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GROWING BACKYARD CITRUS IN KERN COUNTY

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This publication is divided into two major sections. The first, "**Avoiding Trouble**," The second "**Trouble-Shooting Common Citrus Complaints**."

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AVOIDING TROUBLE

Introduction to Citrus in Kern County

Citrus such as oranges, lemons, grapefruits, mandarins, tangelos and pummelos grow well in Kern County, often with very little care. However, as is the case with most plants, maintaining a tree in a healthy condition by following a few basic horticultural practices, is often much easier than trying to return a declining tree back to health. Citrus trees are one of the longest-lived fruit trees that we have in Kern County. Commercial groves planted 80 years ago are still in commercial production in the Edison area of Kern County and one of the original Washington Navels first brought to California is still alive in the city of Riverside. The following topics are designed to give the homeowner some guidelines that may help keep the new or existing citrus tree in a healthy, beautiful and productive condition for many years to come.

SELECTION OF A TREE

Variety

The backyard citrus grower does need to be aware that it is currently illegal to import citrus trees, budwood, or other parts of citrus trees into Kern County from areas outside the Central Valley and the interior desert areas of California. Kern County citrus is free of many of the disease and insect pests which plague other citrus-growing areas of the world.

A Note on Mandarins (tangerines)

In the United States a wide variety of fruit has been sold for many years under the name "tangerine." In fact, so many different kinds of fruit have been sold under this name that it has lost meaning. In an effort to educate the consumer of citrus, some marketers are encouraging the selling of fruit based on the particular variety. For example, mandarins are further subdivided into satsumas, clementines or into a large number of varieties that have resulted from cross breeding other mandarins. In the past, interspecific crosses such as the Minneola tangelo have been sold as tangerines, as well.

Scion/Rootstock Considerations

The citrus tree that may be purchased from many nurseries in Kern County is not as simple as it looks. All trees purchased at commercial nurseries have been budded. Budding refers to the practice of placing a bud from the desired "eating" variety onto a rootstock. The portion of the tree that grows from the bud is called the scion. The point of attachment of the bud to the rootstock is visible for the life of the tree since the rootstock and the scion usually demonstrate different growth rates. Budding has been found to reduce the time required to bring the citrus into bearing and to provide greater disease resistance to the tree, particularly in regard to soil fungal diseases. Some scions and rootstocks are incompatible so buying the tree from a reputable nursery is important. In Kern County, resistance to Phytophthora root rot and tolerance to calcareous soils are important characteristics in choosing a rootstock. Rootstocks such as "C35" and "Carrizo" have demonstrated good adaptability to Kern County soils and provide reasonable resistance to fungal rots in combination with good productivity. Sour orange rootstocks should be avoided due to their susceptibility to the tristeza virus and quick decline disease. The "Flying Dragon" rootstock is used as a dwarfing rootstock and the resulting tree is often used in patio plantings. Rootstocks with lemon heritage, like Rough Lemon, Schwab Rough Lemon, or Volkameriana, produce fruit that tends to have lower sugar content and less acid producing a bland taste. These rootstocks will produce a tree that grows quickly and produce plenty of large-sized fruit but the quality of the fruit usually suffers. Macrophylla is a rootstock popular on the coast as a lemon rootstock but is too frost sensitive for most Kern County conditions.

WHERE TO PLANT THE NEW TREE

Topographical Location

Citrus is a perennial subtropical crop and frost sensitive. Commercially, citrus is grown in a band along the edge of the valley at an elevation of approximately 450 - 900 feet above sea level or 150 to 400 feet above the elevation of the valley floor. Generally, in Kern County, citrus will do better on south-facing hillsides that provide good cold drainage. The citrus belt is still located within the fog belt, but above the level of cool air which typically ponds on the valley floor. Typically, during the winter, a warm inversion layer forms on still nights above the floor of the San Joaquin Valley which helps protect the citrus belt from fruit freezing temperatures.

