

GITRUS FRUIT

for

HOME PLANTING



Division of Agricultural Sciences
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CITRUS FRUIT FOR HOME PLANTING

Citrus fruits can be grown on home grounds in many areas of California. They can contribute substantially to your food supply with relatively little effort. They have excellent food value and, unlike most fruits, can be stored on the trees over long periods without loss of nutritional qualities.

If you are thinking of planting citrus trees, this leaflet helps you in the selection and management of young trees.

If you now have a home citrus orchard, this leaflet also tells you how to care for your trees for maximum production.

THE VARIETIES GROWN

Many citrus varieties are available to the home orchard grower both as standard trees and as dwarf trees. Some varieties have a wide range of climatic adaption while others are limited in the areas where they will survive and provide satisfactory crops of good quality fruit. Frost tolerance is one limiting factor. Of the principal varieties, Satsuma mandarin is most tolerant; oranges, grapefruit, other mandarins and tangelos are intermediate; lemons are less tolerant; and limes the least tolerant to frost.

Cool summer temperatures are another limiting factor, in this case affecting the fruit quality of some varieties. Locations with strong coastal influence are often too cool for good quality fruit of varieties such as navel orange and grapefruit.

The most commonly available varieties with comments on their adaptability to different locations are described here.

ORANGES

Washington navel orange—an early variety, maturing mid-November to February, depending on location. Does not develop its best quality in coastal areas, and yields are low in desert. An excellent dessert fruit, seedless, it

can be held on the tree from three to four months.

Valencia orange—a late variety of wide adaptation, coastal to desert, maturing from April to June, according to location. In most areas the fruit can be stored on the tree until September or October. In many areas, planting both navel and Valencia provides fruit throughout the year.

GRAPEFRUIT

Marsh grapefruit—the only variety commonly grown in California. Fruit matures from late November to June, depending on location, and can be stored on the tree for several months. Generally, the quality of grapefruit grown in cool coastal areas is not acceptable; it is at its best in the warm interior areas, particularly the desert valleys.

Redblush or Ruby grapefruit—a variety very similar to Marsh grapefruit except for the red blush of the rind and red flesh. Except in the desert and hot interior valleys, red color development of this variety is not pronounced. Like the Marsh, fruit quality in coastal areas is generally poor.

LEMONS

Eureka lemon—usually bears fruit at all seasons. Especially good as a dooryard tree, but not as vigorous as the Lisbon nor as tolerant to frost.

Lisbon lemon—vigorous, more thorny, and more resistant to cold than the Eureka. Tends to mature more of its fruit in the fall and early winter but furnishes some fruit all year in many locations.

Meyer lemon—preferred by many for home planting. It is a smaller tree than either the Eureka or Lisbon lemon and is more resistant to cold. It carries fruit during most of the year. This lemon is similar to ordinary varieties, except that it is orange-yellow in color. It has a mild flavor, a pleasant aroma, and high juice content.

Most old Meyer lemons carry forms of the tristeza virus, and its planting has been prohibited outside the quick decline quarantine areas. A new Improved Meyer lemon, which is virus-free, has been developed and will be available soon for planting in all areas.

LIMES

Bearss seedless lime—the most popular lime variety in California. It is more hardy to frost than the Mexican lime but is not as resistant as the lemon. The tree is of medium size, round and vigorous. The fruit is slightly smaller than most lemons, seedless, very acid, and has excellent flavor. It bears some fruit during most of the year.

Mexican lime (West Indian lime, Key lime)—the trees are small and can be grown as bushes. They are very susceptible to frost and survive only in the most favorable of locales. The fruit is seedy, highly acid, about an inch in diameter, and is round or oval.

MANDARINS

The mandarins include a large group of loose-skinned, highly flavored fruits. Those with orange-red colored peel are commonly called tangerines. Described are varieties usually available at nurseries.

Satsuma mandarin—particularly suited to the northern limits of citrus culture, it stands more cold than most other citrus varieties and matures where summers are relatively cool. It is not suited to the desert areas. Usually grown on trifoliolate or citrange rootstock, the tree is small and thornless, rarely reaching a height of more than 10 feet. Fruit is orange color, medium to small, flat or necked, rind loose and pebbled; practically no seeds; peels easily; mild, sweet flavor. If left on the tree, the fruit deteriorates rapidly after maturity, but can be picked and stored for a considerable length of time. Season is November to February, depending on location.

Dancy mandarin (tangerine)—the most commonly grown variety in this group. The tree is vigorous and large for a mandarin. It is at its best in the desert, but is cold resistant and can be grown under many conditions. Fruit is reddish-orange color, medium size, slightly necked, slightly pebbled and loose rind; seedy; peels easily; tart to sweet flavor. Season is December to March according to location.

Clementine or Algerian mandarin—a medium size tree. Fruit is red-orange color, medium size, slightly elongate to slightly flat; pebbled; few to many seeds; peels easily; sweet flavor. Fruit can be held on the tree longer than most mandarin varieties, although in some years flesh may granulate or dry. Season is November to February, depending on location.

Clementine usually bears light crops unless another variety is planted for pollination.

Kara mandarin—a cross between Satsuma and King mandarins. The tree is vigorous, spreading, and fairly large. Fruit is orange color, medium to large, slightly flat, and slightly rough; many seeds; peels fairly easily; rich flavor. It is an excellent juice fruit. Season is March to May.

The fruit will not tolerate cold winters, and it is not at its best in the desert.

Kinnow mandarin—a cross between King and Willowleaf mandarins, a vigorous upright variety. Fruit is yellow-orange color, medium size, slightly flat with smooth rind; seedy; peels poorly; rich sweet flavor. The Kinnow tends to produce heavy crops in alternate years. This alternation can be modified to some extent by thinning the crop while the fruit is small during "on-crop" years or by pruning out some of the branches following an "off-crop" year. Season is December to February in desert valleys, and February to May in coastal-interior areas.

