and contaminated equipment, clothing, animals, and humans. Young leaves, shoots, and fruit are susceptible to infection (Browning et al. 1995). Pinpoint spots on leaves and fruit appear first. These are followed by raised, brown spots on leaves, stems, and fruit. The spots can be circular or irregular. They are surrounded by a yellow halo. Heavy infestations may result in defoliation and weakening of the tree. Plant trees in full sun with good air movement and avoid wetting the foliage during watering to help reduce the severity of this disease. Timely applications of copper-based fungicides to newly emerging leaves will also lessen the impact of this disease.

Citrus greening (Huanglongbing/yellow shoot disease). Lemon trees are susceptible to citrus greening (Spann et al. 2008b). Citrus greening is caused by the bacterium *Candidatus* Liberibacter spp. The bacteria are spread by the Asian citrus psyllid (*Diaphorina citri*). Citrus greening symptoms include sections of the tree showing symptoms that resemble severe leaf nutrient deficiencies (e.g., yellow blotching and yellow veins, corky main veins, and reduced leaf size). Other symptoms include stem and limb dieback. Any fruit produced may be small, distorted (lopsided), and bitter. Eventually, stems, limbs and the entire tree decline and die (usually within 5–8 years) (Spann et al. 2008b). At present, there is no treatment for the disease. Only removal of infected trees will help to decrease the spread of the disease to other citrus trees. Purchase and planting of certified citrus trees propagated under the Florida Citrus Budwood Program will help reduce the spread or introduction of this disease on your landscape. Removal of infected

trees will prevent their spreading the infection to nearby citrus trees.

Citrus scab (*Elsinoe fawcetti*). Scab is the major fruit disease of lemon. Like greasy spot and melanose, this disease is most prevalent during the rainy season. Young leaves, stems, and fruit are most susceptible to infection. The major symptom is development of corky outgrowths in infected tissues (Browning et al. 1995). Scab symptoms include distortion and malformation (wart-like formations) of foliage, stems, and fruit (Jackson 1991; Tucker and Wardowski 1976). If citrus scab is a problem, the disease may be controlled by 1 to 2 copper-based sprays at early fruit development.

Foot rot (*Phytophthora parasitica*). Resistance to foot rot varies by rootstock with Trifoliate orange immune; Swingle citrumelo, Cleopatra mandarin, and sour orange resistant; Troyer and Carrizo citranges and Rangur lime tolerant; and sweet orange and rough lemon highly susceptible (Browning et al. 1995). Symptoms of foot rot include bark peeling in the crown, roots, and trunk at the soil level; gumming at the wounded area; leaf chlorosis; stem dieback; and tree decline and death. The best way to avoid this disease is to grow lemon trees on foot-rot-resistant rootstocks, avoid trunk damage, avoid wetting the trunk when watering, and keep mulch away from the base of the tree trunk.

Greasy spot (*Mycosphaerella citri*). Lemon leaves may be severely affected by greasy spot. Initially, yellow spots appear on the upper leaf surfaces. Then irregularly-shaped brown blisters with a greasy appearance develop on the lower leaf surfaces (Browning et al. 1995). Eventually, brown blisters appear on the upper leaf surfaces. The disease may lead to defoliation, which weakens the tree. Greasy spot is prevalent during the rainy season (May to September) and easily prevented and controlled with 1 to 2 copper or copper plus horticultural oil sprays.

Melanose (*Diaporthe citri*). Immature leaves, stems, and young fruit are most susceptible to melanose (Browning et al. 1995). Early leaf symptoms appear as small, brown, sunken spots that later become raised and that have a sandpaper rough feel. Fruit symptoms appear as raised, irregularly shaped, brown spots surrounded by white/off-white halos caused by cracking of the peel. Like greasy spot, this disease is most prevalent during the rainy season. Usually not a major disease on lemons, this disease is usually controlled by the same foliar treatments for greasy spot.

Postbloom fruit drop (*Colletotrichum acutatum*). Occurrence of this disease is most prevalent during the rainy season. Overhead watering may increase the incidence of this disease in the home landscape. The initial symptoms of this disease include brown to orange, water-soaked lesions on the flower petals. The petals then turn orange and dry up (Browning et al. 1995). Next the pistil and young fruitlets drop off, leaving the floral disk and calyx (button), which may remain attached to the stem for a number of years. Strategies to minimize the incidence of this disease include planting the tree in full sun in an area of the landscape with good air movement so that flowers dry off quickly after rainfall, periodically pruning the canopy to facilitate sun and air penetration, and not watering the tree foliage during bloom. Do not apply copper to the foliage and flowers during bloom as this aggravates postbloom fruit drop.

