

CITRUS

Recognizing freeze-damaged citrus

During periods of low temperatures, citrus leaves can appear wilted or flaccid. This is the citrus tree's natural protective response to freezing temperatures, and does not always imply permanent frost damage to your tree. If a hard frost does occur, frozen leaves will appear firm, brittle and sometimes curled. Leaves will become flaccid after thawing, and if the injury is not too severe, they will gradually regain turgor and recover. Dark flecks on the leaves can be an indication that a freeze and thaw has occurred. Leaves that have been exposed to a prolonged frost will mostly likely shrivel, die and remain on the tree. New and tender foliage are most susceptible to frost damage. If twigs or wood have been seriously damaged, the frozen leaves may remain on the tree for several weeks. If the twigs and wood have *not* been damaged severely, the leaves are rapidly shed. Contrary to what many growers believe, it is actually a good sign when a tree sheds its leaves rapidly. This usually indicates mild frost damage to the trees.

Cold damage to twigs appears as if the twigs have absorbed excess water and also become discolored. In older branches and on the trunks, cold damage will be indicated as splitting or loosening of bark, where the cambium has been killed. Bark may curl and dry with many small cracks. Dead patches of bark may occur in various locations on limbs and trunk. Sensitivity to frost is dependent upon many variables. In general, mandarins are the most cold hardy followed by sweet orange and grapefruit. Lemons are very frost sensitive with Eureka decidedly more sensitive than Lisbon. Limes are the least cold hardy. Healthy trees are more tolerant than stressed ones. The rootstock also imparts sensitivity onto the scion. Injury to the foliage and to young trees may be immediately recognizable, but the true extent of the damage to larger branches, trunks, and rootstocks can take up to four months to show damage following the freeze. No attempt should be made to prune or even assess damage from the frost until spring when new growth appears.

Rehabilitation of freeze-damaged citrus

WHITEWASHING

The only treatment that should be done after a hard freeze is whitewashing. Often the most severe damage following a freeze results from sunburn of exposed twigs and branches after defoliation. Temperatures do not have to be extremely high to cause sunburn. A white latex paint that has been diluted with water (making it easier to spray), is the best way to whitewash the exposed tree parts. The whitewash needs to dry white on the tree, so careful not to overly dilute the paint.

PRUNING

Pruning should be carried out to prevent secondary pathogens and wood decay organisms from slowing down tree recovery. Again, as previously mentioned, there should be no rush to prune. Premature pruning, at the very least, may have to be repeated and at the worst, it can slow tree rehabilitation. It should be remembered that when pruning, all cuts should be made into living wood. Try to cut flush with existing branches at crotches. Do not leave coat hooks (branch stubs) or uneven surfaces. Tools should be disinfected in bleach or other fungicide before moving on to the next tree.

IRRIGATION

Irrigate carefully! Remember that when leaves are lost, evaporation from leaves is greatly reduced, and therefore the amount of water needed should also be greatly reduced. A frost-damaged tree will use the same amount of water as a young or smaller tree. Over irrigating will not result in rapid recovery. Instead, it may induce root damage and encourage the growth of root rotting organisms. Irrigation should also be applied less frequently, with smaller amounts of water until trees have regained back their foliage that was lost due to the freeze.

FERTILIZATION

Fertilization of freeze-damaged trees should be carefully considered. There is no evidence to indicate that frozen trees respond to any special fertilizer, including fertilizers that are supposed to stimulate growth. If trees are severely injured, with large limbs or even parts of the trunk killed, nitrogen fertilizer applications should be greatly reduced, until the structure and balance of the tree become re-established.

Trees should be monitored for evidence of micro-nutrient deficiencies. Deficiencies of zinc, manganese, copper, and iron are most likely to develop. For citrus, these nutrients should be applied as sprays, and they should be used as often as symptoms are observed. Two or more applications may be required the first year.