If your home is not located within the citrus belt there is still hope of producing citrus, but growers of citrus should be aware of the increased risk of freezing. Homeowners in colder areas of the Valley floor, as in southwest Bakersfield for example, often are able to take advantage of microclimates in the backyard which provide protection to citrus on cold nights. Freeze damage to fruit is a function of the maturity of the fruit, the dew point, and the duration of the cold temperature as well as the actual low temperature experienced by the fruit. Homeowners can expect some serious freeze injury of ripe navel orange fruit when temperatures drop below 26°F and the death of live wood when temperatures drop below 22°F. Fruit of lemon and green Valencia orange may be frozen at higher temperatures (28 to 29°F) and lime at 30°F or higher. Valencia navel is somewhat unusual among the commonly grown citrus varieties in that it matures in the spring and summer. The late maturity of Valencia orange means that during the winter the fruit is green and low in sugar, and very susceptible to freezing. Frozen Valencia oranges will stay on the tree even if frozen, and will have dry juice sacks when picked the following spring and summer. The Mexican lime fruit and the tree itself is extremely frost sensitive. Meyer lemon is the most frost tolerant lemon commonly available at most nurseries. Sugar acts as natural antifreeze so sweet, ripe fruit freeze at a lower temperature than immature, sour fruit.

Soils

Citrus thrives on deep, well-drained sandy, sandy-loam and loam soils. Even though citrus has many surface roots, with most of the root activity in the top 2 or 3 feet, it does not tolerate poor drainage. Citrus grows best when the soil is allowed to dry out to approximately 50% of its water holding capacity between irrigations. Clay soils and areas that drain poorly should be avoided. Because of its shallow root system, citrus does not compete well with deeply rooted grasses like Bermuda. Citrus should not be planted directly into a Bermuda grass lawn. Bermuda grass should be removed to a distance of 3 to 4 feet from the trunk for a new planting and not allowed to regrow into the planting circle.

Light

Citrus can survive and produce lush foliage under low light conditions. Citrus makes an interesting indoor plant if placed near a south-facing window. However, for good fruit production citrus must receive full sun in an open backyard situation. Make sure your planting site is free of shade from another tree or structure for at least half the daylight period.

PLANTING THE NEW TREE

Citrus trees do best when planted before the weather becomes too hot. Generally, citrus should be planted after the danger of frost is passed, usually in late March through April. Citrus trees may still do well when planted through the summer but special care should be taken to ensure that they have sufficient water. Late fall or winter planted citrus have an increased risk of frost damage.

When planting the citrus tree, the bud union should be above ground level, preferably by at least 12 inches. As with any nursery tree, avoid using the trunk as a handle. Trees should be removed from any pot before planting and roots that have begun circling within the pot should be pruned. To avoid fertilizer-burn, do not place manures or fertilizers in the hole before planting the tree. Water should be applied to the tree immediately after planting, especially so if the temperatures are warm, to remove air from the soil around the tree and to provide water for transpiration.

Citrus trees are relatively large trees and should be planted at least 12 feet (more is better) from fences, walls and buildings. This rule is good even semi-dwarf citrus (which really can grow into a large tree). True dwarf trees on ‘Flying Dragon’ rootstock can be planted 6- 8 feet from structures. Trees planted too close to structures will often lean and grow into light, become unbalanced, develop stress cracks in the trunk, and break or fall over.

CARING FOR THE NEW TREE

Irrigating the New Tree

The root ball should be kept moist until the roots grow into the surrounding soil. Frequent but light irrigation will accomplish this. Failing to irrigate a new tree will often result in a dead tree, but over-watering a new tree may be as damaging as no water at all. For best results, use a hand probe or a water meter of some sort to ensure about half the available water is gone from the root zone before irrigating again. Care should be given to avoid splashing water and mud on the trunk of the tree to avoid fungal infections.

Fertilizing the New Tree

During the first year a citrus tree will use only 1 or 2 ounces of actual nitrogen. For example, if a fertilizer with an analysis of 20-20-20 (20% nitrogen, 20% phosphoric acid, 20% potassium oxide) is used, 5 to 10 ounces will need to be applied the first year. Applications could be made as follows: two ounces at planting, and once a month thereafter (example: 2 ounces April 1, May 1, June 1, July 1 and August 1). Fertilizer applications in the fall and winter should be avoided to encourage some dormancy for the winter.

FERTILIZING AND IRRIGATING THE MATURE TREE: A COMPROMISE BETWEEN MAXIMUM FRUIT YIELD VERSUS A REASONABLE FRUIT YIELD

Commercial growers in Kern County regularly get upwards of 900 oranges from a single tree. To accomplish this though, on average, they may apply as much as 1.5 lbs of actual nitrogen per tree and up to 60 gallons of water per day during the summer or 8200 gallons over the season. Most homeowners have no use for 900 oranges and unless the tree is in full sun, it is unlikely to attain a yield of this magnitude. A healthy tree may be maintained with less nitrogen and water than is necessary for maximum yield.

