

AVOCADO PROPAGATION

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Avocados may be propagated in a number of different ways. Nursery trees are produced by budding or grafting the various varieties on seedling rootstocks. Trees can be grown from cuttings, but the performance of such trees is not known and most varieties are difficult to root. Older trees are topworked to new varieties by various types of grafts or by budding into vigorous new shoots. There are numerous methods used to propagate avocados. Only the more common procedures are discussed here.

Avocado trees grown from seed are usually slow to come into bearing. The fruit is extremely variable and rarely of acceptable quality. Even if the fruit were good, it would be difficult to market because each tree would bear fruit differing in size, color, shape and quality. Seedling trees are occasionally used for a windbreak. In cold locations where it is difficult to establish nursery trees, growers sometimes plant hardy seedlings directly in the orchard. After the seedlings have grown two or more seasons, they are grafted to the desired variety.

ROOTSTOCKS FOR AVOCADOS

In California, seedlings of the hardy Mexican varieties are preferred for rootstocks. Seedlings of the Guatemalan varieties make strong growth and produce vigorous trees when budded or grafted, but the stocks are more susceptible to disease and injury from cold. For this reason, their use is not advised.

Mexican seedlings are more resistant to lime-induced chlorosis, *Dothiorella* canker and *Verticillium* wilt than those of the Guatemalan race.

SELECTING THE SEED

Select seed from trees of a hardy Mexican variety known to produce seedlings that make vigorous disease-free trees. If possible, the tree or trees should be isolated so they will not receive pollen from less desirable varieties. The varieties most commonly used as a source of seed are Topa Topa, Mexicola, Ganter and Duke. There are a number of other varieties and individual trees equally good as seed sources. It will be best to discard seed that is small for the variety.

The virus disease, sun-blotch, is sometimes carried by seed. Since some trees carry the virus without visible symptoms, it is important to know that seedlings from trees used as a seed source produce disease-free trees when budded or grafted. The avocado root rot disease can also be carried by seed. Fruit that has been permitted to contact

infected soil will be invaded by the fungus and many of the seeds will carry the disease and infect the nursery. For this reason, it is wise to take seed from sound, mature fruit and avoid the use of windfalls. Your farm advisor can assist you in locating reliable seed.

It is best to plant seed soon after it is removed from the fruit. It should always be protected from drying. Since fruit of the Mexican varieties mature in the fall, it will, in some cases, be necessary to store the seed until spring if the nursery is to be located out-of-doors. Seed may be kept for several months if packed in dry moss, sand or sawdust and placed in a cool location. Temperatures between 40 and 45 degrees are desirable.

PLANTING THE SEED FOR STANDARD NURSERY TREES

Avocado seedlings should be grown in a soil that has never been planted to avocados or other crops that carry the root-rotting cinnamon fungus or *Verticillium* wilt fungus. To insure freedom from disease, soil fumigation with a recognized soil fumigant is recommended. Methyl bromide and vapam are currently recommended. Sandy soil, that has not recently been manured, is best. A mixture of half sand and half loam is preferred by some growers.

A convenient and economical way to grow seedlings for field planting is in beds 12 inches deep, 3 to 4 feet wide, and long enough to accommodate the number of seeds desired. It is often desirable to build a frame of 1" x 12" boards on the soil surface and fill with soil specially prepared or selected for the seedbed. If rodents are likely to be a problem, place a wire netting under the frame before filling. Rats and squirrels often remove or damage seeds in the beds. It may sometimes be necessary to screen the top of the beds until the seedlings are well established. Fumigate the bed before planting to avoid soil-borne diseases.

Seed can be planted directly in the field in nursery rows. This requires special care and does not permit culling weak and offtype seedlings without leaving blank spaces. In addition, sprouting will be slow with some seeds, causing an irregular stand. Some growers place a paper cup or hot cap over each seed to protect them from drying and facilitate weed control. When seed is covered in this way, weed-killing contact sprays can be used in the nursery.