Other mandarin hybrids—several of recent introduction are of excellent quality. They may be difficult to find, but some nurseries are growing them:

- Encore — season April-July; excellent flavor
- Fortune — season February-April; rich sweet; pollinator necessary
- Fremont — season November-December; rich sweet
- Fairchild — season November-January; rich sweet; pollinator necessary
- Page — season November-January; excellent flavor; pollinator necessary
- Pixie — season March-June; seedless; mild sweet

TANGELOS

The tangelos are the result of crossing mandarins and grapefruit. In general, they are highly flavored and have the characteristics of both parents.

Minneola tangelo—a cross between Duncan grapefruit and Dancy mandarin. The tree is medium in size. Fruit is large, red-orange color, necked, nearly smooth; few to many seeds; peels easily; rich tart flavor. This variety may need a pollinator for good production. Season is December-January in desert; February-April in coastal-interior areas.

Orlando tangelo—a cross between Duncan grapefruit and Dancy mandarin. The tree is medium in size with distinctively cupped leaves. Fruit is orange color, medium large, slightly flat and pebbled; seedy; peels poorly; mild sweet flavor. May need pollinator for good production. Does best in desert where season is November-December; January-March in coastal-interior areas.

TANGORS

The tangors are a cross between mandarin (tangerine) and sweet orange.

Temple—exact origin unknown but its characteristics suggest it is a tangerine x sweet orange hybrid. The tree is not cold hardy. Fruit is highly colored red-orange, large size, round to slightly flat, and slightly rough; seedy; peels fairly easily; tart to sweet flavor. Does best in desert where season is January-February; fruit grown in coastal-interior areas is usually quite tart.

OTHER VARIETIES

There are many other varieties of citrus and citrus relatives which make interesting and enjoyable trees in a home orchard or garden. These are not always available at nurseries, but often they can be found. Many are excellent ornamentals. Included are:

- Kumquats
- Ponderosa lemon
- Calamondin
- Rangpur lime
- Tarocco blood orange
- Palestine sweet lime

Dorshapo lemon

Citron

Shaddock or pummelo

POLLINATORS

Pollinators are needed for some mandarin types. Of the varieties described above, Clementine mandarin, Minneola, and Orlando tangelo produce more consistently and bear larger crops if a pollinator is provided. For Clementine: Dancy, Kinnow, or Orlando can be pollinators. For Minneola and Orlando tangelos: Dancy, Temple, Clementine, or Kinnow are pollinators.

STARTING A NEW ORCHARD

Choosing trees—go to a reliable nursery

Commercially grown citrus trees are made up of two parts—a scion, or fruiting portion of the tree, and a rootstock on which the scion is budded. Rootstocks different than the scion are used because of certain advantages they have such as tolerance to soil diseases and pests, cold hardiness which they impart to the scion, or improvement of fruit quality in the scion. An exception to the use of rootstocks is the Meyer lemon which is often propagated as a cutting or a “tree on its own roots.”

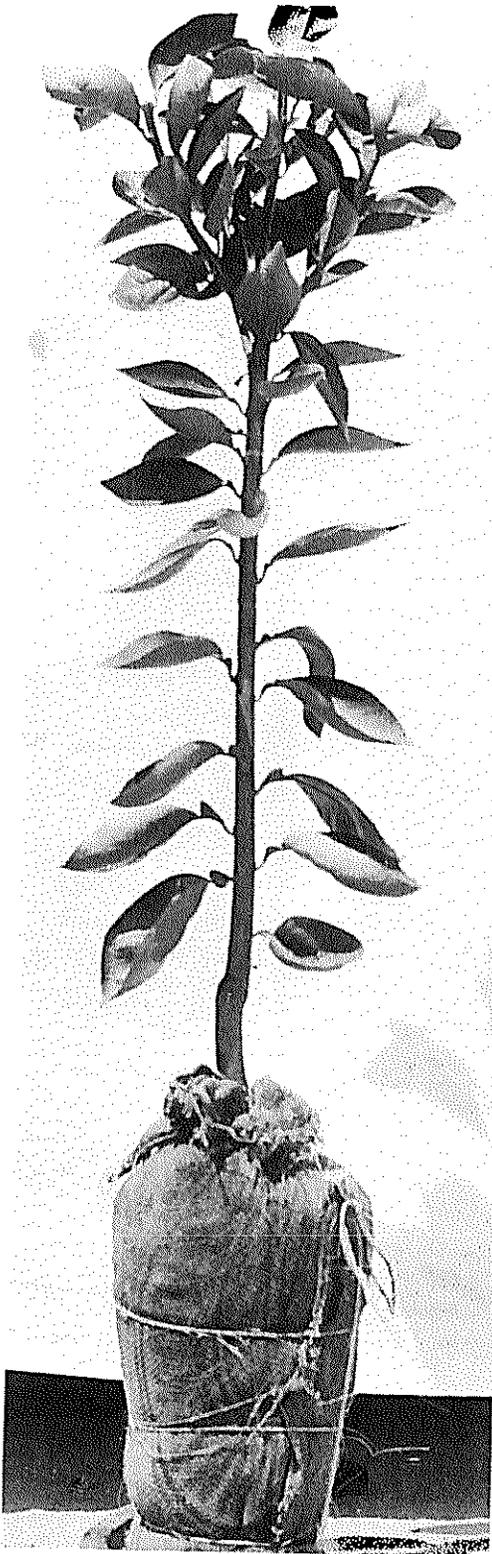
Several different rootstocks are satisfactory for citrus. The most desirable for oranges, grapefruit, and mandarins are sweet orange, Troyer or Carrizo citrange and, in areas where salinity is a problem, Cleopatra mandarin. Oranges and mandarins also may be grown on trifoliolate orange root. On this stock, most trees are somewhat dwarfed, a very desirable characteristic for many home orchards. Sweet orange or *Citrus macrophylla* are suggested as

stocks for lemon varieties. On clay soils, Lisbon lemons do well on sour-orange roots.