Fertilizing and Irrigating Mature Citrus

To avoid root-rot problems, citrus roots should not be kept constantly wet. Citrus trees do best when the soil is allowed to dry out to about one-half of its water holding capacity between irrigations. Citrus roots tend to be fairly shallow, with few roots deeper than three feet. Citrus often produces a mat of feeder roots right at the soil's surface. Citrus should be fertilized annually. Apply approximately 3/4 to 1 pound of actual nitrogen to the mature tree per year (after the tree is about 12 years old). A five- or six-year-old tree should receive about one-half this amount. Remember that the first of the three numbers listed on most fertilizer bags refers to the percent nitrogen by weight in the fertilizer. Begin applying the fertilizer in late February or early March. Discontinue nitrogen fertilizing by August to prevent excessive vegetative flushes of new growth carrying into the winter. In addition to nitrogen, citrus trees will do best if fertilized with a complete nutrient fertilizer containing the primary, secondary and micronutrients. Citrus trees in the San Joaquin Valley usually require supplemental zinc, manganese, and copper fertilizers. A good way to meet the micronutrient needs of citrus is to spray the leaves with a complete foliar fertilizer such as "Miracle Grow®," at intervals through the growing season. Use of composts and manures are also very beneficial, but the material should not be piled directly around the trunk. Mulches help control weeds and prevent excessive evaporation of irrigation water, but should be less than one inch thick to minimize the root-rot diseases to which citrus is prone. Gypsum or similar product may be applied around the tree to improve water infiltration.

Pruning

An explanation of the growth habit of citrus can assist the citriculturist in pruning citrus. The growth habit of a tree will determine if and how it will be pruned. Commercial citrus cultivars in California have been selected for an upright growth habit. In these cultivars, branches are characterized by strong apical dominance. As long as the branch grows upright, growth of nonterminal shoots is suppressed. Normally, however, with time, the citrus branch will be forced over into a more horizontal position by the weight of leaves and fruit. When this eventually occurs, the tip no longer will be the most elevated point of the branch. Terminal dominance ceases and the lateral buds now at the most elevated part of the branch begin to grow vigorously. These new lateral branches then become the upright fruiting branches, until they eventually bend over, and the cycle repeats. As a result of this growth habit, unpruned citrus trees can be characterized as having shells of vigorously green foliage over an ever expanding core of weak or dead branches.

Citrus may be pruned and tolerates even severe pruning well. However, in many instances there is no reason to prune citrus and the removal of dead branches is all that many homeowners do. Most citrus is pruned through the use of thinning cuts with very little "heading back" normally required. The major reason citrus is pruned is to open up the interior of the trees. Trees full of dead wood cause mechanical damage to the fruit and provide a dark, humid environment which encourages citrus insect pests, such as California red scale, citricola scale, cottonycushion scale and whiteflies to flourish. Predators and parasites of these pests are usually much more effective against these pests when air flow and sunlight penetration into the tree is encouraged. Additionally, more interior-canopy fruit is produced when light is able to penetrate into the canopy. Many commercial growers as well as homeowners prune off the branches that tend to trail on the ground. These branches are collectively known as the "skirt" of the tree, and the skirt often provides a good habitat for the brown garden snail, earwigs, scale insects, rodents and other pests.

Pruning is best done during the spring and summer. Pruning encourages new flushes of growth and should be avoided as winter approaches as the new growth will probably freeze under cooler winter temperatures. Citrus trees may be topped without harming the tree. However, sunburning of the scaffold branches may occur if the top of the tree is removed. To reduce sunburning of a topped tree, the scaffold branches should be painted with a 50:50 mixture of *interior* latex paint and water.

Training Young Trees

During the first two or three years of growth, very little pruning of trees should be done. Suckers, those branches that arise from below the bud union on the rootstock, should be removed at regular intervals. Suckers will produce rootstock fruit. Rootstocks are selected based on properties other than the appearance or taste of the fruit. The homeowner will want the fruit wood to have the characteristics of the scion. As a result of previous severe freezes, many homeowners in Kern County have trees that no longer have a scion. The scion was frozen, died and now the tree is composed entirely of thorny branches that produce nothing but bitter, wrinkled, yellow fruit.

