

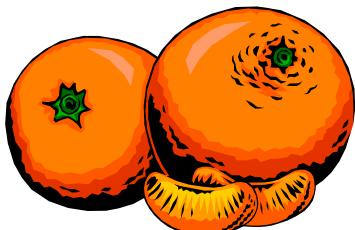


# GROWING CITRUS IN THE SIERRA NEVADA FOOTHILLS

AUTHOR: Cindy Fake, Horticulture and Small Farms Advisor, Nevada & Placer Counties

Mandarins are the signature fruit of the Sierra Nevada foothills. Warm days and cool nights during the growing season provide near-perfect conditions for production of high-quality flavorful fruit, the Mountain Mandarin®. Recent research has also revealed that mandarins contain significant amounts of synephrine. Synephrine is a natural antihistamine, which can alleviate the symptoms of colds and allergies, so mandarins are also health foods.

Commercial mandarin production flourishes in the foothills at elevations from 400 to 1000 feet. Most of the production is Owari Satsuma mandarins: sweet, seedless, zip-skin fruit. A few other varieties of Satsumas and some Clementine mandarins are also produced.



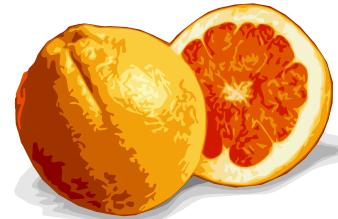
Mandarins dominate commercial citrus production in the foothills, but many other citrus species can also be grown. Navel, blood, and Valencia oranges, lemons, limes, grapefruit and kumquats are all produced commercially in the foothills. Microclimates created by foothill topography also allow production of more exotic citrus species such as pommelo, shaddock, limequat, calamondin, and yuzu. Not all varieties can be grown in all microclimates, however. For more information on citrus varieties, see UCCE Publication 16C: *Citrus Varieties for the Foothills*.

## *Eco-requirements for citrus production*

### *Site Selection*

Citrus are subtropical in origin, thus the cold temperatures which occur occasionally in the foothills can pose significant risk of frost and freeze damage. Tolerance to cold temperatures varies among the citrus species. Kumquat (18°F) is hardier than Satsuma mandarin (20°F) >

Meyer lemon (22°F) > oranges - Navel, blood, etc. (24°F) > grapefruit (26°F) > true lemons (Eureka, Lisbon) (28°F) > lime (30°F). Low temperature tolerance depends on many factors, including tree age, nutritional status, soil water status, acclimatization, and fruit maturity, among others. These temperatures are guidelines, given to assist in selecting appropriate species. All of the citrus species cited can successfully be grown in the right microclimate of the lower foothills.



The best sites for citrus are ridgetops or south-southwest facing upper slopes, with good cold air drainage. Impediments to cold air drainage such as vegetated fence lines, brush, blackberries, or hills may cause cold air to back up and damage the orchard. Mandarin is among the most cold-hardy of citrus,



COOPERATIVE EXTENSION,  
Placer County

11477 E Avenue, DeWitt Center  
Auburn, California 95603  
**530.889.7385**  
FAX 530.889.7397  
E-Mail: [ceplacer@ucdavis.edu](mailto:ceplacer@ucdavis.edu)

WEB SITE: [ceplacernevada.ucdavis.edu](http://ceplacernevada.ucdavis.edu)

The University of California prohibits discrimination or harassment of any person in any of its programs or activities. (Complete nondiscrimination policy statement can be found at [http://groups.ucanr.org/ANR\\_AA/files/54634.pdf](http://groups.ucanr.org/ANR_AA/files/54634.pdf)). Direct inquiries regarding the University's nondiscrimination policies to the Affirmative Action Director, University of California, ANR, 1111 Franklin St., 6th Floor, Oakland, CA94607, (510) 987-0096.



Nevada County

255 So Auburn Street.  
Grass Valley, California 95945  
**530.273.4563**  
FAX 530.273.4769  
E-Mail: [cenevada@ucdavis.edu](mailto:cenevada@ucdavis.edu)

however, elevation does limit production. In general, the upper limit for citrus orchards is about 1,200 feet elevation.