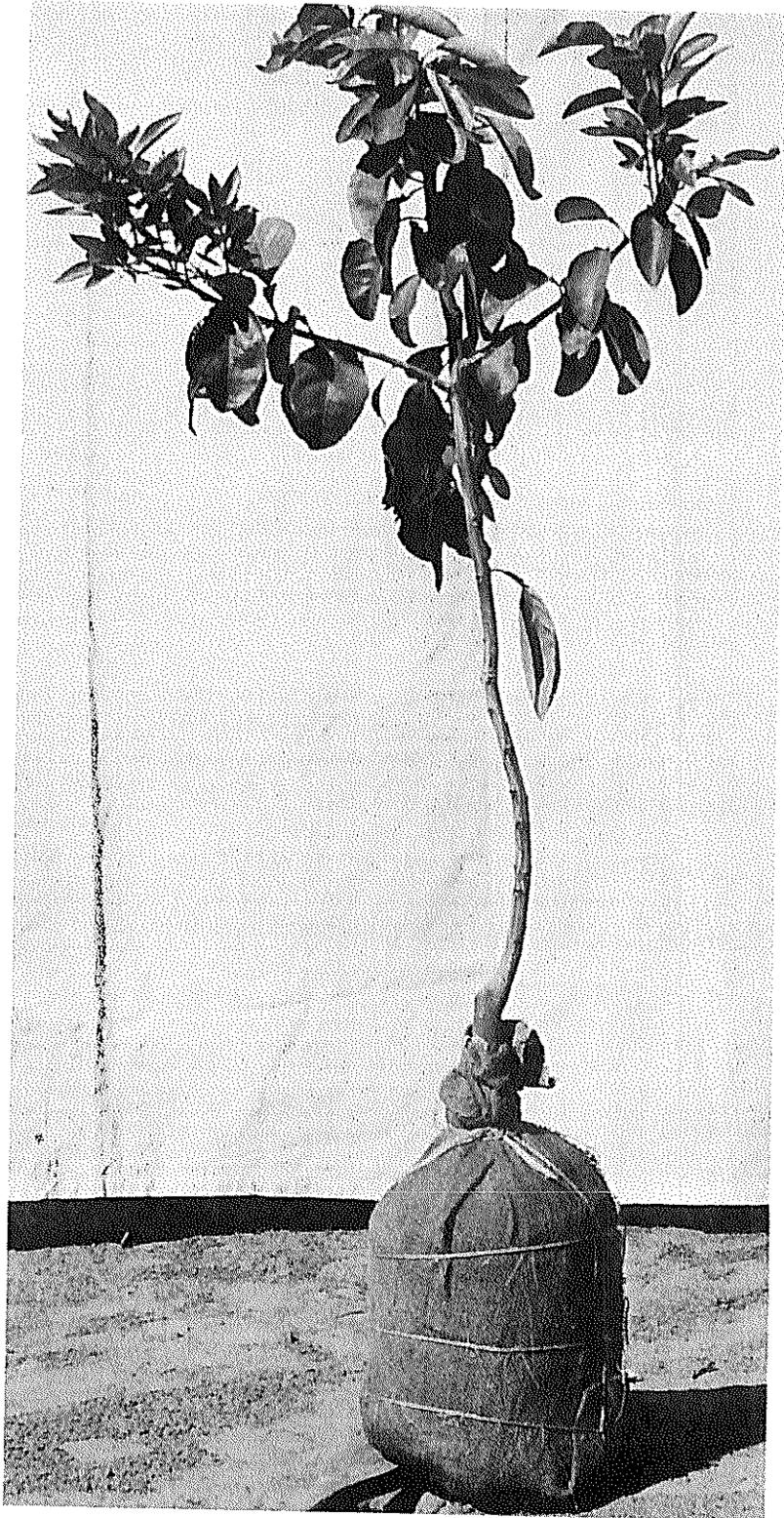
Sour-orange stock is not recommended for oranges and grapefruit. Sweet oranges on sour-orange stock may be destroyed by the virus of quick decline disease. Grapefruit on sour-orange stock also is affected, but to a lesser extent.

In the nursery, the varieties are budded on suitable rootstocks and grown for one or two years. Either one- or two-year-old trees are satisfactory; avoid older ones because they are likely to be culls.

Well-grown one-year-old citrus trees should be $\frac{1}{2}$ to $\frac{3}{4}$ inch, and two-year-olds $\frac{3}{4}$ to 1 inch in diameter, measured 1 inch above the union of the bud and the rootstock on the trunk. The trees are sold either balled and wrapped in burlap, or in containers. Reject trees on which the soil has been broken away from the roots by careless handling of the ball. Also, reject trees that have been held so long in containers that they are root-bound.



BUY THIS This tree is less than 2 years old.



. . . . NOT THIS

Trunk and top growth of this tree indicates advanced age.

Certain virus diseases, not easily detected in the nursery, affect citrus trees. To avoid them make sure your nurseryman has used buds that have been registered by the state nursery service as being virus free.

Purchase trees from experienced and reliable nurserymen, because in most cases it is necessary to take the word of the nurseryman as to their quality.

Planting—watch out for these factors

Soil. Citrus trees do best on well-drained loam or sandy loam soils. With good care, though, they can be made to produce on almost any well-drained soil that does not contain injurious amounts of salts.

Time. Trees can be planted any time after the danger of frost has passed. Early planting is especially desirable in the interior areas, where sudden hot spells are likely to damage trees that are not well established. Early planted trees also are better able to withstand the cold weather of the first winter. In most regions, April or May is a good time to plant.