Heat and its importance in citrus

Heat will effect citrus depending on variety. Heat determines when fruit ripens and how sweet it will be. Grapefruit has one of the highest heat requirements of all citrus. When grown along the coast, with a cool marine influence, grapefruits tend to be sour. However, when grown in the Central Valley, with a long and hot growing season, grapefruit can be distinctly sweet. A Pixie mandarin grown along the coast will ripen 6-8 weeks later than in the Central Valley; and will also hang on the tree much longer. Acid fruits, like lemon and Bearss lime, have low heat requirements and are well adapted to the coast. The everblooming characteristics of lemons and limes are accentuated along the coast, where there may be continuous cropping with lemon blooms year round.

High temperatures can have negative effects on citrus. Coastal citrus may suddenly drop fruit when temperatures swing from the cool 60's F to the 90's F as often happens with Santa Ana conditions, along the Southern Californian coast. Sudden warm weather can cause fruit to split, induce flower and leaf drop, and cause sudden burn to both the fruit

and tree. These problems are compounded by dry soil moisture and problems can be reduced if there is adequate moisture present during the heat wave, mulching helps (with attention to keeping it away from the base of the tree). In hot environments, some citrus like the Navel orange, may produce less fruit.

You call them tangerines, but they are actually mandarins

Mandarins are a large diverse group of easy peeling, sweet, juicy and orange colored fruit. The Satsuma varieties are always early and seedless. Clementine mandarins, on the other hand, can be harder to peel and can have a mouthful of seeds, but they can still taste great. There are only a few tangerines, so called, because they originated in Tangiers. 'Dancy' is a tangerine, but it is also a mandarin. Confusing? There are mandarin varieties that fruit at different times of the year, so that you could have a mandarin every day of the year.

Seediness and citrus

Seediness in citrus is often unpredictable. Officially, a fruit can have up to 5 seeds and still be considered seedless. Some varieties such as 'Washington' navel, 'Pixie' mandarin and 'Armstrong' satsuma are consistently seedless. Some varieties, such as the Valencias are consistently seedy. Others, such as 'Clementin' and 'W. Murcott' mandarin only produce seed if there is a pollinizer nearby. The fruit number and size may be reduced without seeds, though. There is no precise list of compatible pollinizers and varieties may perform differently depending on the region and the weather that year. In the spring time the trees are alive with bee pollinators (notice the difference, the tree is a pollinizer and the insect is the pollinator).

What size plant should I buy?

The longer the plant has been in the container, the longer it takes the plant to adjust to the soil in your background, and the higher chance of the plant being root bound. The smaller the plant is that goes in the ground that can survive, the more rapid the growth. A 5 gallon container grown lemon will have outgrown the 15 gallon container in three years.

Pruning

Leaving a citrus unpruned is not as critical as it is for deciduous trees. They form a blob with leaves extending to the ground. Pruning however, improves air circulation (reduces fruit disease), increases fruit size, reduces alternate bearing (especially in mandarins), reduces limb breakage and controls trees size. Light pruning to open up the centers in late winter at flowering is the best time. It helps even out flowering, allows for regrowth during the summer, avoids spread of disease to cuts during the rainy season and reduces the likelihood of sunburn which can be a problem when done in the summer time. Late fall/winter pruning stimulates growth that can easily freeze.

Severe pruning can rejuvenate an overgrown tree, but expect yield reduction. Also expect to whitewash the tree (dilute latex paint), to reduce sun burn.

Suckering

all citrus is sold as grafted trees. The tree is a combination of a rootstock (used because it consistently propagates well for the nursery) and the scion (a known variety that consistently reproduces the same fruit). Early on and even later the rootstock growth (suckers) may be more vigorous than the scion and out grow it. Rootstock growth is often more thorny than the scion. Know where the graft union is on your tree. It can usually be seen as a diagonal scar between 6 and 12 inches from the soil. Remove all shoot growth below the graft. Remove suckers as soon as they are observed.

Rootstocks

There are many different rootstocks available to growers. A certain rootstock will be chosen because it has greater nematode resistance, salt resistance, and/or disease resistance. The retail nursery typically sells whatever rootstock the wholesale nursery propagates. Wholesale nurseries do not all use the same rootstocks, but use those that they feel grow best for them. In some cases, a retail nursery may be able to special order a rootstock for a special situation. You can always ask.