In some areas, foothill topography creates locations where temperatures are much more moderate than

one would expect for a given elevation. These are the so-called “banana belts” or warm microclimates where citrus production may be possible above 1,200 feet. Citrus production may also be possible at higher elevations in an area where frost risk is moderated by a large body of water, pavement, or warm upwinds from a canyon or lower elevation.

Citrus require full sun for flowering and fruit production. A citrus orchard should be as sheltered as possible from strong winds. Mandarins, in particular, should be protected from winds, without impeding cold air drainage. Their thin rind is susceptible to damage from wind and wind-driven rain from winter storms and damage is exacerbated by cold weather. Sites offering protection from wind will also increase the available heat for the trees in frost/freeze events.

For home plantings of a few trees, planting next to south-facing cement or stone walls or a patio can mitigate the risk of cold. The stone or cement absorbs heat during the day, and reradiates it back at night, protecting the trees. In marginal zones, containerized trees in wine barrels or tubs can be moved next to south facing walls, or indoors for protection in cold weather.

If you are interested in planting mandarins in the foothills, but are unsure of the suitability of your property, it is best to collect temperature data for your particular site for at least a year. Purchase several maximum/minimum thermometers and place them around your property, especially up and down slopes, to gauge where cold air backs up the slope. Record minimum temperatures throughout winter and spring, at least on a weekly basis.

### ***Soil Conditions***

Citrus are shallow-rooted trees. Feeder roots are in the top two feet of soil, with most activity occurring in the top 12 inches. Deep soil is not necessary for successful production as the majority of commercial mandarins in Placer County are grown on 18 inches of soil or less.

Citrus do not require deep soils, but they do need well drained soils. They will grow well on most

foothill soils, as long as they are on slopes or soils that drain well. Clay soils have smaller pore spaces and absorb more water than granitic soils, so the danger of waterlogging is greater. Citrus do not tolerate waterlogged roots and are susceptible to *Phytophthora* root disease when they are overirrigated. Do not plant citrus in lawns or in areas which become saturated with winter rains. Plant in raised beds or mounds if waterlogging is a risk.

Foothill soils typically have low native fertility and organic matter. Many foothill soils are clay or decomposed granite and quite acidic (pH <7). At lower elevations, there are more neutral and slightly alkaline soils. Citrus grow well in slightly acidic soils, but a very acidic soil (below pH 6) will need to be amended with lime to correct pH.

An analysis by a professional soil laboratory is recommended before planting. Your amendment and fertilizer program will depend on the results of your soil tests. In order to avoid costly errors, it is best to use a commercial lab rather than home soil test kits. See UCCE publication 74C: *Soil Analysis* for information on area soil laboratories and analyses.

You will need a number of standard soil tests to provide a baseline for your soil management program. Most labs

have a basic package, which provides a good baseline. You should have your soil analyzed for:

- ◆ pH: acidity or alkalinity
- ◆ soil nutrient status: at N, P, K at a minimum; Ca S, Zn, B and Fe are recommended.
- ◆ CEC (Cation Exchange Capacity), a measure of native fertility
- ◆ organic matter
- ◆ ppm (parts per million) of Ca, Mg, K, and Na (base saturation %)
- ◆ Ca: Mg ratio

Use a California lab to get accurate information. If you inform the lab that you will be planting citrus, they can provide recommendations on the nutrients or amendments needed. Most labs will give guidance on organic amendments, if you specify that it is organic. For more information on organic amendments, see UCCE publication 72C: *Organic Amendments*.

### ***Certified Planting Stock***

Citrus are very long-lived trees, often producing for 50 years or more. Placer County has productive trees that are more than a century old, and several major orchards are over 60 years old. Planting a citrus tree is a long-term investment in the

future, so it is best to start with high quality planting stock.