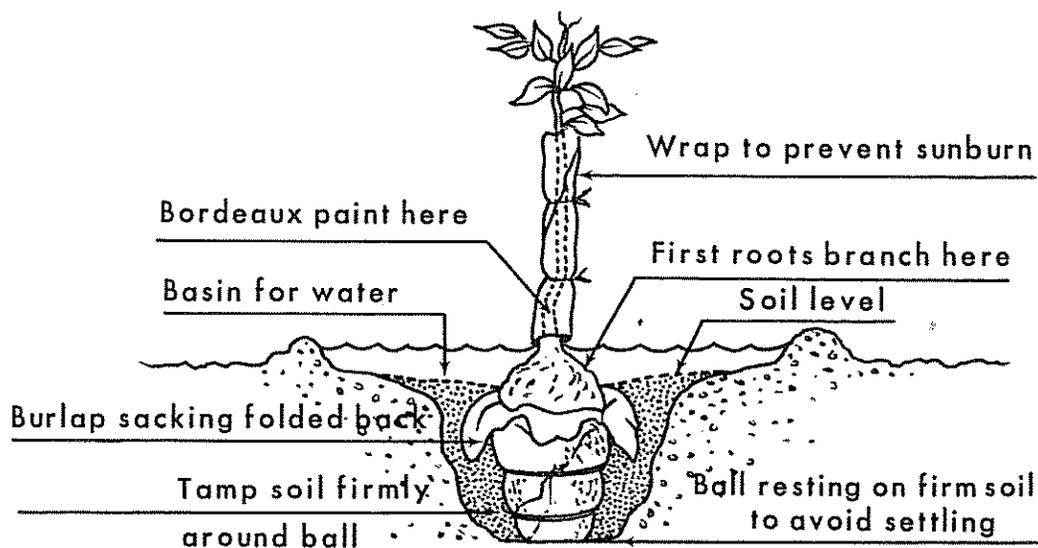
Spacing. In commercial orchards, the trees are commonly planted from 20 to 24 feet apart;

in home grounds, much closer planting is often desirable or necessary.

Planting. Holes for planting the trees need be only deep enough to accommodate the ball of soil surrounding the root system and wide enough to permit easy filling. If holes are unnecessarily deep, there will be excessive settling after planting. On poor soil, dig large holes and fill them with good top soil; then allow the new soil to settle two or three months before planting.

Balled trees are placed in the holes without removing the sacking. They should be planted a little higher than they were in the nursery, with 2 or 3 inches allowed for settling. Try to have the uppermost roots branch out at about ground level, after the trees have settled. Trees in containers are similarly handled. Carefully remove the container before or after placing the tree in the hole, depending on the type of container. Be careful not to drop or break the ball of soil surrounding the root system.

These precautions are important because trees set too deep are likely to be killed by brown rot gummosis, which frequently develops where the soil comes into contact with the bark of the scion.



Irrigation. After the tree has been properly placed, fill its hole three-fourths full of soil, and tamp the soil firmly around the ball. Next, release the sacking which covers the ball, folding it back so as to expose the top of the ball. Complete filling the hole. Throw up a small basin around the tree and irrigate it thoroughly. The bottom of the basin should slope toward the tree trunk, so that most of the water goes into the ball. As an added precaution against gummosis, paint the lower 6 or 8 inches of the trunk with a Bordeaux wash. Use plenty so that some of it soaks into the soil around the tree. Use Bordeaux powder, and add water to make a mixture about as thick as paint.

Sun protection. To protect the trees from sunburn during the first year, wrap the trunks in several thicknesses of newspaper and tie them loosely.

Fertilization. It is sometimes recommended that fertilizers be placed in the hole when the trees are planted. This practice has frequently resulted in severe damage to the trees. Fertilizers can be more safely applied to the surface of the soil after the trees have been planted.

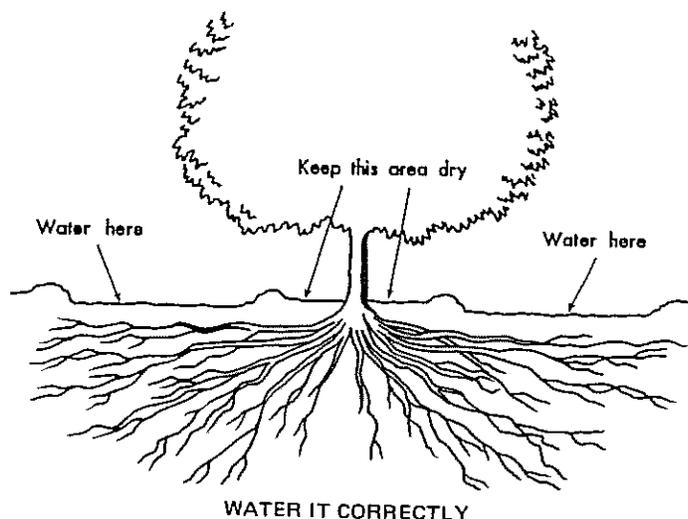
Cross pollination. With the exception of Clementine mandarin, Minneola tangelo, and Orlando tangelo, citrus trees do not need cross pollination and can be grown as single trees.

Care of trees—watering is most important

Watering. The most important point in caring for young citrus trees is to see that they get sufficient water without being over-irrigated. Under most conditions, water every week or ten days during the first year and about every two weeks for the next two or three years. Young trees on Troyer citrange rootstock can be overwatered. A longer interval between irrigations may be necessary if they grow poorly. If drip or trickle irrigation is used, water is generally applied in smaller amounts but much more frequently.

After the third year, trees will require irrigation every two to six weeks, according to soil and locality. On sandy soil or in hot weather, irrigation must be more frequent than on clay soils and in cool weather.

For the first year, the best way to apply water is in basins about 2 feet in diameter around the trunks of the trees and deep enough to hold 3 or 4 inches of water. When the trees are established, water may be applied in furrows or basins or by sprinklers. After the first year, enlarge the basin and keep water away from the trunk of the trees as much as possible to avoid gum disease. This can be achieved with an inner circular ridge of soil around the trunk, and 1 to 2 feet from it.



Cultivation is necessary only to maintain irrigation furrows or basins and to control weeds and grass which compete with the trees for water and fertility. It is not beneficial, of itself, and should be kept to a minimum.

Pruning. Avoid pruning young trees as much as possible. The removal of green leaves retards growth and increases the time required for the trees to come into bearing. For the sake of appearance, rub off growth on the tree trunk while it is young and succulent, but leave the tops unpruned until the trees are in bearing.

Frost protection. Young citrus trees are likely to be damaged by frost, and in most regions must be given protection for the first two or three winters. The most common method is to wrap the trunk and main branches in some material such as fiberglass building insulation or cornstalks. The wrapping should be 3 or 4 inches thick and snug enough to prevent free access of cold air to the trunk. Cover only the trunk and main limbs, and be certain that the wrapping makes good contact with the soil. Trees are fed by materials produced in green leaves in the presence of light. Therefore, if the leaves are covered or shaded, the tree is starved and becomes more liable to cold damage. It is better to risk injury to the leaves by frost than to cover them and starve the tree. Examine the wrapping occasionally to see that it remains in place.

