

**Cooperative Extension**

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## Avocado Production in Home Gardens

Avocados are grown in home gardens in the coastal zone of California from San Diego north to San Luis Obispo. Avocados (mostly Mexican varieties) can also be grown in the Monterey – Watsonville region, in the San Francisco bay area, and in the “banana-belts” in the San Joaquin Valley. Avocados are grown successfully in frost-free inland valleys in San Diego County and western Riverside County, but attention should be made to locating the avocado tree on the warmest microclimates on the property.



tolerant, staying hearty into the low 20’s.

Avocado trees can be protected from light frosts by placing a blanket on top of a structure built just a few inches above the canopy. In colder areas some people will have a

light bulb (to provide a small amount of heat) inside the canopy for protection during the night. Heat can also be supplied to the tree by running the water on the ground or through a mini-sprinkler all night.

Avocados are also sensitive to wind, which can cause fruit drop and defoliation. Trees should be located in protected areas.

Avocados become unproductive (poor fruit set and excessive fruit drop) if temperatures exceed 100°F for long periods of time. Avocados also set fruit poorly if daytime temperatures in the spring remain below 70 F for extended periods. Hot days (above 90 F) in late April or May will often cause excessive flower and fruitlet drop. Due to the heat and cold problems, avocados are not grown successfully in the desert regions.

**Climatic Requirements**

The Guatemalan race of avocado (includes varieties such as Nabal and Reed) are more frost-tender. The Hass variety (a Guatemalan/Mexican hybrid which is mostly Guatemalan) is also very frost tender; damage occurs to the fruit if the winter temperature remains at 30°F for four hours or more. Guatemalan/Mexican hybrids that are mostly Mexican, such as Fuerte, are a little more tolerant of frost, showing damage at 27°F after four hours. The hybrids that are mostly Mexican, such as Zutano and Bacon are more tolerant, indicating damage at 24 – 26°F for four hours. The Mexicola variety is the most frost

## **Soil Requirements**

A fine sandy loam with good drainage is necessary for long life and good health of the tree. It is better to have deep soils, but well-drained shallow soils are suitable if irrigation is frequent. Clay soils, or shallow soils with impermeable subsoils, should not be planted to avocados. Mulching avocados with a composted greenwaste (predominantly chipped wood) is highly beneficial, but manures and mushroom composts are usually too high in salts and ammonia and can lead to excessive root burn and "tip-burn" in the leaves. Manures should never be added to the soil back-fill when planting a tree.

## **Varieties**

The most popular variety in the coastal areas is Hass. The peel texture is pebbly, peel color is black at ripening, and it has excellent flavor and peeling qualities. Fruit can be size-picked (8 oz or larger) as early as January in San Diego. Fruit maturity is delayed in the more northern counties; Hass is usually not harvested until April or May in Santa Barbara and August to October in Watsonville. The Hass season extends into August in San Diego; if fruit is stored longer on the tree it often becomes rancid when ripening.

The Reed and Fuerte are also very popular in home gardens. Reed sets fruit well when no other avocados are nearby. Fuerte, however, often requires an avocado tree with an "A" type flower nearby to set a good crop. "A" flowers are a characteristic of Hass, Lamb Hass, Gwen, Reed and Topa Topa. The harvest season for Reed is July-October. The harvest season for Fuerte is November-June. Fuerte is alternate bearing and an inconsistent producer. (For more information on pollenizers and

pollination, please refer to "Pollination Facts" at the end of this publication).

A newer variety, 'Lamb Hass', appears to consistently set more fruit than Hass. The season is Hass-like, but is later; fruit does not appear to be ready for harvest until May-June in San Diego. Lamb Hass tends to set more fruit on the inside of the canopy, thus lending them more easily to pruning without substantially reducing the crop. It has not been determined how late the fruit will hang on the trees. (Lamb Hass is named after a grower, Bob Lamb, who helped the University screen thousands of seedling avocados for higher fruit production).

Bacon is the most frost tolerant of the popular varieties, but has a short season. Fruits are harvested December-January in San Diego and May-June in Watsonville. If Bacons are left on the tree too long the fruit develops a breakdown in the tissue and rot at the blossom end.

Zutano is a consistent producer, is somewhat frost tolerant, but eating quality is only fair. The fruit is often described as "watery". The harvest season is similar to Bacon. Zutano appears to be a good pollenizer tree for Hass.

Gwen can be a heavy producer, but is very intolerant to cold, heat, wind or drought. Gwen fruit mature later than Hass, with the first pick about May-June in San Diego. Gwen has a rough pebbly skin like Hass, but does not turn evenly black at ripening as does Hass. Gwen has a strong requirement for a pollenizer variety; Zutano is often used for cross-pollination.