Citrus grown for fruit production are almost exclusively budded trees. Very few citrus are grown on their own roots because they are not as productive as those grown on rootstocks. Budded trees will consistently produce the same true-to-type fruit. Very few citrus fruit produce seed that will come true to type. Planting a seed from a citrus fruit rarely gives you a tree that produces the same fruit, and without a rootstock, it will probably be a weak tree.

### ***Rootstocks***

Each citrus tree has two parts: the rootstock and the scion. The rootstock is a species selected for specific characteristics, such as disease resistance or tolerance of certain soils. Rootstocks used in the foothills are selected for cold tolerance and for size control.

Two rootstocks, of the species *Poncirus trifoliata*, are very well adapted to foothill conditions. These Trifoliate rootstocks are Rich 16-6 and Rubidoux, both of which provide cold hardiness and are semi-dwarfing. Another Trifoliate rootstock, Flying Dragon, has a greater dwarfing effect (~75%) and is well suited



for container citrus, but not for production orchards. Carrizo rootstock is sometimes used in the foothills, producing high quality fruit, but later in the season. Carrizo does not impart quite as much cold tolerance as Trifoliate, however. Older trees are often on Cleopatra rootstock. However, Cleopatra has no dwarfing characteristics, and trees will become very large, so it has fallen out of use.

The valley citrus industry standard is a rootstock called C-35. It is preferred there because it begins to bear earlier than trees on Trifoliate rootstocks.

Some foothill orchards are on C-35, however, it has a number of drawbacks for the foothills. C-35 does not provide as much cold resistance, and young trees are often severely damaged by frost. The C-35 rootstock is very vigorous and overgrows the scion, reducing the longevity of the orchard. In addition, the consensus among foothill growers is that C-35 fruit are not as sweet as those on Trifoliate.

Rootstocks are usually grown from true-to-type seed (available from some nurseries). After a year or so, a bud from a certified mother tree of the specific cultivar (named variety) of desirable fruit is attached to the rootstock and the top of the rootstock plant is cut off. The two plants are allowed to grow together and they become the citrus tree.

**It is important to buy certified citrus trees from a reputable nursery**, even if you only intend to plant a couple of citrus trees for home use. A reputable nursery will sell trees that are certified disease-free and true-to-type. If you are intending to plant an orchard, it is best to use a specialty citrus nursery which sells to the industry. A commercial citrus nursery will not only guarantee certified, true-to-type plants, but the quality and longevity of the trees will be much better. For many of the varieties used in commercial production in the foothills, trees need to be budded to order.



If you buy citrus trees outside of your home county, your County Ag Commissioner must inspect them before you plant. Citrus can carry many disease and insect pests, and you could unwittingly be bringing in a new pest. There are quarantines between California counties and County Ag Commissioners have the authority to order trees destroyed that do not meet local quarantine standards. Citrus cannot legally be brought into California from other states without going through quarantine procedures because of the danger to California's citrus industry. Even if it is only one

tree for your yard, **please do not bring any citrus from another state or country**. The health of the California citrus industry depends on abiding by quarantine laws.

### ***Preparing the Soil and Cover Cropping***

If you are planting more than a couple of trees, it is a good idea to find out how deep your soil is and whether or not there is a hard pan. The soil survey, available on line (<http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>) or in Natural Resources Conservation Service (NRCS) offices, can give you some basic information about your soil. The best way to find out about your soil is to dig some holes 6 feet deep or more with a backhoe. Many foothill soils are layered and you will be able to see the layers and whether a hard pan exists or not.

Land should be prepared by ripping before laying out and planting the orchard. Ripping the soil in several directions is essential in clay soils or if there is a hard pan. It opens up the soil, allowing roots to penetrate and water to drain through. Ripping is particularly critical for citrus because of their sensitivity to waterlogging. If possible, add amendments such as lime or compost before ripping so as to incorporate them.

While good land preparation can be somewhat costly, your orchard and the quality of your fruit will suffer in the long run from the lack of soil preparation. Poorly prepared ground can result in water stress and irrigation issues for the life of the orchard. Giving your plants the best possible opportunity to establish themselves will result in a long, productive life.