Seed should be planted with the large flat end down, leaving the tip flush with the soil surface. Be sure the soil makes firm contact with the seed. Spread a layer of clean sand, sawdust, or ground peat moss over the beds, deep enough to cover the seeds 1/4 to 1/2 inch. This will avoid forming a crust over the soil after irrigation and will protect the seeds from drying. Provision should be made to shade beds during hot weather to avoid burning the tender sprouts as they emerge.

Germination can be hastened by cutting a thin slice off the tip and base of the seed. This is not considered necessary when seed is planted immediately after removal from the fruit.

Seedlings that are to be transplanted to the nursery bare root are planted at 2-inch intervals in the bed. If they are to be removed with soil around their roots, they are

planted at 4-inch intervals to permit easy digging. Some growers prefer to plant in 2 x 2 x 8 inch paper pots to facilitate moving the seedlings into the nursery.

If a hot house or hot bed is available, seed can be planted as it becomes available. Seedlings grown in this way from fall or early winter plantings will be ready to line out in the nursery by spring.

In warmer locations, seed planted in the fall, out-of-doors or in a lath or cloth shelter, will also be ready to transplant by spring. Seed lings, lined out in spring, should be ready to bud by summer. Under favorable conditions, seedlings from fall plantings, made directly in nursery rows, can also be budded during summer. In cooler locations, field plantings are made in March or April and budding can begin in the fall.

CARE OF THE SEED BED

The seed bed should be kept moist at all times. This will require sprinkling every two or three days. In cool locations, germination will be hastened if the beds are covered with black paper. This will warm the soil, decrease moisture loss, and discourage weed growth. The paper must be removed at the first sign of germination to avoid injury to the tender sprouts.

Germination will require about 30 days when seed is planted in a hothouse or out-of-doors in spring. Most of the seedlings will be ready to transplant 60 to 90 days after the seed is planted. Seed planted out-of-doors in fall or winter will usually require 60 or more days to germinate and the seedlings will be ready to transplant 30 to 60 days after germination. Seedlings are ready to transplant when they are 5 or 6 inches high.

It is not necessary or desirable to fertilize avocado seedlings at this stage. The seeds provide an adequate supply of nutrients.

THE NURSERY

The nursery site should be as free as possible of frost, strong wind and ocean breezes. The soil should be free of rocks, and well drained, but containing enough clay to form a good ball when the trees are dug. As with the seed bed, the soil should not have been used for avocados or other crops that may have carried the cinnamon or Verticillium fungus. Avoid locations below established avocado orchards or land formerly planted to avocados where drainage water may carry disease to the nursery. It will save expense and trouble if the site is also free of noxious weeds such as nutgrass, bermudagrass or morning glory. It is important to have an ample supply of good water available at all times.

Before planting, the soil should be moist and worked to form a good planting bed. If furrows are to be used for irrigation, they should also be established and tested for grade before planting. furrows should rarely be more than 100 feet long.

Planting distances should be adjusted for equipment (and other local considerations). The usual practice is to space the rows 3 feet apart and plant the seedlings 14 to 16 inches apart in the rows.

DIGGING THE SEEDLINGS

When the seedlings are ready to transplant, have the soil in the seedbed moist. Begin at one end of the bed, draw the soil away from the seedlings and remove them with as many small roots as possible. Use special care to leave the seed attached to the seedlings, otherwise they will not make satisfactory growth. Plant the seedlings immediately and protect them from drying at all times. They can be kept in moist burlap, moss or shavings for a short time. Discard all weak and off-type seedlings. They rarely produce good trees. Sort the good seedlings into 2 or 3 sizes and plant the different sizes in separate rows. This will give a more uniform and better-appearing nursery.

Seedlings with 4 and 5 leaves can be planted without reducing the leaf surface. Large seedlings will do better if half of each leaf is clipped off before planting. Do not clip or damage the growing tip.

Holes for planting are usually made with a large dibble. They should be deep enough to accommodate the whole root system without bending. If the holes are made deeper than necessary, the root can be inserted to the full depth of the hole and then lifted to the proper planting level. This will straighten the tender root tips and prevent formation of crooked tap roots. Plant the seedlings at the same level as they were in the seedbed and press the soil firmly around the roots and seed. When seedlings are grown in paper pots, it is necessary to remove the pot before planting. When seedlings are taken from the seedbed and planted in pots or other containers, it is best to dig them with a ball of soil around their roots.