There is one choice that the buyer can make, though, whether it is dwarfing or not. The 'Flying Dragon' rootstock creates small tree, under 6 feet and it is very slow growing. It especially lends itself to container culture.

Growing citrus in a lawn

Do you irrigate to the needs of the lawn or the tree? Frequently, the amount of water that is applied to turf is controlled by irrigation timers. The timers are usually scheduled to water by putting on short bursts of water, in order to avoid run-off. However, citrus trees like most trees prefer a deep watering. Shallow watering can lead to an accumulation of salts in the tree's root zone, resulting in salt burn to the tree. If possible, keep a 6 foot diameter around the trunk of the tree that is free of turf. It is also recommended to irrigate the tree separately from the turf and make sure the lawn sprinklers do not wet the trunk which can lead to crown rot in the tree.

Container grown citrus

Citrus grows well in containers, especially if you choose varieties like 'Meyer' lemon which is a less aggressive tree or use 'Flying Dragon' dwarfing rootstock on one of the other citrus varieties. There is a long history of orangeries in Europe, where full sized trees were grown outside in containers in the warm weather and then moved into large greenhouses when the season changed. Half barrels and terra cotta pots can be used, but if a large container is used and you want to be able move it, put the container on some wheels first. Fill the container with a good quality potting mix and plant your tree. Containers dry out much faster the soil grown trees, so stay on top of the irrigation. When irrigating, make sure water comes out of the bottom of the pot to avoid salt accumulation in the root zone. Prune as necessary to keep the canopy in balance with the pot or pot up to the next size.

Asian citrus psyllid (ACP) and Huanglongbing (HLB) disease

<http://www.californiacitrusthreat.org/>

Currently in much of the southeast there is a pest-disease complex. A small insect about the size of an aphid can carry a bacteria that causes fruit to be distorted and bitter, causes a mottled color of the leaves and eventually kills the tree in five to eight years. This disease is in Louisiana, Florida, the Caribbean, Mexico and Brazil. Massive amounts of energy and pesticides are being used to keep in under control. The psyllid is now in California along the California border, but the psyllid at this point is not carrying the bacterial pathogen. The insect is being monitored and tested for the bacteria at this time and it is hoped that control practices in that area and in Mexico will prevent the introduction of psyllids carrying the bacteria.

Budding and grafting of avocado and citrus

By: Pam Geisel

It is often tempting, after eating a particularly good orange or avocado, to plant the seed and grow our own tree full of these delicious fruit. Trees grown from these seed, however, may produce fruit that are not edible at all, or the trees may not bear fruit for many years. The best way to produce good-quality fruit is to grow seedlings from them and then attach, by budding or grafting, material from trees that are known to be good producers. Budding and grafting can also be used to change or add varieties to mature citrus or avocado trees, a process known as top working.

Established seedlings

The best time of year to start citrus or avocado seedlings is in early spring. To germinate citrus or avocado seed, plant them in a shallow container such as a nursery flat or a pan with drainage holes in well-drained commercial potting mix. Plant the seed two to three times deeper than their length. For example, a citrus seed about $\frac{1}{4}$ inch (6 mm) long should be planted about $\frac{1}{2}$ to $\frac{3}{4}$ inch (12 to 18 mm) deep. Keep the seed in a warm place-between 70° and 80° F (21° to 27° C)-and keep the soil moist. Covering the nursery flats with clear glass or plastic will help maintain the proper humidity. Avocado seed can also be germinated by suspending them in water. Place toothpicks horizontally into the seed near the top. Suspend the wide end of the seed in a small container of water with the toothpicks resting on the edge of the container. Place it in indirect light and refresh the water at least weekly.

After germination (usually 12 to 15 days), replant the seedlings into a larger container of good-quality commercial potting mix. (If all danger of frost has passed, the seedlings may be planted directly into the ground where you want the tree to grow instead of replanted into containers.) Good choices for containers include a cardboard milk carton cut horizontally in half or a one-gallon can. Punch drain holes in the bottom of the

container. The seedling will be ready for budding or grafting when it has grown to 24 to 30 inches (60 to 75 cm) tall.