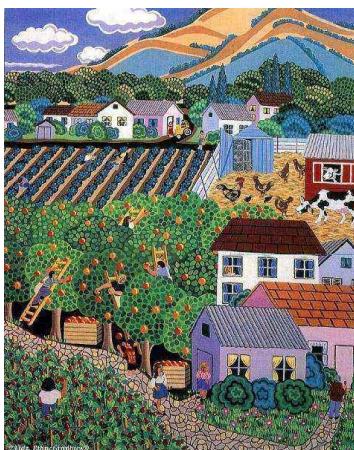
Once your soil is prepared, establish a cover crop, especially if you are not planting immediately. A cover crop is typically a grass or grass and legume mix. It is used to stabilize soil, add organic matter, and in the case of the legume, fix nitrogen. A cover crop will protect your soil from erosion in winter rains and can significantly increase soil organic matter and/or soil nitrogen, depending upon what is planted. It may also facilitate rainy season work. Seed mixes appropriate for the foothills are available from local farm supply stores. All foothill orchards should have vegetative cover on the soil. Bare soil and intense winter rainfall result in significant erosion and soil loss in a very short time. Once lost, soil cannot be replaced.

### ***Plant spacing & planting***

Citrus tree spacing and layout vary greatly in the foothills. If you are planting an orchard, spacing will depend on several factors: the species and rootstock,

the degree of slope, the turning radius of your tractor or other equipment, and your pruning and training plan. Common spacings in the foothills range from 12 to 18 feet. Generally, 10 feet between trees in the row and 12 feet between rows is adequate for small trees such as mandarin and Meyer lemon, if they are on a semi-dwarfing rootstock such as Trifoliate and pruned to maintain small size. Oranges and grapefruit need a minimum of 12 feet between trees and wider is better.

Orchards are often laid out in north-south lines to facilitate capturing sunlight. The foothills do not have a shortage of sunlight, but do have slopes. Flat ground sufficient for an orchard is not common, so the direction of the slope is much more critical to row direction than compass directions. Generally, it is safer to drive a tractor up and down the slope than across the slope, so it is important to plan your orchard layout according to the slope.



The best time to plant citrus is in springtime, after danger of frost has passed, but well before hot weather. Planting citrus in March and April, when the soil is moist, gives the trees an opportunity to establish roots before the heat of summer. Citrus may be planted in the fall, but usually it is better to wait until spring as young trees will be easier to protect from frost damage in containers.

Dig each tree hole no deeper than the container and twice the width. Auguring tree holes in clay soils is not recommended, because the augur creates a smooth surface that makes it difficult for roots to grow out of the hole. If you do augur the holes, make sure the surfaces of the hole are roughed up before planting the tree.

Do not amend the soil in the planting hole with fertilizers or manures. Plant on a mound or in raised beds if soil drains slowly or contains heavy clay. Keep the rootball as intact as possible when planting the tree. If the trees have been in containers a long time, they may have circled or kinked roots. If that is the case, make a small mound in the bottom of the hole. Unwind the roots and spread them over the mound, ensuring that tips point downward.

After planting, trees should not settle deeper than the level they grew in their containers or in the nursery. Look for the crown, the

limit between the trunk and roots and make sure it is not below the soil line. Trees planted too low or in a depression will not thrive. After planting, compost or mulch may be spread on the surface of the soil along the tree line, but keep it at least 2-4 inches away from the trunk.

Using compost or mulch on the surface of the root zone creates healthy soil conditions for the trees. It helps maintain soil moisture, reduces weed growth, and keeps roots cooler in the summer, reducing the stress on the tree. In addition, it adds organic matter, beneficial microbes, and some nutrients to the soil. Compost or mulch should be renewed on an annual basis for the life of the tree.

Protect young trees from sunburn by whitewashing the trunk with a 1:1 solution of white interior latex paint and water. Paper trunk bands can also protect young trunks.

