

– PRODUCTION GUIDELINE –

# Avocado

*Persea americana*



agriculture,  
forestry & fisheries

Department:  
Agriculture, Forestry and Fisheries  
REPUBLIC OF SOUTH AFRICA

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## GENERAL ASPECTS

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### Classification

Scientific name: *Persea americana*

Common names: Avocado, alligator pear (English); Aguacate, Palta (Spanish), Avokado (Afrikaans)

Family: Lauraceae

### Origin and distribution

It was suggested that avocados may have originated in southern Mexico but were cultivated from the Rio Grande to central Peru long before the arrival of Europeans. They were then carried to the West Indies and to nearly all parts of the tropical and subtropical regions with suitable environmental conditions. The distribution of avocado continued to the Philippines, to the Dutch East Indies by 1750 and Mauritius in 1780. Avocados were planted in Hawaii in 1825 and were common throughout the islands by 1910. It was first brought to Singapore between 1830 and 1840. It was introduced into Florida from Mexico by Dr Henry Perrine in 1833 and into California, also from Mexico, in 1871.

Vegetative propagation began in 1890 and stimulated the importation of budwood of various types, primarily to extend the fruiting season. It reached India in 1892 and was grown especially around Madras but

Bangalore has never become very popular because of the preference for sweet fruit.



Currently avocados are commercially grown not only in the United States but throughout tropical America and the larger islands of the Caribbean. Other countries involved in cultivation of avocados are Polynesia, the Philippines, Australia, New Zealand, Madagascar, Mauritius, Madeira, the Canary Islands, Algeria, tropical Africa, South Africa, southern Spain and southern France, Sicily, Crete, Israel and Egypt.

Early in the 17<sup>th</sup> century the Spaniards took the avocado to Chile, it was planted from the Peruvian border southward for over 1,600 km. It was reported that actual commercial plantings were not established until California cultivars were introduced in 1930 into two areas within 160 km of Santiago where the industry is now centred.

The first avocado's were planted in Israel in 1908, but named cultivars (Fuerte and Dickinson) were not introduced until 1924. These aroused interest in the feasibility of the crop for the southern coastal plain and the interior valleys, and development of the industry has steadily gone forward.

## Production levels and areas

### *South Africa*

Years	Volumes	Areas
2002/03	70 200	Mpumalanga
2003/04	55 000	Western Cape
2004/05	80 000	Limpopo
2005/06	60 300	KwaZulu-Natal
2006/07	50 000	Gauteng

### *Internationally*

Avocado was commercialised through the work of pioneers such as Dr Wilson Popenoe at the beginning of the 20<sup>th</sup> century and is now widely cultivated in many areas outside its centre of origin. In South Africa, Dr Hans Merensky (the founder of the organisation to which Westfalia Nursery belongs) initiated the first avocado orchards at Westfalia Estate in 1933. Presently the avocado is grown in the tropics on both sides of the equator and in subtropical regions up to 43° latitude. Approximately 76% of avocados are produced in America, 11% in Africa, 9% in Asia and 2% in Europe and in the South Pacific.

## Major production areas in South Africa

Avocado production in South Africa is concentrated mainly in the subtropical areas of Limpopo, Mpumalanga and parts of KwaZulu-Natal. Production in die provinces are as follows:

- Limpopo Province (59% of the national production)
- Mpumalanga Province (33% of the national production)
- KwaZulu-Natal Province (8% of the national production)





## Description of the plant

### *Growth habit*

The avocado is a dense, evergreen tree, shedding many leaves in early spring. It is fast growing and can reach 24 m, although usually less, and generally branches to form a broad tree. Growth is in frequent flushes during warm weather in southern regions with only one long flush a year in cooler areas.

### *Foliage*

Avocado leaves are alternate, glossy, elliptic and dark green with paler veins. They normally remain on the tree for 2 to 3 years. The leaves of West Indian varieties are scentless, while Guatemalan types are rarely anise-scented and have medicinal uses. The leaves of Mexican types have a pronounced anise scent when crushed. The leaves are high in oils and slow to compost and may collect in mounds beneath the trees.