Where there are only a few trees, build a stout frame around each tree and throw a cover over it. Burlap, an old but still intact bedsheet, or clear plastic all work. Make sure that the whole tree—top and sides—are covered. The cover should not remain over the plant during the day. Do not merely drape the cover over the tree with no frame to support it, because foliage touching the cover will be damaged by cold. On very cold nights, an electrical line with one or two 150-watt

electric light bulbs placed under the cover gives good protection.

Fertilization. On most soils, young citrus trees grow more rapidly if given a nitrogen fertilizer. Such sources as ammonium sulfate, calcium nitrate, and ammonium nitrate are good suppliers of nitrogen. Sprinkle a heaping tablespoon of chemical nitrogen in the basin around each tree three or four times during the season just before irrigation. Double this amount the second season. The better grades of animal manures can be used with good results. Apply about a gallon of animal manure three or four times during the season, as directed above. In applying fertilizer to young trees, remember that the root system is small, and excessive use of concentrated fertilizer will cause damage. Keep fertilizer from coming into direct contact with the tree trunk, and scatter it well in the basins.

Insect control. Young citrus trees are especially susceptible to damage by aphids, thrips, and red spiders. Aphids feed on the tender, emerging new growth, causing it to cup and curl, and retarding its normal development. Good ant control will often allow effective insect parasites and predators to control the aphid infestations.

Thrips are light yellow insects about $\frac{1}{30}$ inch long. They feed on young foliage and fruit and cause retarded growth, distorted foliage, and scarred fruit.

Red spider mites are common on citrus trees. They are difficult to see but their feeding causes leaves and fruit to turn light greyish green. This injury weakens the tree and may result in leaf and fruit drop and in reduced tree growth.

When infestations of these pests become heavy enough to require treatment, pest control sprays for the particular pest should be applied.

CARING FOR A MATURE ORCHARD

Irrigation—the most important single factor

Area of application. The soil area where roots grow should be supplied with moisture at all times, but excessive use of water can cause root decay, especially if drainage is poor. Normal citrus trees extend their roots well beyond the area shaded by foliage; a circle twice the diameter of the tree top will contain most of the roots. Irrigate all of this area except soil which comes into contact with the bark of the trunk. Keep this soil as dry as possible to avoid bark decay.

Method. Water may be applied by any of several methods. Most commonly used are furrows or basins or sprinklers. The important thing is to wet as much of the root area as possible. If the soil or water contains injurious amounts of salts, use either basins or sprinklers to prevent accumulation of salts in the soil. Apply enough water at each irrigation to wet all of the soil as far down as the roots go. In most soils this will be to a depth of 3 to 4 feet and will require enough water to cover the soil 3 to 5 inches deep, less being necessary for a sandy soil than for a clay soil. You can check water penetration by digging a small hole three or four days after irrigation. This will provide a guide for future irrigation.

Application of water by drip or trickle systems is a more recent method of irrigation. Several emitters are normally needed for mature trees, and more frequent irrigation is required to maintain an adequate moisture supply in the root zone.

Time. The timing of irrigations cannot be precise because it is dependent on many factors including climate, soil, and tree vigor. Apply water as often as the soil approaches dryness, not after it becomes dry. This will be less often on clay soil than on sandy soil and less often in spring and fall than in the heat of summer. In cool coastal areas, four or five

irrigations per season will be enough; in hot interior areas, seven to ten irrigations will be needed. Continue irrigation in the fall until adequate rains occur.

When trees are located on lawns, it is difficult to irrigate properly. Grass has shallow roots and requires frequent light sprinkling. You can keep the trees in fairly good production by giving the grass only as much water as it needs and by heavily watering the trees at three- to six-week intervals.

Fertilization—supply nitrogen, perhaps zinc

Nitrogen. Fertilization is necessary on most soils, but, fortunately, the only element which is commonly lacking is nitrogen. This can be supplied by animal manures or by commercial fertilizers.

If poultry or rabbit manure is available, use 50 to 75 pounds per tree; spread it over all of the root area but do not pile it against the trunk of the tree. If you use a good grade of steer or cow manure, apply 100 to 200 pounds. Manures give best results when applied in the fall or early winter and should be worked into the soil for full benefit. If left on the surface, roughly half of their nitrogen value is lost.

The most desirable sources of nitrogen (N) are chemicals such as calcium nitrate (15% N), ammonium sulfate (21% N), ammonium nitrate (33% N), and urea (45% N). A mature citrus tree requires about $1\frac{1}{2}$ pounds of elemental nitrogen (N) per year, so the amount of material to apply will depend on the kind of fertilizer used. For example, to supply $1\frac{1}{2}$ pounds of elemental nitrogen it would take 10 pounds of calcium nitrate; $7\frac{1}{2}$ pounds of ammonium sulfate; $4\frac{1}{2}$ pounds of ammonium nitrate; or 3 pounds of urea.

This fertilizer should be applied before spring rains are over. Better still, equally divide the total amount into three or four lots. Apply the first in January or February and the balance at about monthly intervals just before irrigation. Spread fertilizers evenly over all of the root area, and do not place them in piles or lumps. Where furrow irrigation is used, fertilizer applied after the rainy season should be spread in the furrow bottoms so that it will be carried down into the soil by the water.

Mixed fertilizers are often offered for use on citrus. In addition to nitrogen, they contain other elements which may or may not be needed. If you use them, follow the directions of their manufacturer as to how much to apply.

If citrus trees are growing in a lawn, it is difficult to give them an adequate supply of nitrogen without excessively stimulating the grass. The grass often takes most of the nitrogen, leaving little for the tree. Under these conditions, a spray of urea can be used.

Apply a foliage spray containing two heaping tablespoons of *low biuret* urea (1 ounce) per gallon of water. Use material prepared especially for use as a foliage spray, and do not exceed the amount recommended. Larger amounts may cause serious leaf injury. Apply the spray three or four times a year or as often as a slight yellowing of the leaves indicates a need for nitrogen. Three to 5 gallons of spray per tree should be sufficient.

