

# Avocado

## **How do I choose an avocado variety?**

There are over 900 named varieties of avocado, how do you pick one? Well for one the selection at commercial retail nurseries is somewhat limited, compared to what is offered at nurseries that growers use. But you do have options. In general, avocado trees are big and need room. 'Hass' has an umbrella-shaped canopy, but 'Reed' is more columnar and needs less room. 'Holiday' is a much smaller tree than 'Hass' and 'Littlecado' is a somewhat smaller tree. You can also choose on the basis of when you want to pick your fruit. For example, 'Fuerte' is a winter fruit and 'Reed' is a summer fruit. That means they taste best in those periods, but they will hold on the tree for a much longer period of time. You can also choose on the basis of taste. Of course, this is very subjective, but 'Zutano', 'Bacon' and 'Stewart' have a lower oil content than 'Hass', 'Pinkerton' and 'Reed'. Many consider 'Nabal' the best tasting fruit. It's a summer variety and hard to find in retail nurseries, but sometimes you can order them for delivery later.

You can read more about varieties at the website:

<http://ucavo.ucr.edu/AvocadoVarieties/VarietyFrame.html#Anchor-47857>.

But remember, most of these are not available at retail nurseries.

## **How do I know when an avocado is ripe?**

The avocado is an amazing fruit. It grows on a tree and comes to maturity, reaches certain oil content and a stage at which it will ripen, but does not ripen on the tree. It needs to be removed from the tree before it will soften. If the fruit is removed before it has reached maturity it will not soften, and will remain rubbery and inedible. One of the problems is that the fruit will hang on the tree for an extended period of time and it is hard to know when they are mature. Avocados are not like apricots where you have about 2 weeks to get the fruit off before it falls off. As the fruit stays on the tree it gradually develops more and more oil content and has a richer flavor.

If the fruit stays on the tree too long, the oil can develop an almost rancid flavor, however. So it is good to know when the best, acceptable flavor is. Avocado varieties fall into general seasonal periods when they are mature – 'Fuerte' in winter, 'Hass' in spring/summer, 'Lamb-Hass' in summer/fall. Or you can pick a fruit and put it on the counter and watch to see if it softens evenly. If it does in a two week period, the rest on the tree are good to go.

## **Mulch and avocados?**

I just raked up all the leaves under the avocado and it looks so nice. **PUT THEM RIGHT BACK.** The avocado tree is shallow-rooted and depends on the natural leaf mulch to protect its roots. In fact, the roots will actually colonize the rotted leaves as if it were soil. The avocado trees own leaf mulch is also a first line of defense against root rot. The decomposing leaves create a hostile environment to the microorganism that causes the disease- HOW? The mulch also helps to reduce evaporative loss of water and

therefore reduces water needs. Avocado growers will actually spread mulch in cases where trees are too young to produce adequate leaf drop for mulch or in windy areas where mulch has blown away. The key to remember is that mulch should be kept at least six inches away from the trunk, this is done to avoid collar rot which can result moist mulch against the trunk.

### **How to irrigate avocados**

Under ideal conditions, mature avocado trees can grow to a substantial size, however young and old trees both have very shallow roots. The majority of avocado roots are in the top 8 inches of soil. As opposed to a deep rooted walnut, The tree therefore does not have access to a large volume of stored water. they need frequent, small amounts of water. A young tree in the summer might need multiple applications per week, but because the root system is small, each application may only be 5-20 gallons. An older tree with its wider rooting pattern may go a week to a month between irrigations depending on the weather and rainfall. Proper irrigation is the best way to keep the avocado from getting root rot. Both over and under irrigation can induce the conditions for root rot, although over irrigation is more common. And remember, it is not just the amount applied at an irrigation, but the timing that is important, as well. Because you are managing such a shallow root system, just poking your finger into the root system will tell you if there is adequate moisture there before you irrigate again.

### **How to identify root rot and treat it?**

Symptoms include: a thin canopy, leaves that begin to turn smaller in size and yellow in color, as well as significant dieback in the canopy, characterized by leafless tips on the branches. To check if your avocado tree has root rot, you might want to dig around under the canopy and you can't find roots within 6 inches of the soil surface or if you do find them and if they are black, this is a good indicator of root rot. If there are weeds growing under the tree, since avocado trees have dense canopies that do not allow for plant to grow underneath them, could also be a sign of root rot disease. However, all of these symptoms could also a sign of insufficient water, because that is exactly what is happening in either situation– there are no roots to take up water. And one of the things a gardener will often do, is start watering the diseased tree more, thinking it is lack of water, which if it is diseased only makes the condition worse. Adding more water to a tree that can not easily take it up only creates an asphyxiation that makes matters worse. Irrigation and mulch are the two most important factors for avoiding the disease.