## **Rootstocks**

Mexican seedling rootstocks (Topa Topa, Zutano) are normally used as

rootstocks due to good tolerance of cold soils. The Mexican seedling rootstocks do not have resistance to root rot (caused by the fungus *Phytophthora cinnamomi*) or saline water. Clonal rootstocks such as Duke 7, Thomas, Barr Duke, Toro Canyon or D-9 have some resistance to root rot. These rootstocks were selected from survivor trees in groves in Southern California where other trees had died from the disease, or from promising seedlings imported from Guatemala. Recent research has shown that rootstocks imported from South Africa, 'Dusa' and 'Latas' have even better resistance to root rot than those listed above.

Research is currently being conducted with West Indian selections developed in Israel that have been reported to have tolerance to salinity. West Indian or West Indian hybrids may have potential for rootstocks in the future, but only in frost-free locations.

### **Irrigation**

Irrigation is by far the most important cultural operation. It is important for the grower to know both frequency of irrigation and how much water to apply during an irrigation event. Frequent and relatively shallow irrigations (water penetrating at least 16" to 20" deep in the soil) are recommended on San Diego's sandy loam soils on the hillsides. Heavier soils require less frequent irrigation, but it is important that the shallow feeder roots not become excessively dry. (See attachment for amount of water a tree uses on a daily basis in San Diego inland valleys.) Although the attached table shows a historical quantity of water used by avocados on a daily basis, avocados are not watered every day. Rather, the frequency of irrigation is determined by feel of the soil (when a ball of soil starts to crumble in the hand) or by a tensiometer reading (usually 20cb to

25cb from a tensiometer set at 8" below to the soil surface in the wetted pattern of the sprinkler). For instance, if the tensiometer indicates that the soil reaches critical dryness in five days, and the chart indicates that trees are using about 30 gallons of water per tree per day, the grower would apply  $5 \times 30 \text{ gallons} = 150$  gallons per tree during the irrigation event. Recent research findings have indicated that the water requirement for maximum production of avocados in a grove is probably about 30-50% higher than that presented in this chart. However, in home garden situations, avocados often are able to steal water from neighboring plants.

A better way to determine water use in real time is to log onto the website [www.growers.avocadosource.com](http://www.growers.avocadosource.com) and get into the irrigation scheduling calculator under the "tools section". By using the CIMIS weather stations, one can estimate actual water use by a tree (based on the water use in the previous week) fairly accurately.

During peak water use months the soil should be leached every 4 to 5 weeks. This permits removal of salts from the root zone. A leaching irrigation can be accomplished by the homeowner by letting the hose or sprinkler run slowly for 24 hours under the tree. Avocados are sensitive to salts and these must be kept in a dilute state. By reducing the salt uptake in the tree, less tip-burn occurs, which means that the tree does not have to drop these leaves and grow new leaves during the early spring. More energy reserves are then available for fruit set and fruit development.

Irrigation is done predominantly through mini-sprinkler systems. Drip irrigation can be used successfully but large trees should have at least 8 – 10 drippers under each tree, and output from the sprinklers must match tree

use. Water use by the tree is controlled by factors in the environment (sunlight, temperature, humidity, wind speed and length of wind run), therefore changing an irrigation system to drip does not necessarily "save" water.

### **Fertilization**

The soil supplies most of the mineral elements necessary for growth, but nitrogen and zinc are often lacking and must be replaced by the grower with either chemical fertilizer or mulch/composted manure. Nitrogen deficiency results in a general yellowing color in the foliage. Rates of application are from a quarter pound (young trees) to 1.5 – 2.0 lbs (mature trees) of **actual nitrogen** per tree per year. Fertilizers most commonly used are calcium ammonium nitrate, ammonium nitrate, urea or calcium nitrate. Ammonium sulfate is not used on our slightly acid soils due to their tendency to make the soil even more acid.

Zinc deficiency is characterized by mottled yellowing between the veins, small leaves and more rounded fruit. Zinc sulfate (purchased from a farm supply store) is usually applied at the rate of 0.5 lbs per tree per year, scattered on the soil in the wetted pattern and watered into the soil. Alternatively, zinc sulfate can be applied at the rate of about 3 – 4 lbs per tree every five years.

In some situations, other elements may be lacking. Iron deficiency (causing sharp green veins against a yellow background between the veins) is common in calcareous soils. Iron, manganese, zinc and copper can be applied as a foliar spray in the late spring to supply minor elements. Commercial growers usually do leaf analysis in the late summer/fall to determine which elements, if any, are lacking.

Some long-term studies have indicated that yield may be improved with applications of phosphorous and potassium.