Citrus trees, especially early-maturing navels, and mandarins may grow very slowly. The tree needs most of the existing canopy to produce carbohydrates for good root development and more canopy growth. As the tree continues to grow, some branches should be thinned and strong scaffolding branches selected which will be necessary to support large fruit loads. Since the fruit will tend to pull branches down considerable distances, the scaffold branches should arise on the trunk at least two to three feet above ground level. Lemons, grapefruits, pummelos and pummelo X grapefruit crosses like the Melogold or Oroblanco grow very rapidly and may need a light annual pruning once they become four or five years old if strong scaffolding branches are to be produced.

FRUITING CHARACTERISTICS

Young Trees and Fruit Bearing

Normally, in commercial production, budded citrus do not produce fruit until their third year. The fruit produced by young trees can be highly variable and can often appear very rough and misshapen. Due to the small leaf canopy of young trees, the fruit is prone to sunburn. Often young trees will produce a large mass of fruitlets, but most, if not all, may drop from mid May into July. Hot temperatures, excess or deficient irrigation, lack of fertility and hot, dry winds can initiate periods of high fruit drop. Some citriculturists advocate removing the fruit on young trees so that vegetative growth is encouraged.

Alternate Bearing in Citrus

Citrus growth in more temperate climates will often shift to an alternate bearing cycle. One year may see a large crop load followed by a year with a small crop load. Most of the mandarin varieties, Valencia and tangelo varieties are alternate bearers. The fruit of the heavy crop year will tend to be small in size, while on the light crop year will tend to be significantly larger.

Pollination Requirement and Seeds in Citrus

Seeds are produced in the plant kingdom, generally, as a result of pollination. Many of the commercial species in the citrus genus, are self-fertile, meaning that the pollination of a pistil (female flower part) may occur by pollen from stamens (male flower part) on the same plant. Additionally, most citrus varieties express some level of parthenocarpy. Parthenocarpy is the ability of plants to develop fruit without pollination (which means no or very few seeds if trees with fertile pollen are not located nearby). Most varieties of navel oranges, such as Parent Washington, Frost Nucellar, Atwood, Fisher, Bonanza or Lane Late, produce mostly parthenocarpic fruit. These navels rarely produce seeds because they are male sterile (i.e. they produce no pollen) and even if pollinated the mother cells will tend to abort. Occasionally a seed may develop but the seed is usually produced asexually. A similar form of seedlessness exists for some of the satsuma mandarins, such as the Frost Owari, Okitsu Wase, or Dobashi Beni varieties. Parthenocarpic fruit has a greater tendency toward early drop. Hot weather in late spring and early summer, or other stresses, can greatly increase early fruit drop in navels and satsumas. Cross pollination almost always improves fruit set in all varieties of citrus and this translates into increased number of fruit. For the same number of fruit per tree, pollinated fruit tends to be larger in size but seedier.

Some citrus varieties, such as many of the clementines and mandarin hybrids, are not parthenocarpic and require cross pollination by another variety to produce fruit, or will produce seeds if cross pollinated by another variety with fertile pollen. A major vector of citrus pollen is the honey bee. The degree of seediness of the fruit of a given mandarin tree often becomes a function of how many other varieties of pollen-bearing varieties of citrus are within a bee's flying distance from that tree. The weather during the pollination period in the spring is also a factor in that bees are less effective pollinators during cold, wet and windy weather. Parthenocarpic mandarins, such as the 'Page' mandarin, can be made seedless by the use of netting over small trees that exclude bees, however, if the mandarin requires cross pollination, such as many of the clementines, excluding bees will also result in poor fruit set. Even seedier varieties, such as 'Olinda' Valencia, 'Lisbon' and 'Eureka' lemons, and the 'Marsh' grapefruit, occasionally produce parthenocarpic fruit, although, generally, the fruit will average three to five seeds.

Freeze Protection

The hard freeze of December 1990 and similar episodes earlier in the century vividly demonstrated that no citrus tree in the San Joaquin Valley is immune from freeze damage. Freezes during the winter of 1998-99 and in 2007, also damaged citrus trees in Kern County.

A given citrus tree will be more tolerant of cold temperatures once it has become semi-dormant (for example as in January) as compared to its level of tolerance in the fall or in late winter as temperatures increase again in March. It may take a temperature of 12°F to kill a mature navel tree in February, but only 20°F prior to the tree going into dormancy in mid-November. Young trees are at much greater risk of being killed from a frost than are older trees. Lemons and limes are much more sensitive to frost than are oranges. Grapefruit are intermediate.