Tristeza. Lemons are susceptible to severe tristeza virus strains regardless of rootstock, and less severe strains when propagated on *Citrus macrophylla* (macrophylla) and rough lemon (*C. jambhiri*) rootstocks. Tristeza is transmitted by the brown citrus aphid (*Toxoptera citricida*). Purchasing certified disease-free trees under the Florida Budwood Registration Program will greatly reduce the chances of purchasing a tree with this disease.

Nutritional Disorders

Nitrogen deficiency. Nitrogen deficiency first appears on the older leaves. With prolonged deficiency younger leaves are affected as well (Zekri and Obreza 2003a; Futch and Tucker 2008). In the mild deficiency, the foliage will be light green; however, as the deficiency intensifies, the light green turns completely yellow. Nitrogen-deficient trees may be stunted, with sparse canopies and little fruit production.

Phosphorus deficiency. Like nitrogen deficiency, phosphorus deficiency appears first in older leaves, with more severe deficiency also appearing in young leaves (Zekri and Obreza 2003a; Futch and Tucker 2008). Symptoms begin with a loss of deep green color. New leaves are small and narrow and may have a purplish or bronze discoloration. Fruit from deficient trees have a rough, thick rind and a hollow core.

Potassium deficiency. Potassium deficiency first appears on older leaves as a yellowing of the leaf margins and tips; subsequently the yellow areas broaden (Zekri and Obreza 2003a; Futch and Tucker 2008). If the deficiency persists and becomes severe, leaf spotting and dead areas may develop.

Magnesium deficiency. Magnesium deficiency occurs first in older leaves. The first symptoms of magnesium deficiency appear on mature foliage as a yellowish green blotch near the base of the leaf and between the midrib and the outer edge (Zekri and Obreza 2003b). The yellow area enlarges until the only green parts remaining are at the tip and base of the leaf as an inverted V-shaped area on the midrib. With acute deficiency, the leaves may become entirely yellow and eventually drop.

Manganese deficiency. Manganese deficiency appears first on younger leaves. The deficiency appears as dark green bands along the midrib and main veins surrounded by light green interveinal areas (Zekeri and Obreza 2003b). As the severity increases, the light green interveinal areas develop a bronze appearance.

Zinc deficiency. First symptoms occur in young leaves. In the early stages, zinc deficiency appears as small blotches of yellowing occurring between green veins in the leaf (Zekri and Obreza 2003b). Severely deficient leaves may become entirely yellow except for the green veinal areas, and leaves will also be smaller and have narrow pointed tips. This deficiency has been referred to as "little leaf" and "mottle leaf." The distance between leaves (internodes) becomes reduced, giving the shoot a rosette appearance.

Iron deficiency. Iron deficiency symptoms first appear in young leaves with the leaf veins darker green than the interveinal areas (Zekri and Obreza 2003b). If the deficiency persists, the yellow in the interveinal areas expands until eventually the entire leaf turns yellow. Leaf size is also reduced. Trees may become partially defoliated.

Lemon Trees, Lawn Care, Mulch, and Pruning

Lemon trees in the home landscape are susceptible to trunk injury caused by lawn mowers and weed wackers. To prevent damage, maintain a grass-free area 2 to 5 or more feet (0.5–1.5 m) away from the trunk of the tree. Never hit the tree trunk with lawn mowing equipment and never use a weed wacker near the tree trunk. Mechanical damage to the trunk of the tree will weaken it, and, if severe enough, can cause dieback or kill the tree.

Roots of mature lemon trees spread beyond the drip-line of the tree canopy. Heavy fertilization of the lawn next to lemon tree is not recommended because it may reduce fruiting and/or fruit quality. The use of lawn sprinkler systems on a timer may result in over watering and cause lemon trees to decline. Too much water too often applied causes root rot.

Mulch

Mulching lemon trees in the home landscape helps retain soil moisture, reduces weed problems next to the tree trunk, and improves the soil near the surface. Mulch lemon trees with a 2- to 6-inch (5- to 15-cm) layer of bark, wood chips, or similar mulch material. Keep mulch 8 to 12 inches (20–30 cm) away from the trunk because mulch against the tree trunk may cause trunk rot.

Pruning

Prune your lemon tree to remove water sprouts (vigorous, thorny shoots) and dead wood (sources of disease), and to shape the tree and control its height and spread. Three to 5 main shoots should be selected at planting to form the primary scaffold framework for the mature tree (Tucker and Wardowski 1976). These are maintained by removing competing shoots when they are small.