### *Flowers*

Avocado flowers appear in January to March before the first seasonal growth, in terminal panicles of 200 to 300 small yellow-green blooms. Each panicle will produce only one to three fruit. The flowers are perfect, but are either receptive to pollen in the morning or shed pollen the following afternoon (type A), or are receptive to pollen in the afternoon, and shed pollen the following morning (type B). About 5% of flowers are defective in form and sterile. Production is best with cross-pollination between types A and B. The flowers attract bees and hoverflies and pollination is usually good, except during cool weather. Off-season blooms may appear during the year and often set fruit. Some cultivars bloom and set fruit in alternate years.



### *Fruit*

Guatemalan types produce medium, ovoid or pear-shaped pebbled green fruit that turn blackish green when ripe. The fruit of Mexican varieties is small (170 g) with paper-thin skins that turn glossy green or black when ripe. The flesh of avocados is deep green near the skin, becoming yellowish nearer the single large, inedible ovoid seed. The flesh is hard when harvested

but softens to a buttery texture. Wind-caused abrasion can scar the skin, forming cracks which extend into the flesh. “Cukes” are seedless, pickle-shaped fruit.

Off-season fruit should not be harvested with the main crop, but left on the tree to mature. Seeds may sprout within an avocado when it is over-matured, causing internal moulds and breakdown. High in monosaturates, the oil content of avocados is second only to olives among fruit, and sometimes greater. Clinical feeding studies in humans have shown that avocado oil can reduce blood cholesterol.

## **Cultivars**

### *Fuerte*

Pear shaped; small to medium or a little larger; skin slightly rough to touch, with many small yellow dots, thin, not adherent to flesh; flesh green near skin, 12 to 17% oil; seed small, tight. It is an early mid-season bearer, has an excellent flavour and is susceptible to fungal diseases.

### *Hass*

Pear shaped to ovoid; has a tendency to be undersized, except in New Zealand; skin tough, leathery, dark purple or nearly black when ripe; pebbled; fairly thin; flesh of good flavour, 18 to 22% oil, generally; seed small. Mid-late season, medium sized fruit with good shipping qualities. Excellent taste, heavy production, somewhat alternate bearing, increasingly popular with the European market.

### *Ryan*

Pear-shaped; of medium size, skin medium-rough; flesh of fair quality. Tree large and bears regularly but not as heavily as Fuerte or Hass. Late season, large seed, medium vigour tree.

### *Pinkerton*

Early crop, roundish; late, pear shaped with neck; of medium size, skin medium-leathery, pliable; flesh thick, up to 10% more than in Hass or Fuerte; smooth textured, of good flavour, high in oil, rated as of good quality but inferior to Hass and Fuerte; tends to darken in the latter part of the season; seed small, separates readily from the flesh with the coat adhering to the seed. Mid season, high yielding, occasionally post-harvest problems after storage.

### *Reed*

Round; medium to large, (227–510 g); skin slightly rough, medium-thick, pliable; flesh cream-coloured with rich, faintly nutty flavour; does not darken when cut; rated as excellent quality; seed small to medium, tight; coat adheres to seed. It bears early regularly; and is sensitive to cold.

### *Edranol*

Pear shaped; of medium size; skin olive-green, slightly rough, thin, leathery; flesh of high quality and nutty flavour and rated as excellent, 15 to 18% oil; seed small, tight. This cultivar is disease resistant.

### *Bacon*

The fruit is small to medium size, round-ovoid, smooth green, almost colourless, and seed cavity moulds rapidly.

## **Climatic requirements**

From climatological point of view, the best areas for commercial avocado production are therefore the cool, subtropical parts of Mpumalanga and KwaZulu-Natal situated at an altitude of 825 to 1 250 m, where the rainfall is fairly high and mist frequently occurs.