### ***Frost/Freeze Protection***

Damage to citrus from cold temperatures usually occurs in early winter (December) before the tree is completely hardened off. Mature mandarin trees can withstand temperatures below 20°F; although leaves and green wood will die if temperatures remain at that level for any length of time. Fruit are much less cold hardy than the woody parts of the trees and are usually damaged at 26°F, or higher if it

remains cold for a long period. Trees with fruit are less cold-hardy than trees without fruit.

Young trees (1-3 years old) are much more susceptible to frost and freeze damage than older trees. They may be killed to the bud union in a cold year, if left unprotected. Leaves and green wood may be lost in a single incident, but trees usually come back after a minor freeze. In general, flowers are the most sensitive to cold, followed by fruit, leaves and wood.

Planting in an area with frost hazard requires a plan for frost protection. In the past, overhead sprinklers were used for frost and freeze protection. However, they require a lot of water: adequate to run 24/7 over the entire orchard for the duration of the freeze. More damage can occur if the sprinklers are shut off prematurely than if the trees are left unprotected. The weight of the ice may also cause damage.

With less water available for agriculture, most orchards have moved away from overheads to microsprinklers (microjet, microspray), which use a much lower volume of water. Microsprinklers can offer several degrees of frost protection. They also must continue to run for the duration of the freeze event. If running irrigation for such long periods is not feasible, saturating the soil before the freeze event will offer the best protection.

For small trees, covering them with burlap, rowcover, or plastic may be feasible. The cover should entirely cover the tree, but not touch the foliage. Plastic that touches the foliage may actually cause more damage because of condensation and subsequent freezing that can occur. Remove the cover after temperatures rise each morning. Strings of small incandescent lights can be used to protect single trees.



### ***Tree Care***

### ***Irrigation***

Monitor the soil around newly planted trees to determine when to water. When soil begins to dry in the top 6-8 inches, trees need to be watered. Young trees have a limited root volume, so it is important to irrigate often with small amounts of water. Frequency of irrigation is determined by soil type and by weather conditions, but generally will be several times a week for young trees. In time, roots will expand and have a greater area from which to extract water and nutrients, and intervals between irrigations will increase.

Learn about your trees' water use by digging shallow holes on the edge of the root zone and seeing how long it takes the soil to dry after an irrigation. There are many useful tools for monitoring soil moisture, including matrix blocks and tensiometers, but they need to be backed up by firsthand knowledge of the soil conditions in different sections of the orchard.

As subtropicals, citrus trees can be stressed by hot, dry foothill summers, thus, it is important to keep trees adequately watered. When temperatures above 95°F are predicted for several days, trees should be irrigated in advance of the heat. Keep root systems moist but not saturated. A saturated soil has all its pore spaces filled with water, which deprives the roots of oxygen.

In cold, wet springs, citrus trees may turn yellow and look sickly. This occurs because roots are not able to function in cold, wet soils. The tree is not able to take up the nutrients it needs, especially nitrogen, so it uses up internal reserves, causing chlorotic (yellow) leaves. Typically, the problem resolves itself as the soil warms and dries. If it does not, then consider installing drains in the orchard or moving the tree to a location with better drainage.

### ***Fertilization***

Citrus are not heavy nutrient users, but they need adequate nutrition for quality fruit

production. An effective fertilizer program is initially based on soil information, and subsequently on leaf tissue analysis. For more information on nutrient management programs, see *UCCE publication 11C: Fertilizing Citrus in the Foothills.*



Leaf tissue analysis is the best tool for determining tree nutrient status. An accurate assessment of plant, rather than soil, nutrient status will identify deficiencies so they can be corrected. Such an analysis may indicate nutrient levels above or below optimal levels, but symptoms may not yet be visible. Starting in the fourth year, samples should be taken every other year in the fall and analyzed for nitrogen, phosphorus, potassium, zinc, manganese, and boron.