Zinc. Another element which citrus trees in home grounds are likely to lack is zinc. Zinc deficiency causes the nutritional disease known as mottle-leaf. Leaves become yellow between the veins and are smaller toward the ends of the twigs. In severe cases, the ends of the twigs die back.

Zinc can be supplied to the trees most economically by spraying it on the leaves. It can be used at any time, but late winter and early spring are the best periods. To prepare zinc sprays, use 1 ounce of zinc sulfate and 1 ounce of washing soda per gallon of water.

If washing soda is not available, use $\frac{1}{2}$ ounce of hydrated lime instead.

Other convenient and effective sprays can be prepared by (1) adding 1 ounce of zinc oxide to 1 gallon of water or, (2) adding $\frac{1}{2}$ ounce of zinc sulfate to 3 gallons of water. Occasionally, these sprays may cause a pitting of leaves, but fruit is rarely affected.

It is not necessary to drench the tree to get results, but some spray should reach all of the leaves. Three to 5 gallons will be ample for most mature trees.

Iron deficiency occurs in many locations in California and can be quite severe in some. It is also known as "iron chlorosis" and has often been termed "lime-induced chlorosis" when occurring on soils high in lime. With this deficiency, leaves become lighter green to yellow with a network of green veins. In severe cases the leaves become nearly white, the veins lose most of their green color, and twigs and branches die back.

This deficiency is often associated with over-irrigation or poor drainage. Correcting these conditions often helps. Chelated iron, either as a foliar spray or soil application, sometimes corrects iron deficiency but is not effective under all situations. When used, follow the manufacturer's directions.

A number of sprayers are available and may be used in applying foliar nutrients. The size and capacity will depend on the number of trees you have. If they are hand operated be sure the materials are well dispersed in the tank before spraying. One caution: Don't use a sprayer for nutrient sprays that has previously been used for herbicides or other possibly harmful materials.

Other nutritional needs. With a few exceptions, other nutrients generally occur in sufficient quantities in California soils to supply the needs of citrus. If questions arise, consult your County Farm Advisor for local information.

Pruning—confine it to dead and broken limbs

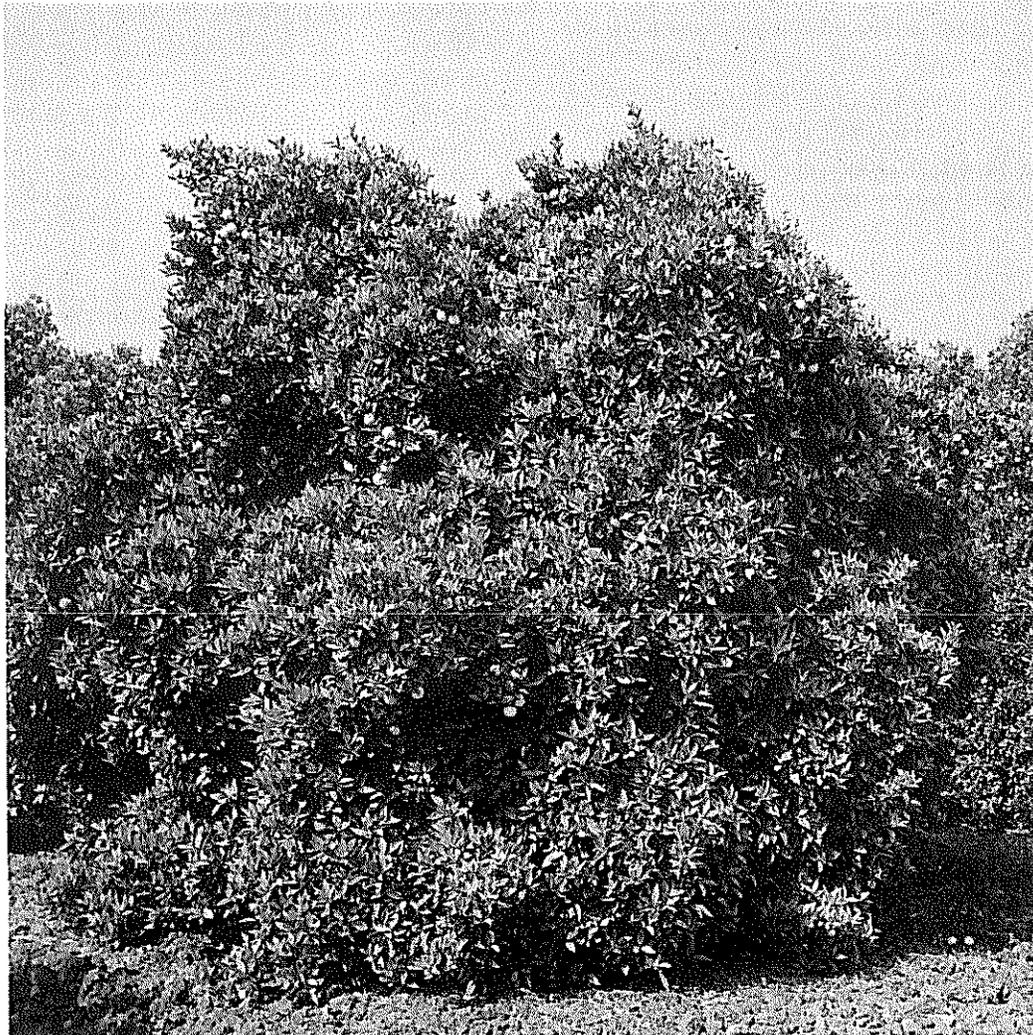
Pruning of citrus trees grown for fruit production should be confined almost entirely to removing dead and broken limbs. Removal of green leaves reduces the ability of the trees to bear fruit and should be avoided as much as possible.

For the sake of appearance and to facilitate tree care, all shoot growth may be removed from the tree trunk up to the first scaffold branches. Citrus trees normally produce long, vigorous sprouts called suckers. Remove them if they are not well placed, but leave them, whenever possible, to build up the tree. Pull them out to the sides of the tree to tame their

wild growth and increase the leaf area of the tree. If left alone, they tend to fill the top and center of the tree with a tangle of brush.