### *Temperature*

Commercial avocado cultivars are best suited to cool, subtropical conditions with average daily temperatures between 20 and 25 °C. Light frost can be tolerated but not during flowering and fruit set (August to September). Average temperatures during flowering and fruit set should preferably be above 18 °C.

The cultivars in increasing order of sensitivity to cold temperatures are: Edranol, Hass, Pinkerton, Fuerte and Ryan. For Fuerte, the daily mean temperature during flowering should preferably be above 18,5 °C, but definitely above 13 °C.

### *Rainfall*

All avocado cultivars that are grown commercially in South Africa are known to be sensitive to water stress. A well distributed rainfall in excess of 1 000 mm p.a. is desirable, although most avocado production regions experience a dry period during flowering. In the vast majority of cases, therefore, supplementary irrigation during this period is essential.

### *Humidity*

High humidity is desirable, as it decreases stress conditions, (particularly high temperature) especially during flowering and fruit set. However, humidity at this time is usually at its lowest, indicating the need for irrigation at this time.

## **Soil requirements**

### *Soil analysis*

Before making a decision to plant avocados on a particular soil, an analysis should be carried out to determine the chemical suitability of the soil, and indicate what amendments need to be made prior to planting.

### *Soil colour*

Only reddish-brown, red and dark-brown soils, particularly in the subsoil, are suitable. Temporary to permanent waterlogging with concomitant root rotting usually occur in yellow, grey, light-brown and white soils. Very dark and black soils usually have either a high clay content that could lead to poor root development, or a large percentage of organic matter that can lead to excessively acid conditions and aluminium toxicity. The aluminium toxicity can be rectified through liming.

### *Soil texture*

Avocados do best in soil with a clay content between 20 and 40%. If the clay content is below 20%, the soil has a limited water retention ability and unless optimum irrigation is applied, the trees will sometimes suffer from temporary drought. A high clay percentage makes irrigation difficult because over-irrigation and high rainfall lead to oversaturation of the soil. This means water drains away relatively slowly, which promotes root rot. At a higher clay percentage the resistance of the soil to root penetration is great and this adversely affects tree growth. An advantage of a higher clay percentage is that more water is available for the trees, which means that the irrigation cycles can be extended in accordance with tensiometer readings. The clay content can be up to 40%, provided the subsoil is apedal. In such soils the trees should be planted on ridges.

### *Soil structure*

In soils with a moderately to strongly developed block structure, i.e. soils that can be broken into hard clods when dry, root development will be re-

stricted. Ideal avocado soils display only small, fine cracks when a dry profile wall is examined—in other words, it has a poorly defined structure or micro structure. Soils with a prismatic or column-like structure are therefore quite unsuitable.

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## **CULTIVATION PRACTICES**

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### **Planting**

Spacing is determined by the habit of the cultivar and the character of the soil. In light soil, 7,5 x 7,5 m may be sufficient. In deep, rich soil, the tree makes its maximum growth and a spacing of 9,1 or 10,7 m may be necessary.

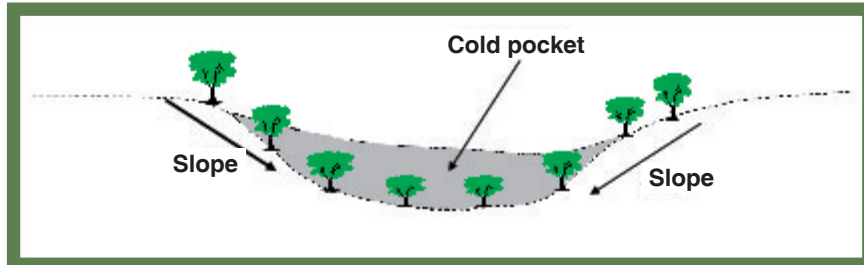
If trees are planted so close that they will ultimately touch one other, the branches will die back. Some growers plant 3 to 4,5 m apart initially and remove every other tree at 7 to 8 years of age. If the surplus trees are not bulldozed but just cut down leaving a stump, application of herbicide may be needed to prevent regrowth. Ammonium sulphamate has been proven to be effective. In modernised plantings, space between rows is necessary for mechanical operations.