As soon as the seedlings are planted, they should be watered to settle the soil. For late plantings, when sudden hot spells are expected, provide protection from the sun by placing a shingle on the south side of each plant. The seedlings should be irrigated again the day following planting.

CARE OF THE NURSERY

After the seedlings are established, irrigation will be needed every week to ten days. The success of the nursery depends more on careful irrigation than any other operation. The soil should be examined at frequent intervals to make sure it never becomes dry. This will keep the seedlings growing without interruption and produce the most desirable type of seedling for budding or grafting.

It is important to keep the nursery free of weeds. They compete with the seedlings and retard their growth. Be especially careful to keep noxious weeds out of the nursery; otherwise, state regulations may prevent moving the trees.

Fertilization will usually be needed. Use 1 lb. of a chemical nitrogen carrier to 150 ft. of nursery row as needed. This must be determined for each soil by the color and vigor of the seedlings.

Except in cool coastal areas, most seedlings will be large enough to bud by fall and the rest will be ready by spring.

BUDDING THE SEEDLINGS

Budding can be done in the fall or in the spring, as soon as the bark will slip. Budding can be done during the summer, but it is difficult to get a good stand. There is a tendency for the eye of the buds to fall out. Seedlings should be at least 3/8 inch in diameter where the bud is to be inserted before budding. Those which have not made vigorous growth or show diseased or off-type growth should be discarded. They usually produce poor trees.

The most difficult part of the job is to select suitable buds. They will be found on mature terminal growth that is not producing new growth. Those nearest the terminal end are usually best. Select plump dormant buds on mature wood. For late summer or fall buds, select new growth with fully expanded mature leaves. For spring budding, the best time to obtain buds is in late winter before growth begins.

Since varieties differ in growth habit, only experience will enable one to select the best buds for the various varieties. Some varieties bear good buds at most seasons. Others have acceptable buds only during short periods. Buds cut before spring growth begins can be kept in polyethylene bags at temperatures between 40 and 45 degrees for 1 or 2 months. When suitable buds are located, cut the leaves off 1/4 inch from the bud and keep the sticks in moist burlap till used or placed in storage. Always protect them from drying. It is often best to employ a professional propagator to bud the trees. This will insure a good set of buds and save time and money. However, with a little practice, most growers can bud successfully.

When the seedlings are ready to bud, use a sharp, thin-bladed knife with a rounded point. Make a T cut in the bark of the seedling at a smooth place on the seedlings, about 3 or 4 inches above the soil. The T cut may be either upright or inverted. When making the cut crossing the T, hold the knife at an angle so as to raise the edge of the bark slightly. This makes it easier to insert the bud.

Next, cut a bud from one of the budsticks with a single, smooth stroke of the knife. It is important to have the cut surface smooth. If the upright T is used, start about 3/4 inch below the bud and remove a shield-shaped chip about 1-1/2 to 2 inches long. Cut deep enough to take a sliver of wood under the bud. As the cut is completed, hold the top of the bud against the knife with the thumb and as quickly as possible insert the bud downward under the bark. Place it with as few movements as possible. Be sure the whole bud shield is under the bark. Bind the bud firmly in place. Cover all of the cut surface, but leave the eye of the bud exposed. Various kinds of budding tape are available, but plastic materials are best.

The wrapping can be removed from spring buds in about 6 weeks and from summer buds in about 4 weeks. Fall buds may be left 8 weeks or more before the wraps are removed. Always remove wraps before the stock is constricted. With fast-growing seedlings, it may be necessary to loosen the wraps in about 3 weeks to prevent constricting the stock.

At the time of budding, or shortly thereafter, remove the tip of the rootstock seedling. This will retard growth and help force the bud. When the wraps are removed, examine the buds to see if they have "taken". Successful buds will be green and the bud or eye

will be firmly in place. If the bud has taken, cut the seedling stock back to 10 inches above the bud to force growth.