Do not remove low-hanging branches; they bear fruits which are within easy reach and shade the ground so weeds do not grow under the trees. The ideal tree has a skirt of foliage extending clear down to the ground.

Lemons need more pruning than oranges. With young lemon trees, it may be desirable to remove or cut back some of the more vigorous shoots. A moderate annual thinning of mature trees reduces the crop and improves the size and quality of the fruit.



This citrus tree, which has never been pruned, has grown to its normal shape.

Tillage—is necessary but keep it to a minimum

Weeds and grass compete with trees and should be kept under control, at least during the growing season. You may accomplish this by (1) cultivating the soil, (2) keeping the weeds down with a hoe, or (3) applying a light spray of diesel oil or other weed killer.

Cultivation is injurious to soil. Limit it to the amount necessary to keep weeds under control, to make irrigation furrows or basins, and to cover manure or other similar fertilizer materials. Avoid all deep tillage because it cuts roots. Remember that tree roots, unlike annual crops, grow in the untilled part of the soil.

Spraying may help. Keeping weeds under control by frequent hoeing avoids stirring the soil but requires a lot of hard work. An easier way to obtain the same result is to spray the weeds with oil. A large area can be kept under control by this method with only a 2- or 3-gallon hand pressure sprayer. The soil is first prepared for irrigation. Then, as weeds come up 1 to 1½ inches in height, they are sprayed lightly with a suitable weed killer. Use these materials sparingly, and do not permit them to touch the tree trunks or foliage.

Apply the weed killers as a fine mist and use only enough to wet the weeds. Avoid letting these materials accumulate on plants to levels at which they will run down the stems. Do not attempt to control heavy weed growth with these materials. Catch it young and keep it down. Several proprietary weed-killing sprays are on the market. If they are registered for use on citrus and applied according to directions of the manufacturer, any one of them can be used effectively.

Diseases—some are incurable but they can be avoided

Gummosis is a fungus disease which causes the bark to die, beginning in most cases at or

near the ground level. Large amounts of gum usually flow from affected areas. The fungus which causes the disease (a species of *Phytophthora*) is present in most soils but usually does not attack trees which have been properly planted and given good care. The disease usually occurs where wet soil remains in contact with the bark for some time. The disease is most common in clay soils because they dry more slowly than sandy soils.

Troyer citrange and trifoliate orange are resistant to this disease and should be used as rootstocks in clay soils and in wet locations. The bark on roots is more resistant to attack than the bark on the trunk. For these reasons, plant your trees so that the first roots branch out at the ground level. With trees already planted, keep the soil away from the trunk down to the level of the first roots. A thin wash of commercial Bordeaux powder mixed with water and applied to the trunk and exposed roots in the fall gives added protection.

If a tree becomes infected, remove the soil down as far as the bark is diseased and determine the extent of the injury. If the bark has been killed more than half of the way around the trunk, it will be best to remove the tree and plant a new one. If half or more of the bark is still sound, carefully remove the part which has been invaded by the fungus and ¼ inch of sound bark around the margins. Bark which is alive may be yellow and gummy next to the wood. Remove only parts that are brown and discolored. After this is done, disinfect the wound with 1 teaspoonful of potassium permanganate to a pint of water. Do not replace the soil.

When the bark shows signs of healing, cover the wound with any good wound compound.

Scaly bark. A common disease found in older trees is scaly bark, a virus disease carried by buds when the trees were propagated. It causes rough scaly areas to develop on the trunk or main limbs, and small amounts of gum usually are produced in affected areas. These symptoms seldom appear until the trees

are mature; affected trees gradually decline in vigor and productiveness. No cure is known. In most cases the practical thing to do is to keep the trees until they are too weak to produce satisfactory crops and then destroy them. This disease is serious in orange, grapefruit, and tangerine trees, but can be carried by all varieties of citrus. In recent years, the incidence of this disease has been greatly reduced by the use of buds from registered scaly-bark-free parents.

Exocortis. A virus disease of citrus, it also is carried by buds when trees are propagated. It causes vertical splits in the bark of the rootstock along with vertical strips of partially loosened outer bark in more severe cases. Of the more common rootstocks used, trifoliate orange is most affected. Citranges also are susceptible to the disease, but to a lesser degree. Exocortis seldom kills trees but causes stunting and reduced production. There is no cure. It can be avoided by planting trees from exocortis-free parents.

Stubborn disease is caused by an organism called a mycoplasma. It may be carried in buds when the tree is propagated or by certain leafhoppers, which can carry the disease from an infected to a healthy tree. Young trees appear more susceptible to infection than older trees. Trees with stubborn disease are stunted, have a bushy type of growth, and produce poorly. The disease is more prevalent in warm interior areas and deserts than in coastal locations. All citrus varieties, regardless of rootstock, may become diseased, and navel oranges are particularly affected. No cure is known. If production is severely reduced, the tree should be replaced with one that is free of the disease.

Quick decline or *tristeza* is a virus disease affecting sweet oranges and grapefruit grown on sour-orange and certain other rootstocks. The disease has few definite symptoms but is characterized by root decay which begins at the root tips and progresses back to the larger

roots. This is accompanied by symptoms in the top resembling those produced by gopher injury or gummosis. The tree may die within a few days after the first symptoms are observed, but more frequently the decline occurs over a period of several months. Sweet orange, mandarin orange, Troyer citrange, and trifoliate orange are among the stocks that can be used for replanting where this disease is present. The County Farm Advisor, once again, is your best source of information.

Fruit drop. The dropping of immature fruit is a common problem with citrus growers. Normally there is a fairly heavy drop of small fruit beginning shortly after the blossoms fall and continuing until the fruit is $\frac{1}{2}$ inch or more in diameter. This is nature's way of adjusting the amount of fruit carried by the trees to their environment. The whole crop often appears to have fallen, when, in fact, a good set of fruit remains.