To maximize the ability of a tree to survive a frost event, the soil surrounding the tree should be bare and firm. Mulches should not be present during the cold months. The soil should be wet to a depth of six to eight inches, prior to the freeze as the water can retain more heat per unit of weight than can the soil. A hose may be left on through the freeze event, and this running water will supply additional heat to the tree. Bare soil and wet soil can absorb more heat from the sun during the day, and reradiate this heat back to the tree at night.

The same insulative materials that are used to wrap pipes to prevent their freezing can be used to wrap trunks of young citrus. Straw and cardboard may be used to wrap the trunks of mature citrus trees, although this usually unnecessary unless very cold weather is expected (i.e. less than 20ºF for lemon and colder for orange). The canopies of younger trees can be covered with blankets, tarps, plastic or whatever else looks like it might work. These covers will absorb heat from the surroundings and radiate this energy back to the tree. It is not necessary to totally enclose the tree unless extremely cold weather is forecasted. Covers should be removed during the day to allow maximum heat absorption by the tree's surroundings. If the covering is plastic, especially clear plastic, it should be removed during the day to avoid 'cooking' the tree. Avoid wetting the covers themselves, as often the water on the covers will freeze, and freeze leaf tissue in contact with the cover.

Propane stoves, incandescent lights, electric heater and the like have been used effectively in conjunction with covers to keep backyard citrus from freezing. ***However, the presence of frost water, high winds, and rain or snow in combination with ungrounded electrical equipment provides a definite risk of electrocution to humans and pets.***

Fruit Cocktail Trees

Different varieties of citrus may be budded on the same tree. Some homeowners have trees with six or seven different varieties of citrus on the same tree. The best time for budding a citrus tree is after the bark begins slipping in the spring. Usually by early May in Kern County budding should be successful if suitable buds are available. Slipping can be described as a characteristic of the bark that allows it to be easily separated from the cambium layer beneath. Usually buds are obtained from the axils of leaves of smaller diameter branches and from wood that is still green but older than that produced during the first spring flush of growth. Best success usually occurs when the budwood and the branch to be budded to are roughly the same diameter. A bud is removed from a desired citrus variety to the depth slightly below the cambium layer, and by means of a T-cut placed firmly against the cambium of the tree that it will be budded to. A rubber band of elastic tape can be used to hold the bud firmly in place until the bud and branch grow together. Often buds are not available until summer, since buds on the tree in spring usually push to produce new shoots. Often the branch above the point of budding is partially girdled or bent over to ensure that most of the energy produced by that branch is directed to the new bud. Virus and other diseases may be spread by budding and care should be taken to obtain disease-free budwood. Citrus may also be bark or cleft grafted, but, generally, budding is so successful that few trees are commercially grafted.

TROUBLE-SHOOTING COMMON CITRUS PROBLEMS

COMMON COMPLAINTS

1. My navels are splitting.

Navel oranges, as they approach maturity are prone to splitting. The split always occurs longitudinally from the stem end of the navel. The splitting is accompanied by the green, unripe fruit prematurely turning orange, especially so adjacent to the split. Often the split fruit will fall from the tree. The split will allow the dried fruit beetle to infest the split orange but they are not the cause of the split. The cause of the splitting is not known but some evidence suggests that it is the result of differential growth between the rind and the remainder of the fruit as a result of alternating hot and cool temperatures in the spring. Often, badly sunburned fruit will split. The thinner skinned fruit, like the Bonanza navel is more prone to splitting. Splitting on any given tree may be quite variable from year to year. Although the problem may look severe, usually only a small percentage of the fruit will split and the homeowner should not be overly-concerned with this phenomenon.

2. My citrus fruit is dropping before it is ripe.

Like most fruit trees, citrus will adjust its crop load based on the season's environmental conditions. Only an extremely small percentage of the flowers that a citrus tree produces will set fruit, and only a small percentage of the initial fruit set will produce a mature orange. All citrus varieties will drop considerable numbers of small fruit when the weather turns hot in May and June. In some years, the drop will continue from May right up to harvest. Drought stress can make the drop more severe.

Fruit drop in navels and satsumas can be particularly severe if temperatures suddenly increase in May from the 70s or 80s to the high 90s and low 100s^{o}F.. The production of parthenocarpic fruit in these varieties makes the fruit more susceptible to drop because the absence of seeds also reduces the production of hormones that encourage the fruit to be more strongly attached to branches.

Fruit drop may be a symptom of some diseases, like root rot, or of an irrigation or fertility problem. However, if the homeowner has followed the suggestions made in the *"Avoiding Trouble"* section above, and if most of the leaves appear dark green, with new growth flushes and a full canopy, the fruit drop is nothing more than a healthy response to an excessive fruit load. Often the loss of fruit will result in larger fruit size for the remaining crop.