When the bud has grown about 6 inches, tie it to the seedling stock for support. Trees are sometimes dug at this stage and planted in the orchards as "tied up buds". This gives good results, but requires more attention than standard trees. They must be given the same care in the orchard as described below for the nursery.

When the bud is ready for the second tie, the trees should be staked, using lath or 4-foot long 1/2 x 3/4 inch redwood stakes, which are available for this purpose. The buds grow rapidly and will need tying at frequent intervals. When the bud has grown 12 or 14 inches, the seedling stock can be cut off close to the bud union. This should be done not less than 2 weeks before the trees are to be dug. Use a coping saw or other fine-toothed saw. Slant the cut down and away from the bud union so the scar will heal quickly. Cover the wound with a good pruning compound, such as emulsified asphalt. Use care to keep all sprouts from developing on the rootstock. Trees can be dug any time after they are 18 inches high.

DIGGING THE TREES

Standard budded avocado trees are usually dug with a ball of soil about 10 inches in diameter and 14 to 16 inches deep. A special balling spade is used. Have the soil moist, but not wet. Insert the spade 5 inches from the tree trunk to a depth of 14 to 16 inches in 4 positions, so as to cut the roots on all sides and make a ball 10 inches in diameter. Next, remove the soil from one side of the ball, leaving the balling spade in place on the opposite side of the ball. Then, using a shovel, cut the bottom of the ball 14 to 16 inches below the soil surface. Remove the ball with the balling spade and lay it on a piece of burlap or material suitable for wrapping the ball. Burlap grain sacks are commonly used. One sack will make 2 wraps. Paper can be used if the trees are to be planted immediately.

To tie the wrap, slip the spade from under the ball and fold the wrap around the ball. Gather the wrap around the trunk of the trees and tie it in place as close to the soil surface as possible. Next, make 3 half hitches around the ball and pass the twine under the ball and up the opposite side to the trunk, where it is tied securely. Have the lower half hitch near the bottom of the ball to protect it from spreading when wet. Always lift the ball from the bottom, never by the trunk. The tree is then ready to plant. The trees can be handled with less damage to the balls if they are held in a shady place and watered lightly for several days. If trees are to be held for some time after digging, the twine used to tie the ball should be treated to resist decay.

GROWING TIP GRAFTS

Many avocado trees are produced by whip grafting seedling root-stocks when they are approximately 1/4 inch in diameter. This kind of tree is known as a "tip graft". Field grown seedlings can be tip grafted, but this is not common practice. Tip grafts are usually produced in a hothouse where temperatures can be maintained above 55 or 60 degrees F. Some growers maintain a soil temperature of 70 or 80 degrees by means of

bottom heat and pay little attention to air temperature⁴ By these methods, trees can be grown more rapidly (and possibly at lower cost?). Seed is planted as early in the fall as it becomes available, and the seedlings are grafted in late winter or early spring. The trees are usually ready to plant in the orchard by spring or early summer.

In cooler areas, where fruit matures later and trees develop more slowly, it is often desirable to store seed from the previous season for summer planting. This gives the seedling an early start so the trees will be ready for spring planting.

Tip grafts are also grown out-of-doors or in lath or cloth shelters. Cloth shelters are best because they exclude wind and maintain more favorable temperature. Seed planted in late summer or early fall will usually be ready to graft in spring and the trees will be ready to plant the following spring or early summer.

Since tip grafts are usually grown in tar paper pots, it is possible, by careful choice of soil and by using soil fumigation, to be more certain the trees do not carry soil-borne diseases. Tip grafts require more care after planting in the orchard, but this is offset by the lower initial cost and the reduced hazard of soil-borne diseases.

Seedlings that are to be tip grafted are usually grown in individual open bottom pots made of 30 lb. felt roofing paper. Some growers prefer 40-60 lb. roofing paper. The most popular size is 12 inches deep and 5 inches in diameter. They are made by cutting a roll of roofing paper into three 12-inch sections. These strips are then cut into lengths to give the size of pot desired. 18-inch pieces make 5-inch pots. The pots are made by rolling the pieces into cylinders, sealing the lap with hot tar or stapling the seams to hold them in place.