A basic fertilizer schedule used for mature trees in farm advisor trials is as follows:

Early February: 6 lbs triple 15 (15-15-15) applied per tree. (equals 0.90 lbs actual nitrogen)

June: 3 lbs calcium nitrate (15.5-0-0) applied per tree (equals 0.465 lbs actual nitrogen)

September: 3 lbs calcium nitrate (15.5-0-0) (equals 0.465 lbs actual nitrogen).

Total actual nitrogen for the year: 1.83 lbs.

Recent research has indicated that yield in Hass avocado may be boosted somewhat by an extra application of nitrogen (0.25 lb actual N/tree) in April and November.

### **Diseases**

Avocado root rot caused by the fungus *Phytophthora cinnamomi* is the most important disease of avocado. The disease is very common in commercial groves and in home gardens. This disease is made worse by poorly drained soils. Planting young trees in mounds to increase drainage, application of gypsum to the soil and applications of wood-based mulches to the soil all help reduce the severity of disease. New plantings should be made using the clonal rootstocks such as Dusa, Latas, Duke 7, Thomas, Toro Canyon, Barr Duke or D-9. Recent research data indicates that Dusa is the most resistant to avocado root rot.

A partially "resistant" rootstock is not enough to control the disease where trees in that location had died from

root rot. The soil around the trees should be mulched yearly with at least 3" of wood-based mulch (usually composted greenwaste), and gypsum should be applied to the soil at the rate of 25 lbs/tree (mature tree). A fungicide such as Aliette, Agri-fos or Fosphite (Phosphonate or phosphorus acid as the active ingredient) should also be used as a drench in the pot at the time of planting and as periodic soil treatments for bearing trees. Refer to <https://ipm.ucdavis.edu> for proper rates to use on avocados. Irrigation should be monitored carefully so as not to over-water, but under-watering can also cause harm to the root system and predispose the trees to more infection by the root rot fungi.

This disease is easily spread in water running down a hill from an infected tree above, or by mud on shoes, shovels, ladders and picking bins. It is important to use only clean equipment around new avocado trees.

Trunk canker caused by *Phytophthora citricola* is becoming more of a problem in avocados. The disease is initiated by injuries to the trunk and scaffold roots and is made worse by water hitting the trunk during irrigations. Experiments have shown that concentrated solutions of Aliette as a trunk paint on the canker (three applications two months apart) may control the disease. Gophers should be eradicated to avoid injuries to the upper scaffold roots.

Sunblotch is a viroid disease that causes sunken yellow blotches on fruit and stems. It can be symptom-less in the host; the only result is reduced fruit set and yield. The disease is spread through vegetative means, such as seed, budwood, root grafts and possibly pruning tools. There is no cure for this disease; infected trees should be removed.

## **Pest Control**

Persea mites cause necrotic spots on the bottom side of leaves, usually along the veins. As the population increases, new necrotic spots appear between the veins giving the leaf a "measles"-like appearance. Each spot is covered with fine webbing that shines silvery in sunlight. Heavy populations will cause leaf drop, especially if the trees are under-watered. For trees under stress by persea mites, extra fertilizer and water should be applied periodically through the summer to help the trees keep growing.

There are a number of predator mites and insects in the trees that feed on persea mites. Growers have tried to augment biological control with releases of the predator mites *Galendromus annectens* and *G. helveolus*, but this has met with mixed success. If leaf drop in the tops of trees is severe enough to expose fruit and branches to sunburn, then trees should be sprayed with wettable sulfur or 1.5% citrus 415 oil mixed in water. Care should be taken to spray up through the trees to wet the undersides of the leaves.

Avocado thrips are relatively new pests in California. These tiny yellow insects (about 1 mm in length) cause brown scarring on the young fruit, and darkening of the veins on the bottom side of young leaves. If the young fruit stay on the tree through the fruit drop period, they may have large patches of brown leathery peel at maturity. It may be necessary to spray the trees with sabadilla (Veratran-D) mixed with molasses (as a bait) during or just prior to the fruit set in the spring. Commercial growers use abamectin (Agri-Mek), spinetorum (Delegate), fenpropathrin (Danitol), or spinosad (Entrust, Success). Biological control of this pest appears to be increasing in

recent years and most people do not find it necessary to treat for this pest.

Brown mite feeds on the top side of leaves, leaving tiny brown spots. Although brown mite damage may look severe, it does not lead to loss in yield. By the time the grower notices the damage, the pest is usually under good biological control by Stethorus beetles (small black beetles that resemble a tiny ladybug).

Loopers occasionally feed on leaves and fruit, but are kept in check by spiders. Loopers may become a problem after a chemical spray kills the spiders, or a cold winter reduces the spider populations. All groves

have a resident population of loopers and we do not recommend attempts to control this pest. All pests in avocado are generally kept under control by parasites and predator mites and insects.