Holes at least 0,6 m deep and wide are prepared well in advance with enriched soil formed into a mound. After the young plant is put into place mulch is beneficial, weeds should be controlled, and watering is necessary until the roots are well established. Keeping the upper soil moist has been greatly facilitated by drip irrigation, which also may carry 80% of the fertiliser requirement.

Because some cultivars tend to grow too tall for practical purposes, commercial growers cut trees back to 4 to 5,4 m, let them grow back to 9,1 m and top them again. However, decapitation is not a perfect remedy because the tendency of the avocado tree is to grow a new top very quickly. Avocado branches frequently need propping to avoid breaking with the weight of the developing fruit.

Some growers find it profitable to interplant bananas until the avocado trees reach bearing age.

Slope: Cold pockets will occur in low-lying areas such as the bottom of a valley as illustrated on the following page. It is important to remember that cold air is heavier than warm air. The cold air will accumulate in the lower-lying areas of an orchard, which could lead to frost damage. This should be kept in mind when establishing plums in areas that are prone to frost.



The steeper the terrain the more expensive orchard management becomes.

### Fertilisation

Commence feeding of young trees after one year of growth, using a balanced fertiliser, four times a year. Older trees benefit from feeding with nitrogenous fertiliser applied in late winter and early summer. Generally small quantities of fertiliser are given every 2 months with the quantity gradually increasing until fruiting begins. Bearing trees need, on the average, 1,5 to 2 kg three times a year, beginning when the tree is making vegetal growth. No fertiliser should be given at blooming time; one must wait until the fruit is firmly set.

Nitrogen has the greatest influence on tree growth, its resistance to cold temperatures, and on fruit size and yield. Fertiliser mixtures vary greatly with the type of soil. Mineral deficiencies determined by leaf analysis, are usually remedied by foliar spraying. Yellowed leaves (chlorosis) indicate iron deficiency. This can usually be corrected by a chelated foliar spray of trace elements containing iron. Mature trees often also show a zinc deficiency.

### Irrigation

Avocado trees may not need irrigation during the winter rainy season, but watch for prolonged midwinter dry spells. Overirrigation can induce root rot which is the most common cause of avocado failure. To test to see if irrigation is necessary, dig a hole 10-15cm deep and test the soil by squeezing.

If it is moist (holds together), do not irrigate; if it crumbles in the hand, it may be watered. Watch soil moisture carefully at the end of the irrigating season. Never enter winter with wet soil.

Avocados tolerate some salts, though they will show leaf tip burn and stunting of leaves. Deep irrigation will leach salt accumulation.

## Pests and diseases

Rats and squirrels will strip the fruit. Protect with tin trunk wraps. Leaf-rolling caterpillars (*Tortrix* and *Amorbia*) may destroy branch terminals. Avocado brown mite can be controlled by powdered sulphur. Six-spotted mite is very harmful; even a small population can cause large-scale leaf shedding. A miticide may be required if natural predators are absent.

Two fungi and one virus cause more damage than any other pests. Dothiorella (*Botryosphaeria ribis*) canker infects the trunk, causing dead patches that spread to maturing fruit, causing darkened, rancid smelling spots in the flesh. Flesh damage begins after harvest and is impossible to detect on the outside. Mexican types are immune to trunk cankers but the fruit is not. The disease is rampant near the coast and has no economical control method.

### Sunburn

Sunburn, sometimes called sunscald, typically occurs in the case of defoliation of trees, exposing fruit or previously shaded bark. Newly planted trees that grew with the bark shaded in the nursery, and trees that are unable to take up enough water because of unhealthy roots or inappropriate irrigation, are highly susceptible to sunburn. Prevent sunburn by providing trees with good growing conditions and proper cultural care, especially suitable volume and frequency of irrigation. Where feasible, prevent conditions that cause the foliage to drop prematurely, including *Phytophthora* root rot and high *Persea* mite populations. If trees are defoliated, do not irrigate until soil in the root zone approaches dryness. Defoliation reduces the trees' use of water, so the soil will remain wet longer than with unaffected trees. Examine the soil carefully and frequently and modify irrigation to prevent excess moisture in the root zone.