Some growers, especially those who produce trees without artificial heat, cut 90 lb. felt roofing paper rolls in two and make pots 18 inches deep and 6 inches in diameter to allow for greater root development. Pots this deep tend to buckle near the base unless given support. This support can be provided by cutting the top and bottom out of gallon tin cans, slitting the side, wrapping them around the pots and tying them in place with wire.

It is important to choose soil that has not been used to grow avocados or other crops subject to cinnamon root rot or Verticillium wilt. It must drain readily and remain in good condition under frequent irrigation. It is a good idea to pot some of the soil and see how it works before making large scale plantings. A sandy loam is usually preferred. Drainage can be improved by adding peat moss, compost or well-rotted manure. These materials sometimes contain excessive amounts of salt and should be checked before use. Clay loams can be used to advantage if treated with a suitable soil conditioner. Krillium, used at 1 lb. to 1500 lbs. of soil, has given good results. Avocados are usually sensitive to salty soils. Be sure the soil has a low content of soluble salts and always irrigate the pots so as to obtain adequate leaching.

To fill the pots, place about 2 inches of moist soil in the bottom and tamp it firmly so it will not fall out when the pot is handled. Complete filling the pot to within 1-1/2 inches of the top, making the soil firm but not too compact. To keep the soil in the pots from being contaminated by the cinnamon fungus, place them on a plank bench. If there is no infected soil in the area, gravel or sand beds are satisfactory. Before planting the seed,

it is often best to fumigate with a good fungicide after the pots are filled and in place, treating the whole bench. The seed may be planted directly in the pot, leaving the tip flush with the soil surface. Because avocado seed does not germinate uniformly, some growers prefer to sprout the seed in moist sand, moss or vermiculite. This practice is especially desirable with seed of questionable germination. Care must be used in planting the sprouted seed to avoid injury to the tender root. This practice insures more uniform development of seedlings and simplifies their care. The seed should be covered with 1/2 inch of clean sand, vermiculite or other suitable material to prevent drying and to keep a crust from forming on the soil. After planting the seed, irrigate at once. Examine die soil in the pots at frequent intervals and keep it moist at all times. It is important to keep the seedling growing vigorously without setbacks.

With most soils, some fertilization will be necessary. A convenient way is to dissolve 1/4 lb. of a chemical nitrogen fertilizer in 10 gals, of water and give each pot 1/2 pint. One application will usually be enough but it should be repeated if the trees do not retain a good green color.

GRAFTING THE SEEDLINGS

Seedlings are ready to graft when they are about 1/4 inch in diameter. The size must be determined by the scion wood available. The seedling and the scion should have about the same diameter. Slow growing or offtype seedlings should be discarded.

Select scion wood as described for budding, but have in mind the size of the seedlings to be grafted.

To make the graft, cut the seedling off 3 or 4 inches above the soil, making a smooth slanting cut about 1 inch long, depending on the size of the stock. Next, choose a scion about 2—3 inches long, with at least one good bud. Make a sloping cut on the base of the scion to match the cut on the seedling stock. A second cut is sometimes made on both scion and stock. Beginning about 1/3 of the way down from the tip of the stock and the base of the scion, make a cut about 1/3 as long as the first cut. This cut is not made with the grain of the wood, but is slanted somewhat across the grain toward the first cut. This cut is not necessary, but it is convenient for some because it holds the scion while it is being wrapped.

Fit the scion to the stock, as illustrated, and wrap firmly with plastic tape. Seal the end of the scion with asphalt emulsion or other good grafting compound. Under usual growing conditions, the wraps can be removed in 4 to 8 weeks when growth begins. Never leave the wrap on long enough to constrict the growth of the tree.

Tip grafts are ready to plant in the orchard when they are 12 to 18 inches high. Trees in 18" pots can be held till they reach larger size. At this point, discard slow growing or offtype trees, since they usually produce unsatisfactory trees in the orchard.

Trees, produced in a hothouse, should be hardened before planting. This can be done by moving the trees to a lath house or a location providing light shade. Allow enough space between pots so the trees do not shade each other. Planting can begin in 10 days or 2 weeks. After planting, the trees should be staked and cared for as described for standard nursery trees.