Excessive drop may have several causes: lack of moisture or fertility; heavy pruning; sudden changes in temperature (especially sudden hot temperatures at fruit set or shortly after); insect infestation; or injurious sprays used to combat insects. Some of the dropped fruit is infected with a fungus called *Alternaria*. No way has been found to control this disease, but it is seldom a serious matter.

In home orchards the fruit is often left on the trees long after it is mature. There is no better way to store fruit, but the continued maintenance of the old crop reduces the ability of the tree to bear fruit the following year and in many cases is a cause of reduced yields. Anything that injures or weakens the trees will decrease the set of fruit.

It is not always possible to avoid excessive fruit drop, but it can be kept to a minimum by giving the trees the best possible care. It is especially important to irrigate carefully, avoid excessive pruning, and keep pests under control.

Pest control

Insects and mites. Citrus trees are attacked by a wide variety of insects and mites. Methods of control must be adapted to the pest or combination of pests as well as to the particular locality and situation. Many times insect predators or parasites of the pests provide sufficient natural control to eliminate the need for chemicals. Eliminating ants from trees greatly increases the effectiveness of biological control.

In cases of severe insect or mite infestations, it is suggested that you call or write to the Farm Advisor or Agricultural Commissioner in your county for local pest control recommendations. The Farm Advisor is the local representative of the University of California Division of Agricultural Sciences. The Agricultural Commissioner is head of the County Department of Agriculture and representative in the county of the California State Department of Food and Agriculture.

Some of the more common insect and mite pests found on citrus and the damage they cause are:

- Scale insects (California red, brown soft, black, yellow, citricola) vary from 1.5 to 5 mm in size depending on the species. They have a leathery to hard covering and are stationary after they settle. These insects may occur on fruit, leaves, and twigs. They feed on plant juices and may cause defoliation, fruit drop, and twig dieback. Some excrete honeydew on which black sooty-mold fungus may grow.
- Aphids are small (1.5 to 2.0 mm long) insects, green to black in color, that feed on young tender growth, causing leaves to curl. Some forms are winged. They also excrete a honeydew on which sooty-mold fungus may grow. Heavy aphid infestations can slow the growth of young trees.
- Mites (citrus red mite, citrus rust mite, citrus bud mite) are very small (0.1 to

0.4 mm long), some being visible only with the aid of a hand lens. Depending on the severity of the infestation and kind of mite, they can cause defoliation, markings on fruit, or distorted fruit.

- Citrus thrips are small (0.6 to 0.9 mm long) insects, yellow-orange in color, and winged. They feed on very small fruit and tender emerging leaves. They cause silvery, hardened scars on fruit, and the leaves become thick, leathery, and distorted in shape.
- Orangeworms include the larvae of several species of moths and one butterfly. These "caterpillars" vary in length from $\frac{1}{2}$ to $1\frac{1}{2}$ inches and chew on both fruit and leaves.

Snails. The European garden snail may cause considerable damage to citrus. It feeds on both the foliage and fruit and is particularly troublesome where sprinklers are used for irrigation and conditions are moist and humid. Prepared snail baits generally give effective control.

Gophers. The pocket gopher as well as other rodents can severely damage citrus trees unless controlled. They most often feed on the bark of roots or lower trunk below the soil surface, and the damage is not always apparent. At times, they strip bark from the above-ground portion of the trunk. Rodent damage, depending on the extent, causes tree decline, and, in severe cases, tree death. Keep gophers under control by traps or poison baits.

Frost injury—prune only after you know the extent of injury

Citrus trees in many sections of California occasionally suffer serious injury from cold. It is impossible to determine the full extent of a severe injury for several months. In cases of severe injury to large trees, the dying back

may continue during an entire season following a freeze. During this period little can be done, and treatment should be postponed.

If only twigs and small limbs are killed, you may prune as soon as new growth indicates the extent of the injury. When trees have been killed back to heavy wood, do not prune for six months to a year after the freeze. Always allow sufficient time for new growth to take place and for the dying back to cease so that the extent of the damage is clearly defined. Earlier pruning usually results in leaving some limbs which will continue to die back, and the removal of limbs which would recover.

In the meantime, remove fruit which has no value, and limit the use of water to the need of the tree. In cases of severe injury, reduce the normal amount of fertilizer.

Harvesting—handle fruit to be stored with the greatest care

Citrus fruits can be left on the tree for considerable periods of time without deterioration. Whenever possible, this is the best method of storage. They are, however, subject to damage by wind and frost, and eventually they become overripe and unpalatable. For this reason, the fruit is sometimes picked and stored for future use. The fruit, if uninjured, is resistant to decay and can be kept for several weeks if properly handled and stored. The longer the fruit remains on the tree after maturity, the shorter the time it can be kept in storage.

Citrus fruits which are to be stored must be harvested and handled with the greatest of care. Any break in the rind will open the way

for decay organisms. Always wear soft gloves when picking or handling fruit, for it is almost impossible to avoid cutting the rind with fingernails when bare hands are used. Do not pull the fruit from the tree. Instead, clip the stem with a close, smooth cut. Rough or long stems puncture other fruits during handling. Use clippers with care, for clipper cuts and bruises are a frequent cause of decay.

Avoid scratching the fruit on thorns or dead brush, and do not drop the fruit when putting it into bags or boxes. Transfer from one container to another carefully. See that all the containers are free from twigs and gravel which might damage the rind. Pick the fruit when it is thoroughly dry. Wet fruit is more easily damaged than dry fruit.

Storage—in uniform temperature about 60° F

Citrus fruits keep best in cool rather than cold storage. Temperatures in the neighborhood of 60° F are satisfactory. Choose a place where the temperature is or can be held at a fairly uniform level.

Do not attempt to store fruit that has been injured; remove any that shows decay during storage. A few bad fruits will hasten deterioration in the whole lot. The less citrus fruit is handled, the better it will store.

Place the fruit in convenient containers (clean wooden boxes are usually best) and get it into storage as soon as possible after picking, and with a minimum of handling. Fruits may be stored bare or wrapped individually. Wrapping tends to isolate decaying fruit and prevents the withering that may occur if the air is too dry.