So what do you do if you have disease? There are over the counter fungicides available from local nurseries, but there are a number of things that you can do before applying a fungicide. First of all, get a handle on the irrigation. Make sure you are irrigating to the tree's needs. Check soil moisture before irrigating. Make sure the tree is not getting supplemental water from another area such as a lawn sprinkler. Make sure there is a good thick, woody mulch under the canopy. Adding gypsum (15-20 pounds per tree) evenly spread under the canopy can also help, but reviewing and modifying the irrigation practice is the most important thing that you can do.

### **Fertilizing avocados**

The most important thing you can do before planting is to know the soil pH before planting. Avocados grow best with a soil pH of 5-7. Avocados are very sensitive to alkaline soils, with pH greater than 7. Their uptake of iron and zinc can be terribly compromised with high soil pH and they will suffer. Correcting the soil pH prior to planting is the easiest way to correct pH problems, rather than trying to correct it later when the tree is in the ground. Once the tree has been planted, it will be more expensive and will take more time to correct the problem, without killing the tree. Elemental sulfur (not popcorn sulfur) in pellets is the easiest way to lower soil pH. Watering and waiting for the sulfur to make the change and then checking to make sure the pH has went down, takes about 6 months.

The most commonly required macro-nutrients are N (nitrogen) and K (potassium). These can be applied as either an organic (fish, soybean, manure, etc...) or by synthetic forms (urea, ammonium sulfate, potassium sulfate, etc.) or a combination of both. The thing to remember is that the tree because of its shallow root system likes small, frequent amounts of nutrients. And because it is a subtropical plant, it goes quiescent in the winter and when the soil is cold. So nutrient applications like nitrogen, are best applied when soils are warm spring through fall.

Newly planted trees do not need supplemental nutrients, they are loaded up from the nursery and the young root system can easily burn until it gets established. The first year use the equivalent of 1 ounce per tree total of nitrogen in 4- 5 applications over the spring/fall. The following year double that amount and do so for each succeeding year for the next 5 years. The more small applications you make the less total nitrogen fertilizer you will use. Use the equivalent amount of nitrogen whether it is a synthetic source or an organic source. Once the tree has started to develop a thick leaf mulch, it is possible to back off on nitrogen applications because now the mulch is contributing some of the nutrients. In many garden situations where mulch is maintained, by year 10 the nutrient status is self-sustaining and nitrogen fertilizer may not be needed at all. Just keep an eye on the leaf color to make sure it stays green, indicating adequate nitrogen.

When the avocado starts bearing fruit about year three, it may need potassium. This is not necessary in all situations throughout the state, but the harvested avocado fruit contains twice as much potassium as nitrogen and when the fruit is removed the tree can start showing potassium deficiency symptoms. This can be analyzed for at a lab, but probably the best thing to do is just apply potassium sulfate at an equivalent rate to nitrogen or to use triple 15 fertilizer to meet both the nitrogen and potassium needs. For organic growers can use organic potassium sulfate or kelp. Although phosphorus is used by avocados, there are no documented cases in California where supplemental phosphorus needs to be applied.

### **Flowering habit of avocado**

The avocado is an unusual beast in many ways. And flowering is no exception. It follows what is called synchronous dichogamy. The flower has both male and female parts, but those portions open at different times, opening first as female, closing and then

opening as a male. It does this over two days, so in effect it can not pollinate itself. To make it more interesting there are what are called A and B varieties. These varieties open and close in a different pattern, so that there is some overlap between the male stage of one variety and the female stage of another variety. This is how you get cross pollination. He sounds really good as a model, but the avocados didn't read the book, since for a given variety there are always some laggards and there are often both female and male stages on the same tree.

**The mother of all disease**

Currently in the Florida area there is a pest-disease complex called Laurel Wilt Disease. This is caused by a fungus that is carried by an ambrosia beetle. The beetle is extremely small and carries the fungus in its mouth parts. The beetle bores into the wood, spreading the fungus. Most of the beetles are females. They lay their eggs in the wood, the fungus starts growing, the eggs hatch and the larvae feed on the fungus growing on the wood. The problem with this fungus is that grows, clogging the vessels that carry water (xylem) and the tree dies from lack of water. This happens very rapidly, in under a year. At this point, there are really no effective sprays to control the beetle or fungicides to control the fungus. This pest-disease complex is thought to have come into Savannah harbor on untreated wood packing crates from somewhere in Asia. If it gets to California, it will be very difficult to control.