### Mediterranean fruit flies

Mediterranean fruit flies become a problem in avocado orchards when the fruit is mature (during the earlier stages



of fruit development the skin of the fruit is too tough for the flies to penetrate and lay eggs). In most cases the fruit is picked before it reaches the stage of maturity where the skin is soft enough to be stung.

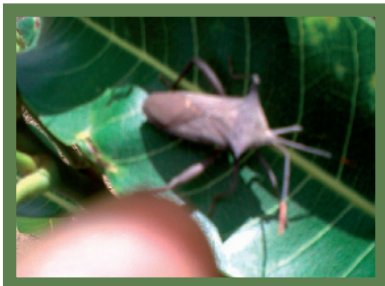
### *Mealybugs*



Male mealybugs resemble tiny flies, the females are wingless and covered with a powdery wax. They damage plants by sucking their sap and spreading disease. Ants spread mealybugs among the plants and protect them from many natural enemies. Out of doors, mealybugs constitute a greater problem in the south, because most species are tropical or greenhouse insects. They primarily affect fruit trees. Commercially available beneficial insects are the best control method for mealybug.

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### *Adult coconut bug*



The nymphs and adults of the coconut bug feed on young and mature avocado fruit. A lesion which is slightly darker than the rest of the fruit skin can be distinguished from about the second day after feeding takes place. With age the area becomes sunken and dark brown to black, much like a hail mark. Internally the lesion forms a typical hard clot. Damage by the coconut bug has mainly occurred on avocados planted next to macadamia and especially if the latter had been sprayed for the control of other stinkbugs.

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Root rot (*Phytophthora cinnamomi*) is a soil-borne fungus that infects many plants, including avocados. It attacks host plants, especially under moderate to warm, moist conditions. It infects the feeder root system, causing stunted growth, dieback of branches and eventual dying off of the plant. This can be controlled or eliminated by placing bait in or near the holes. A selection of a disease-free, certified plants and avoiding planting where avocados previously grew or where soil drainage is poor can also be effective. The disease is easily transported by equipment, tools and shoes from infected soils. Once a tree is infected (signs include yellowing



and dropping leaves), there is little that can be done other than to reduce watering.

### *Sun blotch*

Sun blotch is a viral disease that causes yellowed streaking of young stems, mottling and crinkling of new leaves and occasional deformation of the fruit. It also causes rectangular cracking and checking of the trunk, as if sunburned. It has no insect vector but is spread by the use of infected scions, contaminated tools and roots grafted with adjacent trees. It is important to use virus-free propagating wood.



### **Other cultivation practices**

Columnar cultivars require pinching at early age to form a rounded tree. Others need no training. Current orchard practice avoids staking. The best results are obtained by fencing the tree with plastic mesh for the first two to three years. Container and dwarf trees will need constant staking. The skirts of avocado trees are sometimes trimmed to discourage rodents; otherwise the trees are usually never pruned. Branches exposed to sun by defoliation are extraordinarily susceptible to sunburn and will surely die off. Such branches should always be whitewashed. It is better to avoid any pruning. Most cultivars are ill-adapted to the espalier method. They are too vigorous. Avocado fruit is self-thinning.

### **Harvesting**

Avocados will not ripen while they are still attached to the tree; while the fruit is on the tree, it remains hard. It becomes soft and edible only after it has been picked. Mature fruit ripen evenly. The edible part acquires a smooth, buttery texture and the peel shows no sign of shrivelling. Immature fruit, that is the fruit picked too early, will not ripen properly and the skin will eventually become shrivelled. The fruit that is regarded as matured is the largest fruit on the tree and is picked first. If picked when fully grown and firm, avocados will ripen in 1 to 2 weeks at room temperature. If allowed to remain too long on the tree, the fruit may be blown down by wind and will be bruised or broken open by the fall.