As discussed above, young citrus trees may be erratic fruit producers. Often a three- or four-year-old backyard citrus tree will set a large number of fruit early in the season but many if not all may fall before the fruit is mature. In time the tree will set a good crop and keep it through maturity. Often the fruit of the young tree will appear very rough and misshapen, but this too will pass with time.

3. The ripe fruit of my grapefruit tree is falling off early this year. Usually it will stay on the tree all summer.

The fruit of grapefruit trees, unlike many of the other citrus varieties, will often hang on the tree for many months after they ripen. It is not uncommon to pick grapefruit through the summer. Occasionally, and for still unknown reasons, they drop much more rapidly. Water stress is the most likely cause of earlier than normal drop of grapefruit, but other unknown causes must also play a part.

The fact that grapefruit often hang on the tree through the summer during some seasons should be thought of more as a gift, rather than as a cause for complaint if for some reason they don't.

4. My mature citrus tree has beautiful foliage but it doesn't produce any fruit.

One of the most common reasons for an apparently healthy backyard citrus tree not to produce any fruit is that the tree spends too much time in the shade. Citrus requires lots of sunshine to produce fruit. Often homeowners will plant a citrus tree in the shade of an older tree, or a quicker growing tree will outgrow a citrus tree and shade it. Under conditions of low light a citrus tree will remain healthy looking, but will grow fairly slowly and will produce little fruit.

As discussed above, a few citrus varieties do require cross-pollination for good fruit production. Some of the clementine-type mandarins are in this category. Planting a pollinating citrus tree should improve fruit set in some varieties.

Sometimes homeowners will grow a citrus tree from a seed. The seed is a product of cross-pollination and the genetics of a tree like this are unknown. Often seedling-grown citrus take much longer to produce fruit and the fruit, when it finally appears, may be of very poor eating or juicing quality. Also, since the tree has not been grafted onto an appropriate rootstock, the tree will be more susceptible to root rots.

5. My tree has the following symptoms: gumming on the rootstock or trunk, leaf-yellowing and drop, branch die-back and fruit drop. What is wrong and what can I do?

This malady is probably root rot caused by *Phytophthora* pathogens but other pathogens are also capable of producing similar symptoms. The fungal organism causing *Phytophthora* root rot and gummosis attacks the roots of the tree although lesions may also form on the trunk. A watery gum may exude from splits in the bark of the trunk. Bark will peel away and the cambium will look black and rotten.

In California, the homeowner has limited chemicals available to correct the problem, although some landscape care companies are licensed to use a product like Ridomil® or Alliette® which can kill the organism. If a tree is badly infected, removing a large portion of the tree canopy to bring it into better balance with the damaged root system can give the tree a chance of recovery. All treatments should be done in conjunction with drying out the soil. The disease is encouraged by over-watering as the spores require free water for moving to the roots.

The best defense is prevention. Trees should be budded onto root-rot resistant rootstocks in heavy (clayey) and poorly drained soils. When planting a tree it is important to make sure that the union between the rootstock and scion is planted above ground level. Trunks may be infected by an irrigation system that splashes fungal spores from the soil onto the tree. Irrigation systems should be adjusted so that they do not wet the trunks of trees. Drying the soil down to roughly one-half of its water holding capacity between irrigations provides a root environment that is less likely to provide habitat for this organism.

6. My citrus tree has always been so healthy but now it is dropping a lot of leaves.

Leaf drop is a common phenomenon in citrus. Since citrus is an evergreen tree, leaves are constantly being discarded and produced. Whether or not a tree is dropping leaves is not as important as the overall health of the canopy. Healthy trees will drop old leaves and produce new ones. In the San Joaquin Valley, leaf drop (i.e. normal leaf replacement) generally peaks in the spring after the bloom,

with another episode in the fall. If the tree appears to produce normal spring, summer and fall flushes of new growth, and the canopy does not appear to be thinning, there is no cause for alarm.

When leaf loss exceeds replacement, or when most of the leaves begin turning yellow and begin dropping, then a problem probably exists. Excessive leaf drop can be indicative of many problems including; over or under irrigation, over or under fertilization, fungal diseases, viral diseases, pesticide damage (herbicide, spray injury), weather-related injury (sun or wind burn, freeze damage, etc.), insect or mite problems, excessive shading, soil-related problems (clay soils, hardpans, calcareous soils, etc.) or other causes.