As a tree matures, it should be lightly pruned to form the crown into a dome-shape. Trees should be maintained at 7 to 10 ft (2.1–3.1 m) high and 10 to 15 ft (3.1–4.6 m) wide. Research and observation have demonstrated that lightly pruned trees produce more fruit than vegetation than do heavily pruned trees (Tucker and Wardowski 1976). Since some lemon cultivars produce the majority of their fruit on the periphery of the tree, excessive pruning and removal of the outer canopy may reduce crop yields. Frequent, light pruning will tend to relocate fruit production to the inside of the canopy. Experience has suggested occasional selective removal of non-productive limbs and opening up the canopy to light and air by hand pruning increases fruit production inside the tree canopy (Tucker and Wardowski 1976).

Harvest, Ripening, and Storage

Lemon trees may have fruit at different stages of development at the same time. Harvest only mature fruit, which have a light green peel color. Lemons are typically picked green when about 1 ½ to 2 inches (0.6–0.8 cm) in diameter and allowed to cure. Curing involves placing the green fruit at room temperature and allowing the fruit to slowly become yellow, during which time the peel becomes smoother and the juice content increases. The fruit may then be stored in polyethylene bags in the refrigerator for several days to a week.

Uses and Nutrition

Lemon juice is a good source of potassium, vitamin A and vitamin C (Table 2). Sliced lemon is used fresh as a garnish with fish, meat and beverages. Fruit may be used to make juice and be a component of candies, beverages, and desserts. The peel may be candied or used as an ingredient in cooking and baking. The peel oil is used for its essence and added to beverages and candies and in furniture polish, perfumes, and bleaches.

Literature Cited

Adams, J.T. 1991. Lemons at Big Cypress. Citrus Industry 72:102–104.

Anonymous. 2004. Commodity highlight, lemon production and consumption. USDA, Economic Res. Service, Fruit and Tree Nuts Outlook/FTS-310. P. 16–19. http://www.ers.usda.gov/publications/fts. (May 26, 2004)

Browning, H.W., R.J. McGovern, L.K. Jackson, D.V. Calvert, and W.F. Wardowski. 1995. Florida citrus diagnostic guide. Fla. Science Source, Inc., Lake Alfred, Fla. P. 1–244.

Castle, W.S. 1983. Growth, yield, and cold hardiness of seven-year-old 'Bearss' lemon trees on twenty-seven rootstocks. Proc. Fla. State Hort. Soc. 96:23–25.

Childers, C.C. and T.R. Fasulo. 2005. Citrus red mite. Department of Entomology and Nematology, Gainesville: University of Florida Institute of Food and Agricultural Sciences. p. 1–4.

Davies, F.S. and L.G. Albrigo. 1994. Citrus. ISBN# 0-851988679. p.41-43, 220–221

Fasulo, T.R. 2007. Broad mite (*Polyphagotarsonemus latus* (Banks) (Arachnida: Acari: Tarsonemidae).Department of Entomology and Nematology, Gainesville: University of Florida Institute of Food and Agricultural Sciences. P. 1–6.

Fasulo, T.R. and R.F. Brooks. 2004. Scale pests of Florida citrus. Department of Entomology and Nematology, Gainesville: University of Florida Institute of Food and Agricultural Sciences. P. 1–7.

Halbert, S.E. and L.G. Brown. 2008. Brown citrus aphid, *Toxoptera citricida* (Kirkaldy). Department of Entomology and Nematology, Gainesville: University of Florida Institute of Food and Agricultural Sciences. P. 1–7.

Jackson, L. 1991. Citrus growing in Florida, 3rd Edition. University of Florida Press, Gainesville, Fla. p. 44–48, 102, 114, 142, 177, 193, 195, 196, 235.

Maranto, J. and K.D. Hake. 1985. Verdelli summer lemons: a new option for California growers. California Agr., May/June. P. 4.

Mead, F.W. 2007. Asian citrus psyllid, *Diaphorina citri* Kuwayama (Insecta: Hemiptera: Psyllidae). Department of Entomology and Nematology, Gainesville: University of Florida Institute of Food and Agricultural Sciences. P. 1–6.

Monselise, S.P., R. Goren, J. Costo, and M. Simkhi. 1981. Development of lemon fruits originating at different blossom dates around the year. Scientia Horticulturae 15::23–32.

Moore, G.A. 2001. Oranges and lemons: clues to the taxonomy of *Citrus* from molecular markers. Trends in Genetics 17:536–540.

Morton, J.F. 1987. Fruits of warm climates. J.F. Morton Publisher. ISBN# 0-9610184-1-0. p.160–168.