**Frost protection and avocados**

Avocados in general are very frost sensitive, however backyards tend to be warmer than open fields and homeowners can often grow trees with less concern than growers. All young trees are more susceptible to freeze damage than a tree that has a full canopy down to the ground. The canopy traps heat and keeps the tree warmer than the surrounding air.

When trees are young they are small enough that frost cloth can be framed around the young tree. This usually provides at least 5 degrees of protection. Just a blanket can be used, as well as long as a structure is built to keep it off the tree. When trees get older and are too large to cover, homeowners have used a sting of lights in the canopy to generate heat. Make sure they are lights designed for the outdoors.

There are differences in how much cold a tree will take. 'Hass' and 'Holiday' are very sensitive, while 'Stewart' and 'Zutano' are much more cold tolerant. Here is a comparative chart of the different varieties

<b>Variety Frost Resistance</b>		
<b>Race</b>	<b>Typical varieties</b>	<b>Critical temperature below which fruit and/or trees are subject to damage</b>
Mexican	Duke, Topa topa, Mexicola, Zutano, Bacon	25 Degrees F
Hybrids	Fuerte, Puebla	28 Degrees F
	Ryan, Hass,	29 Degrees F

Guatemalan (Tender)	MacArthur, Nabal, Endranol, Rincon	
Guatemalan (Very Tender)	Anaheim, Dickinson, Carlsbad, Challenge, Hellen	30 Degrees F

### **Recognizing freeze damage in avocado**

Avocado leaves appear wilted or flaccid during periods of low temperature. This is a natural protective response to freezing temperatures and does not mean the leaves have been frozen. Leaves will be firm and brittle and often curled when frozen. Leaves become flaccid after thawing, and if the injury is not too great, they gradually regain turgor and recover, leaving however, dark flecks on the leaves. Seriously frozen leaves collapse, dry out, and remain on the tree. Foliage from recent flushes are most susceptible to this 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. Trees losing their leaves rapidly is often a good sign and is not, as many growers believe a sign of extensive damage.

Cold damage to the twigs appears as water soaking or discoloration. In older branches and trunks it appears 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. For avocados, Hass is about as cold tolerant as lemons, while Bacon is more cold tolerant. Healthy trees are more tolerant than stressed ones. The rootstock also imparts sensitivity to 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 may not appear for up to four months 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 avocados**

#### **WHITEWASHING**

The only treatment that should be done after a 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, there should be no rush to prune. Premature pruning, at the very least, may have to be repeated and, at the worst, 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 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, obviously evaporation from leaves is greatly reduced, and, therefore the amount of water required is also greatly reduced. A frost-damaged tree will use the same amount of water as a much younger or smaller tree. Over irrigation will not result in rapid recovery. Instead, it may induce root damage and encourage growth of root rotting organisms. This is particularly true for avocados. Irrigation should be less frequent, and smaller amounts of water should be applied until trees have regained their normal foliage development.

#### FERTILIZATION

Fertilization of freeze-damaged trees should be carefully considered. There is no evidence that indicates that frozen trees will respond to a special fertilizer that is supposed to stimulate growth. If the 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 watched for evidence of deficiencies of minor elements. Deficiencies of zinc, manganese, copper, and iron are most likely to develop.

### **Budding and grafting of avocado and citrus**

By: Pam Elam

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.

This publication is a brief introduction to budding and grafting for the home gardener. For more information, consult the materials listed at the end of this publication or contact your local Cooperative Extension office.

#### **ESTABLISHING 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  $70^{\circ}$  and  $80^{\circ}$ F ( $21^{\circ}$  to  $27^{\circ}$ 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 is 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**

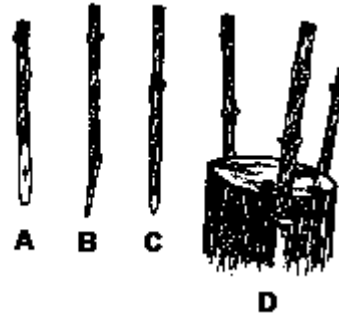
- A. Rootstock stem cut for grafting.**
- B. Tongue cut into rootstock to hold scion in place.**
- C. Scion cut for grafting, with tongue.**
- D. Scion and rootstock properly aligned.**
- E. Graft wrapped with budding rubber.**



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.