Irrigation problems can often be overcome through the use of a soil probe, a tensiometer, or other devices available at the nursery for determining soil wetness. Fertility has been addressed above in earlier sections of this publication (refer to *"Avoiding Trouble"*), as have some of the fungal pathogens. By purchasing a tree from a nursery of good reputation, most of the viroid, virus, or mycoplasm diseases, such as psorosis, exocortis, stubborns and tristeza caused quick decline, may be mostly avoided as well.

Homeowners, sometimes damage their citrus trees through the excessive use of herbicides or using herbicides that are not suitable for citrus. Citrus roots are very close to the surface and using soil sterilants or the wrong herbicide or herbicide rate around citrus can result in root death, leaf drop and tree death. The application of narrow range petroleum oils to control scale insects when the temperature is greater than 95°F will often kill leaves as well. Dormant oils are recommended for many of our deciduous fruit trees in winter time but they should not be used on citrus at this time. Winter applied dormant oils on citrus, especially if the application is followed by a cold snap, can totally defoliate a citrus tree. Citrus trees are not tolerant of chlorine or salts. Pools should not be drained adjacent to a citrus tree. Low winter temperatures, usually below 26°F may kill citrus leaves and many may not fall until spring.

Sedentary, sucking insects such as California red scale and several of the soft scale species, like cottonycushion scale, brown soft scale and citricola scale can all cause defoliation. California red scale infestations are the citrus equivalent of measles in appearance. The bark, leaves and fruit will be covered with many small rust-colored bumps. Heavy infestations of California red or yellow scales can cause leaf drop, fruit encrustation and drop and even tree death. The soft scales produce large quantities of sap called honeydew upon which a black fungus called sooty mold grows. Cottonycushion scale is very distinctive in the mass of white wax produced by the scale insects and the orange color of some of the early developmental stages of the insect. Often cottonycushion scale is controlled by a naturally occurring predator called the Vidalia beetle. Parasitic wasps will sometimes control soft brown scale and citricola scale but severe infestations in the San Joaquin Valley may require insecticidal treatment. Ants should be controlled around citrus as they often protect the scale insects from beneficial insects. Ants, citrus cutworms, fruit-tree leaf rollers, orange dog caterpillars, citrus thrips, Fuller rose beetles, two-spotted and citrus red mites, whiteflies, leaf miners and other insects and snails are capable of causing leaf drop in citrus. A careful examination of the leaves usually provides sufficient information to determine if these types of pests are the cause of the leaf drop.

Poor drainage can cause irrigation water to puddle and reduce root aeration. Often water infiltration can be improved through the use of soil amendments like gypsum, limestone, sulfur or organic matter (like compost or manure). A soil analysis can tell which material is right for your soil, although it is hard to go wrong with moderate amounts of organic and gypsum amendments for most Kern County soils.

7. The fruit is still hanging on the tree but something has eaten the rind off of my lemons or hallowed out the oranges leaving only the rind.

The likely culprits are roof rats. This problem is most common in the older areas of Bakersfield with mature trees, ivy, woodpiles and plenty of hiding places. Rat traps wired high in the tree (peanut butter or bacon make good baits) have been effective control agents. However, care must be taken in the use of traps to ensure that birds, pets or people are not harmed. Cleaning up trash, removing wood piles, pruning vegetation, and boarding up access ports into attics or garages will remove rat habitat and decrease the damage.

8. The leaves on my citrus tree are all black with soot and very sticky.

Vigorously growing citrus is full of plant sap produced during photosynthesis. Thick infestations of many kinds of sucking insects can puncture the sap conducting tissues releasing large quantities of honey colored sap, also called honeydew, on leaves, fruit, and branches. This honeydew then provides a wonderful food base for various fungi. Sooty mold is a common fungus that grows on honeydew and looks very much like the soot produced from burning wood. If the insects which produce the honeydew are controlled, the sap remains in the tree, sooty mold has nothing to grow on.

The major insects that produce honeydew are sucking types such as various species of whiteflies, various species of aphids, citricola scale, brown soft scale, cottonycushion scale and citrus mealy bugs. Aphids tend to be more of an early spring pest. Generally, natural predators and parasites will control populations of aphids and it is rarely necessary to treat them with insecticides. Often, the Vedalia beetle, a beneficial lady beetle, will find populations of cottonycushion scale, and control them. Citricola scale and brown soft scale are similar in appearance and may be controlled by beneficial insects. However, these species, as well as most of the sucking insects discussed above, are often protected by colonies of fire or native gray ants, and pesticides may be necessary to control the ants and the scale insects. The citrus mealy bug has been found only on grapefruit in Kern County and insecticides may be necessary to control this insect, as well.