Keys to Budding and Grafting

Budding and grafting are vegetative propagation techniques in which a single bud or stem (scion) of a desired plant (cultivar) is attached to a rootstock plant. In budding, a single bud with its accompanying bark (often referred to as budwood) is used as the scion. In grafting, part of a stem or branch is used as the scion. One of the most important keys to successful budding and grafting is properly positioning the scion on the rootstock. In order for the scion and rootstock to grow together, the thin greenish plant layer (cambium) just under the bark of the scion and rootstock must be aligned so that they touch each other. If they do not touch each other, the bud or graft will fail. Within 10 to 15 days, a successful bud or graft forms a hard whitish tissue (callus) where the two cambium layers grow together.

Always use sharp cutting or grafting instruments and make clean, even cuts. Options include a budding knife, a sharp kitchen knife, or a single-sided razor blade. Do not allow the cut surfaces of the scion or rootstock to dry out. Immerse cut scions in a pail of water, wrap them in plastic, or graft them immediately after cutting. Also, remove any leaves from scions after cutting to help keep the scions from losing water. Keep the scions in a cool place during the work.

When to Bud or Graft

Budding and grafting are best done in the spring or fall when the bark is easily separated from the wood. It should be timed to be early enough so that warm weather will help ensure a good bud union, yet late enough so that the bud will not begin to grow and callus will not grow over the bud itself. Citrus budded or grafted in the fall must be protected from frost. Avocados are best grafted in the spring when the bark is easily separated from the wood.

Budding

Budding is the standard method used to propagate citrus. Aside from being the easiest method, it allows a large number of plants to be propagated from a small amount of scion wood and is suitable for trees, rootstocks, or branches from 1/4 to 1 inch (0.6 to 2.5 cm) in diameter.

Budwood should be taken only from high-producing, disease-free trees (see Warning at end of this article). The best citrus budwood is located just below the most recent flush of new growth; the best avocado budwood is located near the terminal end of shoots that have fully matured, leathery leaves.

How to make a T-bud

T-budding (see fig. 1) is generally the best budding method for citrus and avocados. To make a T-bud, make a T-shaped cut on the rootstock about 8 to 12 inches (20 to 30 cm) above the ground (fig. 1A). The vertical part of the T should be about 1 inch (2.5 cm) long and the horizontal part about one-third of the distance around the rootstock. Twist the knife gently to open flaps of bark. Avoid cutting through any buds on the bark of the rootstock.

Figure 1 - T-budding

A. Rootstock with T-shaped cut.

B. Cutting bud from budwood

C. Buds ready for insertion.

D. Bud inserted into the cut.

E. Graft wrapped with budding rubber.



On the scion (fig. 1B), cut a selected bud beginning about 1/2 inch (1.2 cm) below the bud and ending about 3/4 to 1 inch (1.9 to 2.5 cm) beyond the bud. Make a horizontal cut about 3/4 inch (1.9 cm) above the bud down through the bark and into the wood. Gently remove the shield-shaped piece for budding (fig. 1C).

Slip the budwood down into the T-shaped cut under the two flaps of bark until the horizontal cuts of the bud match up with the horizontal cut of the T (fig. 1D). After inserting the budwood into the rootstock, wrap the bud and rootstock with budding rubber (fig. 1E). Budding rubber is available from agricultural supply or hardware stores; if budding rubber is unavailable, use wide rubber bands, green tie tape, or stretchy tape. Leave the bud exposed while wrapping. Do not coat the area with grafting wax or sealant.

If the budding is done in the fall, the buds should be healed in about 6 to 8 weeks; in the spring, healing should take about 3 to 4 weeks. After the bud has healed, unwrap it and cut off the remaining shoots or stock about 12 to 14 inches (30 to 35 cm) above the bud union. This will be the nurse branch, which helps protect the new bud union. After the budwood has grown a few new leaves, completely remove the nurse branch to about 1/8 inch (3 mm) above the bud union (fig. 2).