Nutrient management for foothill citrus typically combines the use of compost or composted manure with soil or foliar applications of specific nutrients. Increasing organic matter with compost helps keep applied nutrients in the root zone to be released as the trees deplete the soil solution. Legume cover crops may also contribute nitrogen.

Most orchards need annual applications of nitrogen and zinc, and many need micronutrients such as manganese, boron, or iron. In acid foothill soils, phosphorus may also be needed, and potassium is sometimes needed as well. Soil and tissue analysis should be used to match the nutrient management program to your trees' specific needs.

Nitrogen is a critical nutrient for citrus, but often overapplied. Overuse of nitrogen adversely affects fruit quality and may contribute to susceptibility to frost and insect damage. It is important to match N applications from all sources to actual tree needs, as the trees grow. If a legume cover crop is used, the nitrogen provided by the crop should be included in the fertilizer balance sheet.

The majority of nitrogen applications should occur in spring, as the highest plant needs for N occur from bloom through June. Start applications after heavy rains have tapered off. Nitrogen is mobile in the soil, especially soluble forms, so much of it will be lost to runoff and leaching if applied during winter rains. Slow release forms are more expensive, but may be more convenient for small orchards.

Nitrogen applications should be completed by late July or early August. Later applications may affect fruit quality. Late summer or fall applications promote fall

growth flushes which are more susceptible to frost and freeze damage.

Nitrate forms of nitrogen are recommended for use on acid soils in the foothills, as ammonium fertilizers can further acidify the soil. For the first year, about two ounces of actual nitrogen per tree are needed. The second year,  $\frac{1}{4}$  pound actual N per tree;  $\frac{1}{2}$  lb. in the third year; and  $\frac{3}{4}$  pound in the fourth year. Young trees do not have well developed root systems, so a slow release form should be used or the nitrogen should be split into 4 to 6 applications from March through July.

From the fourth year on, trees require about 1 pound actual nitrogen per tree per year. Actual N can be found by multiplying the percent N in the material by the weight of the material. For example: Calcium nitrate (15.5-0-0) contains 15.5% N. Thus, a 20 pound bag ( $.155 \times 20 = 3.1$ ) contains about 3 pounds of actual N. So, that 20 lb. bag will serve for 3 mature trees or 12 two year old trees.

Synthetic forms of nitrogen have become increasingly expensive in recent years, so growers have begun to rely on cover crops and composts. Some legume cover crops in pure stand can fix up to 250 pounds of N per acre, which is far more than a citrus orchard needs. If you plan to use cover crops to provide a portion of your nitrogen, the UC SAREP Cover

crops database at <http://www.sarep.ucdavis.edu/ccrop/> has all the information you need. Compost nutrient content is completely dependent on the feedstock that went into the compost, so each batch needs to be tested for nutrient content.

Although foothill soils may contain adequate phosphorus, it may not be available to plants, and thus phosphorus may need to be applied annually. Phosphorus deficiency may reduce marketable yield as deficient trees produce more fruit with thick, coarse rinds and lower juice content. Potassium deficiencies do occur in the foothills as well. Potassium helps maintain rind integrity and improves sugar acid balance and flavor in fruit, so some growers apply foliar potassium as fruit are maturing.

Zinc and manganese are usually applied on an annual basis in spring foliar sprays. Iron may also be needed, especially in areas with drainage issues. Do not apply boron unless soil tests and tissue analysis show that it is deficient. The range between deficiency and excess is very narrow, and excess boron can damage trees.

Some or all of these nutrients may be required in foothill citrus orchards. However, soil depth, nutrient and organic matter content vary greatly, even in the same orchard. Rootstock and soil moisture also influence nutrient

uptake, so any fertilizer program should be based on soil and tissue sampling, not on a standard recommendation.

### **Pruning**

Citrus are evergreen trees, thus require less pruning in general than deciduous trees. However, they do need pruning. Young trees should be topped at planting if they are tall and spindly to promote side shoots which will develop into a lower, fuller canopy. The shorter the tree remains, the easier and more cost effective it is to harvest.