Directed sprays of water from the hose may be effective in removing some of these sucking insect pests, especially if repeated at intervals. Insecticidal soaps and spray oils are also effective in controlling these pests, and often preserve many of the beneficial insects.

9. The leaves and fruit of my grapefruit are covered with a sticky white wax or fungus and there is a lot of black stuff around.

This sticky white stuff may be caused by the citrus mealy bug, woolly whitefly or by cottonycushion scale. The citrus mealy bug is often associated with more leaf drop, while cottonycushion scale is often more commonly associated with twigs. The fluted egg sacs of the female cottonycushion scale are usually very prominent and the young instars often have some orange coloring. Wooly whitefly are normally found mostly on lemons and grapefruit, and only on leaves (mostly on the underside of leaves). *Refer to Item Number 8 for more information.*

10. A sticky white fungus with smallish orange things in it is hanging from my citrus leaves and small branches and there is a lot of black stuff around.

These symptoms are usually caused by cottonycushion scale which is an insect pest of citrus. *Refer to Items Number 8 and 9 for more information.*

11. The new leaves on my baby citrus tree are all curling up and falling off.

Refer to Item Number 6 for more general information on leaf drop. This particular symptom is a very common problem, especially noticeable in young trees. Leaves can be characterized as having deformed tissue or scars running parallel to the midrib on each side of the leaf. The cause of these scars and associated leaf deformation, twisting, curling and drop is from the feeding of citrus thrips. Citrus thrips, especially young instars, will feed on the new, very small leaves, when leaves first emerge from the vegetative bud. The feeding damages cells in the epidermis of the leaf, which as the leaf grows and expands, causes twisting and deformation. The thrips have several generations per year, starting in the early spring, and often lasting through summer, so successive leaf flushes may be damaged. Thrips damage to leaves is most severe on later summer leaf flushes. The adults are winged and are capable of flying from tree to tree. The damage is rarely sufficient to defoliate a tree, but it may slow the growth of young trees if severe. Insecticides may be used to control this pest but they are usually unnecessary.

12. My oranges have circular spots on the top around the stem end of the fruit.

This symptom is also caused by citrus thrips. Like the thrips-caused leaf symptoms, the scar is made by young thrips instars when the fruit is less than one inch in diameter. Initially, the thrips will feed under the calyx of the fruit adjacent to the button and later will be found running around the "cup" as the fruit increases in diameter. Once the rind thickens and the thrips are no longer able to damage the fruit, the scar will continue to expand as the fruit grows which produces the characteristic ring or circular area of damaged rind. In sufficiently bad infestations, a large percentage of the fruit may be scarred. Usually, however, the scarring is superficial, and will not affect the taste or eating quality of the orange. Properly timed insecticidal sprays will kill the thrips, but usually, beneficial predatory insects will control the thrips to a tolerable level. Most homeowners will find it unnecessary to spray citrus thrips.

13. The fruit from my citrus tree tastes terrible.

The first fruit produced by young citrus trees, typically, will not be very sweet. Part of the problem is related to the small leaf canopy which allows the fruit to become sunburned. Usually, the first fruit is not produced until the tree is three years old. Many growers will remove the fruit from young trees so that early growth is vegetative.

Time of harvest can greatly influence taste, but even fruit from older trees can vary in taste from year to year, even when the fruit is ripe, as a result of environmental differences in a given year. The taste of citrus is a combination of the amount of sugar in the fruit and the amount of acidity. The acidity and sugar can vary independently which may result in taste differences. Washington navels and Valencias will be sour before they are ripe due to the high acid content. However, fruit like the satsuma mandarin, which is very low in acids, will have an insipid taste before it ripens.

Frozen fruit may not fall from the tree if it is only moderately damaged. Frozen fruit will have low juice content and a woody, bitter taste. Some fruit of trees planted out of the citrus belt on the Valley floor will usually freeze on the outer canopy of most citrus trees every winter.

Citrus exposed to long episodes of drought, especially during June and July when the juice vesicles are filling, will have low juice content and tend to taste pithy. However, most poor tasting citrus fruit in Kern County is probably attributable to freeze damage suffered the previous or current winter.