Pena, J.E. and C.W. Campbell. 2005. Broad mite. Department of Entomology and Nematology, Gainesville: University of Florida Institute of Food and Agricultural Sciences. p. 1–4.

Perez, A. and S. Pollock. 2007. Fruit and tree nuts situation and outlook yearbook – FTS-33 (July 30, 2008). USDA-Economic Research Service, p. 83. [https://downloads.usda.library.cornell.edu/usda-esmis/files/7h149p84n/hm50tv466/0p0969243/FTS-07-30-2008.pdf] (June 2022).

Sauls, J.W. and L.K. Jackson. 1990. Lemons, limes and other acid citrus. FC42. Gainesville: University of Florida Institute of Food and Agricultural Sciences. p.1–4.

Spann, T.M., R.A. Atwood, J.D. Yates, and J.H. Graham, Jr. 2008a. Dooryard citrus production: citrus canker disease, HS1130. Hort. Sci. Dept., Gainesville: University of Florida Institute of Food and Agricultural Sciences. p.1–8.

Spann, T.M., R.A. Atwood, J.D. Yates, M.E. Rogers, and R.H. Brlansky. 2008b. Dooryard citrus production: citrus greening disease, 1131. Hort. Sci. Dept., Gainesville: University of Florida Institute of Food and Agricultural Sciences. p.1–8.

Takele, E. and P. Mauk. 1998. Establishment and production costs – lemons, Coachella Valley, Riverside County, 1998. Univ. of Calif. Coop. Extn., 1998 Coachella Valley lemons cost and return study, Riverside, CA. p. 6.

Tucker, D.P.H. and W.F. Wardowski. 1976. Lemon production and utilization in Florida, Bull. 184. Gainesville: University of Florida Institute of Food and Agricultural Sciences.

Yates, J.D., T.M. Spann, M.E. Rogers, and M.M. Dewdney. 2008. Citrus greening: a serious threat to the Florida citrus industry, CH198. Horticultural Sci. Dept., Gainesville: University of Florida Institute of Food and Agricultural Sciences. P. 1–2.

Chart 1. Cultural calendar for lemon production of mature (bearing) trees in the home landscape.

Operation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry fertilizer[1]			The period from March through September is generally the best time to apply granular mixes containing nitrogen-phosphate-potash-magnesium (N-P-K-Mg).									
Nutritional sprays			Apply 2 to 4 nutritional sprays to the leaves anytime from March through October. These sprays should include magnesium, manganese, zinc, molybdenum, and boron.									
Iron fertilizer				The period from April through September is generally the best time to apply iron materials to the soil.								
Watering			Water trees only during prolonged dry periods. Watering during the summer may be unnecessary unless drought conditions prevail. Water less during the winter (November–February).									
Insect control[2]	Monitor the tree throughout the year for insect infestations. Some insects pests, such as citrus red mite, are more prevalent during the dry season (fall/winter), whereas others, such as the citrus leafminer, are more prevalent during late spring and summer.											
Disease control[2]					During the rainy season monitor for citrus canker, algal disease, greasy spot, and Lemon anthracnose, and if necessary control these problems.							

[1] Dry fertilizer mix, which includes nitrogen, phosphate, potash, and magnesium. See text for makeup of nutritional sprays and iron soil drenches;
[2] See text for more information on these insects and diseases. Contact your local UF/IFAS Extension agricultural agent for more information and current recommendations.

Table 1. Lemon fertilizer recommendations.[z]

Year	Times per year	Amount/tree/ application (lbs)	Total amount/tree/ year (lbs)
1	3–4	0.25–0.5	0.75–2.0
2	3–4	0.5–1.0	1.5–4.0
3	3–4	1.0–1.5	3.0–6.0
4	2–3	1.5–2.5	3.0–7.5
5	2–3	3.0–4.0	6.0–12.0

[z]Typical fertilizer material formulations include 6-6-6-2, 8-3-9, 4-2-12, etc. For higher analysis fertilizer materials (e.g., 15-15-15), reduce the rate applied per application.

Table 2. Nutrient value of raw lemon fruit (3.5 oz or 100 g of fruit).[z]

Component	Value
Water	87%
Calories	20 kcal (84 kj)
Protein	1.2 g
Fat	0.3 g
Carbohydrate	10.7 g
Fiber	4.7 g
Calcium	61 mg
Phosphorus	15 mg
Potassium	145 mg
Sodium	3 mg
Iron	0.70 mg
Vitamin A	30 IU
Vitamin C	77 mg

[z] USDA-ARS. 2008. USDA National nutrient database for standard reference, Release 21. Nutrient Data Laboratory https://fdc.nal.usda.gov/ (June 2022).