### **Soil Management**

Weeds should be controlled. Ornamentals and grass can be grown under avocados, but care must be taken to supply the trees with extra water and nitrogen. Cultivation should not be practiced under avocados because the feeder roots are shallow and will be cut or injured by rototillers and hoes. Mulching under avocados, especially with composted greenwaste, is highly recommended.

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## Pollination Facts

Avocado flowers set more fruit with cross-pollination; bees are the most efficient pollinating insects.

An avocado flower opens first as a female, then closes and opens later as a male. If pollination is not completed (with fertilization of the ovule to form a seed) the flower dries up and falls off. There are two types of flowers, Type **A** opens as a female in the morning of day 1, closes and opens as a male in the afternoon of day 2. Type **B** opens as a female in the afternoon of day 1, closes and opens as a male in the following morning of day 2. About half of the avocado varieties are Type A and half are Type B.

	<b>Morning</b>	<b>Afternoon</b>	
<b>A</b>	female		} Day 1
<b>B</b>		female	
<b>A</b>		male	} Day 2
<b>B</b>	male		

The situation in a grove with both Type A and Type B varieties would therefore be:

	<b>Morning</b>	<b>Afternoon</b>
<b>A</b>	female	male
<b>B</b>	male	female

With both flowering types and bees present in an avocado grove, maximum pollination is accomplished. Self-pollination by gravity, wind pollination or other small insects is thought to be uncommon, but there are research projects underway that are attempting to sort this out. The following cage study demonstrates the need of a pollinating insect for avocado fruit set. Two trees of each variety were caged with or without a small honeybee hive enclosed in the cage during the blooming season. All existing fruit and open flowers were removed from the trees at the beginning of the experiment.

### Number of fruit counted on each caged tree

	<b>Beeless</b>	<b>Bees</b>
<b>Zutano</b>	4	120
<b>Hass</b>	5	284

Wild honeybees are often infected with *Varroa* mite and cannot be depended on for pollination. Growers must consider establishing beehives in orchards to maximize production. Hives should be placed within the grove. If possible bees should be delivered after onset of bloom so that they don't get distracted by neighboring flowering plants. Control of weeds is also helpful in encouraging bees to forage on avocado flowers. Combined with the planting of A and B varieties, these strategies will help fruit yield.

## AVOCADO FLOWER TYPES

<u>Variety</u>	<u>Flower Type</u>	<u>Variety</u>	<u>Flower Type</u>
Alboyce	A	Linda	B
Anaheim	A	Lula	A
Arturo	B	Lyon	B
Bacon	B	MacArthur	A
Benick	A	Marshelline	B
Carlsbad	A	Mayapan	A
Clifton	B	Mayo (Covocado)	A
Collinson	A	Mexicola	A
Decem	A	Nabal	B
Diamond	A	Northrup	B
Dickinson	A	Nowels	A
Duke	A	Pinkerton	A
Edranol	B	Puebla	A
Elsie	B	Queen	B
Emerald	A	Regina	B
Ettinger	B	Rincon	A
Fuerte	B	Reed	A
Ganter	B	Ryan	B
Gehee	A	Santana	B
GEM	A	Sharpless	A
Gwen	A	Sir Prize	B
Harvest	A	Spinks	A
Hass	A	Sharwil (Kona)	B
Holiday	A	Stewart	A
Horshim	B	Topa Topa	A
Irving	B	Witsell	B
Jalna	A	Wright	B
Janboyce	A	Yama	A
Jim	B	Zutano	B

Compiled by Melissa Kimball and Gary Bender, UC Cooperative Extension, San Diego County, Feb. 1996, updated Aug, 2012.

**AVOCADO IRRIGATION REQUIREMENTS**  
(gallons/tree/day)

**Tree Spacing (feet): 20 x 20**

**Diameter of Tree Canopy**  
(feet)

	<b>20</b>	<b>16</b>	<b>14</b>	<b>12</b>	<b>10</b>	<b>8</b>
<b>MONTH</b>						
JAN	7	6	5	4	3	2
FEB	13	11	10	8	6	4
MAR	24	20	17	14	11	7
APR	41	35	30	24	18	13
MAY	49	43	36	29	22	15
JUN	59	51	44	35	26	18
JUL	59	51	43	35	26	18
AUG	52	45	39	31	23	16
SEP	38	33	28	22	17	12
OCT	24	21	18	14	11	7
NOV	14	12	11	8	6	4
DEC	8	7	6	5	3	2

This table represents the average daily evapotranspiration for avocados in San Diego County. These figures are intended to be used as a GUIDE and are based on average weather conditions. Irrigation system emission uniformity is estimated to be 81%. CIMIS Stations: Escondido

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