Figure 2 - After T-bud begins to grow, remove nurse branch

GRAFTING

Whip grafting

The best grafting technique for small-diameter 1/4 to 1/2 inch [0.6 to 1.2 cm]) rootstocks are whip grafting. Whip grafting should be done in the fall or spring. Although whip grafts use more scion wood than budding does, they allow the grafted plant to develop more rapidly.

Figure 3 - Whip grafting

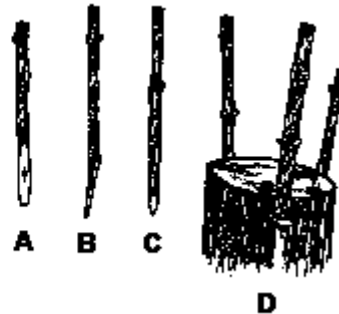
- A. Rootstock stem cut for grafting.**
- B. Tongue cut into rootstock to hold scion in place.**
- C. Scion cut for grafting, with tongue.**
- D. Scion and rootstock properly aligned.**
- E. Graft wrapped with budding rubber.**



To make a whip graft (fig. 3), select as a scion hard and mature green wood. First make a long, sloping cut about 1 to 2½ inches (2.5 to 6.2 cm) long on the rootstock (fig. 3A). Make a matching cut on the scion. Cut a "tongue" on both the scion and rootstock by slicing downward into the wood (figs. 3B-3C). The tongues should allow the scion and rootstock to lock together. Fit the scion to the rootstock (fig. 3D) and secure with budding rubber (fig. 3E). Apply grafting wax to seal the union. To prevent sunburn, new whip grafts should be protected from the sun until they heal. After the scion has begun to grow, remove any growth from the rootstock. If necessary, support new shoots by staking.

Bark grafting

Figure 4 - Bark grafting
A-C Scions cut for bark grafting.
D Scions in proper position
(note flathead nail).



The best grafting technique for large-diameter trees or branches is bark grafting (fig. 4). To make a bark graft, first cut off the rootstock (the trunk or branch to be grafted) just above a crotch where smaller branches sprout out. If possible, try to retain one branch of the original plant as a nurse branch. The nurse branch will provide the scion nutrition and support from wind (the nurse branch will eventually be removed).

Cut vertical slits 2 1/2 to 3 1/2 inches (6.2 to 8.7 cm) long through the bark of the remaining freshly cut rootstock stubs down to the wood. These slits should be spaced 3 to 5 inches (7.5 to 12.5 cm) apart. Cut the scions 5 to 6 inches (12.5 to 15 cm) long with 4 to 6 buds per scion (figs. 4A-4C). If scions are cut longer than this, they may dry out before healing. When cutting the scions, make a sloping cut about 3 inches (7.5 cm) long at the base of the scion.

Using a grafting knife or other very sharp knife, lift the bark on one side of the slit. Insert the scion into the slit with the long-cut surface of the scion facing the wood of the rootstock and push it down into the slit (fig. 4D). Make sure that the scion fits snugly into the slits in the bark and that the cambiums are properly aligned.

Secure citrus scions by nailing them in place with thin flathead nails or tying them with strong cord or tree tape. Secure avocado scions with plastic nursery tape. Coat all cut surfaces thoroughly, including the tops of the scions, with grafting wax or pruning paint. To protect the graft from sunburn, paint it with white interior water-based paint, either undiluted or mixed 50/50 with water. Paint the entire area around the graft union, including the scions, waxed areas, and the exposed trunk below the graft union. Inspect the grafts frequently and re-wax them if they begin to crack or dry out.

Once the scions begin to grow well, remove all but one scion per branch. Early on, however, prune the scions that will be removed to reduce their vigor but do not prune the scion that will be kept. The one scion you keep will eventually become a main scaffold branch. Any nurse branches should also be removed after all the scions are growing well.

TOP WORKING

Top working is the process of changing fruit varieties on a mature tree. Most citrus and avocado are top worked by bark grafting (see above). Top working should be done in the spring or fall.