Any shoots below the bud union should be removed as they appear. Often, water sprouts or gourmands, which are long, thick, very vigorous branches, will appear in the canopy. These branches often remain vegetative for a number of years, contributing little to the productive capacity of the tree, so they should be removed.

Mandarins, in particular, tend to have pendulous branches that hang to the ground. These are called skirt branches, and they can impede weeding, fertilizer and compost application, and provide pathways for ant populations to use the trees. Trees should be skirted up every couple of years as needed.



Fruit needs sunlight to develop flavors and sugars. Dense canopies may not allow enough sunlight to reach fruit, so thinning is needed every few years. A good judge of canopy density is whether or not you can see dappled sunlight on the ground underneath the tree at midday.

There are relatively few citrus insect pests in the foothills, but most of the problems are caused by soft bodied insects such as scale. Scale insects, especially *Citricola* scale, thrive in dense canopies with high humidity and little air movement. Thinning the canopy can significantly reduce scale populations to the point that insecticide sprays are unnecessary.

### **Pest Management**

Foothill citrus generally have fewer insect and disease pests than other areas with high density citrus plantings. However, there are still some key pests that affect orchard vigor and productivity. California-specific information on citrus pest management is available at <http://www.ipm.ucdavis.edu/>. There are separate sections with recommendations for backyard and commercial orchards. Pest management information from other states is not reliable as we do not have the same pests and California restricts the use of many pesticides.



Gophers can be very destructive in young orchards. Citrus roots are not a preferred food, however, they can cause serious root damage just by tunneling through the orchard. Baiting or trapping can be very effective, if the grower is vigilant and acts every time a new mound is found. Some dogs and cats can be very effective gopher hunters, but it is difficult to predict. Most other popularly described methods are not effective, including propane guns.

Citrus may be affected by a variety of insect pests — scale, aphid, mite, thrips, and mealybug. However, a well managed orchard with a healthy natural enemy population can keep most of these insects in balance. Natural enemies are insects which prey on or parasitize insect pests. In the foothills, we have high populations of a variety of natural enemy species. Flowering cover crops and hedgerows that flower before orchards can provide food and habitat to encourage natural enemy populations. Use of broad spectrum pesticides will adversely affect natural enemy populations, and may flare pest populations.

Commercial orchards in the foothills rarely have problems with aphid or mealybug. If citrus are overfertilized with nitrogen,

such as trees in lawns, these insects can become problems. Mites are very rare in citrus in the foothills, and if they become a problem, it is usually a result of broad spectrum pesticide use or poor irrigation management.

Scale insects are the major insect pest for most growers. Effective water and nitrogen management, good pruning practices, and controlling ants can prevent most scale problems. There are two major scale pests, *Citricola* and California red scale; and several minor ones, black scale and brown soft scale. *Citricola* scale is the most common pest issue in the foothills. In most years, populations can be managed with pruning. However, periodically populations can get out of control and pesticide applications may be necessary. Typically horticultural, neem, or stylet oils are adequate for population control. Ant populations should never be allowed to develop in trees. Ants not only prey on natural enemies but actually farm and protect honeydew-secreting pests. Skirt prune lower branches to prevent movement of ants into the canopy, and, if necessary, use sticky bands around trunks.

California red scale is the other major scale pest. It has been introduced on nursery stock in recent years, and become established in a few orchards. Inspection of planting stock by the County Ag Department, and

not importing infested citrus fruit or leaves from other counties will prevent further introductions. Most growers do not spray for red scale. Natural enemy releases are more effective and environmentally friendly. Commercial mandarin growers and a few homeowners cooperate to release *Aphytis* wasps, a tiny parasitic wasp specific to red scale, each spring and fall. The cooperative releases cost about \$12-15 per acre per release, with 6-10 releases per year, so they are very cost effective. If you wish to participate in *Aphytis* releases, please contact the UCCE Placer County office.

Asian citrus psyllid (ACP) has not yet reached foothill orchards, however, it is the subject of major eradication and quarantine efforts in Southern California. ACP can damage citrus trees by feeding, but its major threat is that it carries Huanglongbing, a disease that is deadly to citrus. Many Florida orchards are now affected, and some has been found in Mexico as well. Huanglongbing, if allowed to spread, will devastate California's citrus industry. There is no cure and it kills trees in just a few years.

ACP, Huanglongbing, and another disease called Tristeza are the primary reasons not to bring citrus from other areas into the foothills without appropriate documentation and inspection by the County Ag Department.

**Please respect all quarantine regulations.**

There are few diseases in foothill orchards. *Phytophthora* is a pathogen that is ubiquitous in the foothills. However, it only becomes a problem when citrus roots are kept too wet.

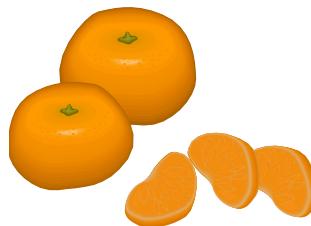
Maintaining good soil drainage, avoiding overirrigation, and using recommended rootstocks will prevent disease problems.

Weeds can be a major issue in citrus orchards. Young trees have limited root systems, thus it is critical to keep weeds away from the root zone. Mulch can help diminish weed growth, but some weeding around the base of the trees is necessary. Weeds can be controlled mechanically with weed whackers, mowers, or other equipment. However, citrus bark is thin and easily damaged, so it is important to take care weeding close to trunks.

Herbicides may be used for strip spraying on orchards, but be careful to choose sprays labeled for citrus and appropriate to the age of the trees and stage of the weeds. Disking is not recommended in foothill citrus orchards because of the damage to soil and subsequent erosion.

Foothill citrus production can be a profitable enterprise. However, being a successful grower requires more than production skills, it also involves marketing and business skills. UC Cooperative Extension offers assistance with both. Contact your local UCCE

office for more information. If you intend to be a commercial grower, plan to join the Mountain Mandarin Growers Association <http://www.mountainmandarins.com/>.



The resources listed were used in preparation of this document and may be helpful in planning and managing your citrus orchard.

**References & Resources**

**Citrus.** 2003. F.S. Davies and L.G. Albrigo. CABI Publishing. UK.

**Citrus: Complete Guide to Selecting and Growing More than 100 Varieties.** 1996. Lance Walheim. Ironwood Press. Tucson, AZ.

**Citrus Growing in the Sacramento Valley.** 1977. UC ANR Leaflet 2443.

**The Cultivar.** Vol. 14, No. 1. University of California, Santa Cruz. Winter 1996.

**Micronutrient Deficiencies of Citrus.** 1981. UC ANR Publication 2115.

**Protecting Citrus from Cold Losses.** 1979. UC ANR Publication 2372.

<http://www.citrusvariety.ucr.edu/>

[citrus/](#) UC Riverside Citrus Variety Collection

<http://lib.ucr.edu/agnic/webber/Vol1/Vol1TP.html> The Citrus Industry Vol. 1.

<http://ucanr.org/sites/placernevadasmallfarms/Crops/Citrus/> UCCE Placer/Nevada Mandarin production information

**UCCE Placer/Nevada citrus publications:**

**Citrus Nurseries in California.** UCCE Placer/Nevada Publication #10C.

**Fertilizing Citrus in the Foothills.** UCCE Placer/Nevada Publication #11C.

**Mandarin and Citrus Information on the Internet.** UCCE Placer/Nevada Publication #12C.

**Citrus Pest Management Summary Sheet.** 2008. UCCE Placer/Nevada Publication #13C.

**Citrus Tissue Sampling.** 2008. UCCE Placer/Nevada Publication #14C.

**Avoiding Cold Damage to Citrus.** 2009. UCCE Placer/Nevada Publication #15C.

**Citrus Varieties for the Foothills.** 2009. UCCE Placer/Nevada Publication #16C.

**Organic Amendments.** UCCE Placer/Nevada Publication #72C.