Formerly, avocados were detached by means of a forked stick and allowed to fall, however, this causes great damage and loss. Currently harvesters usually use clippers for low-hanging fruit. For fruit higher up on the tree a long-handled picking pole with a sharp “V” on the metal rim to cut the stem and a strong cloth bag to catch the fruit are used. Gloves are worn to avoid fingernail scratches on the fruit.

### *Harvesting precautions*

Workers should wear cotton gloves when harvesting fruit, to avoid scratch marks on the fruit made by their fingernails. The fruit should be cut off and not be pulled off from the trees. A section of stalk, measuring 10 to 15 mm, may be left attached to the fruit. Healthy fruit should be carried in canvas picking bags. The bag must be clean inside and contain no sand, twigs or any other material that may damage the fruit.

Not more than 10 to 15 avocados should be carried in such a picking bag at one time. Fruit high up in the tree may be reached by a tripod ladder, while even higher fruit may be harvested by a picking shoot. Use of suitable equipment will prevent fruit from being unnecessarily damaged; it will reduce labour and it is user friendly.

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## **POST-HARVEST HANDLING**

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### **Handling**

Fruit should be taken one by one from the picking bag by hand and placed into the trays. Transport to the packhouse must be undertaken with special care. The trays containing fruit and waiting for transport to the shed should be kept in the shade under the trees and if there is not enough shade, it should be covered with empty trays.

Do not spread a tarpaulin over the trays. This would hamper ventilation and might cause the temperature underneath it to rise. The harvested fruit should be removed from the orchard as soon as possible. It is important to pack and dispatch the fruit to the market, or to place it in cold storage, on the day it is harvested.

### **Grading and packing**

During grading and packing it is necessary to take precautions against bruising. All persons handling the fruit must wear gloves. The tables on which the fruit is placed must be clean and smooth. Each fruit stem must

be cut back with a knife to a length of 6 to 12 mm. At the same time the fruit is graded for export according to appearance. The avocados are suitable for export if they are virtually free of blemishes and have a regular shape. Avocados suitable for export are transferred to a different table. The avocados are then treated with a suitable post-harvest fungicide and after waxing, are packed with cellophane into a suitable box.

### Storage

To delay ripening, fruit must be at low temperatures if possible. The lower the temperature, the longer the fruit will take to ripen. However, storage temperatures that are too low will cause cold damage of fruit. A temperature of 5,5 °C is generally best. Early maturing avocados may be kept at a slightly higher temperature while late season fruit may be kept at a temperature that is slightly lower.

Ripening of avocados may be hastened by exposure to an atmosphere of at least 10 ppm ethylene 25 to 49 hours after harvest. The avocado does not respond to earlier treatment. Changes in pectin esterase activity and pectin content are being studied to measure ripening of avocados in storage. Dipping in latex has delayed decay in avocados stored at room temperature. Avocados ship well and are sent to foreign markets under refrigeration in surface vessels.

The avocados are subject to chilling damage (dark-brown or grey discoloration of the mesocarp) in refrigerated storage and degree of susceptibility varies with the cultivar and stage at harvesting and length of time in storage. Most commercial cultivars can be held safely at temperatures between 4,5 to 12,8 °C for at least two weeks. The best ripening temperature after removal from storage is 15,5 °C.

Removal of ethylene from controlled atmospheric storage of 2% oxygen and 10% carbon dioxide prolongs the marketable life of avocados. Reducing atmospheric pressure to sub-atmospheric 60 mm Hg in the refrigerated storage unit at 6 °C retards ripening of avocados by reducing respiration and ethylene production. Removed after 70 days, avocados have ripened normally at atmospheric pressure and 14 °C. Experimental calcium treatments have delayed ripening and reduced internal chilling injury in storage but made the avocados externally less attractive and they are, therefore, considered commercially undesirable.

Hass fruit dipped in fungicide 24 hours after harvest and sealed in polyethylene bags containing an ethylene absorbent (potassium permanganate on vermiculite or on aluminum silicate), has been successfully stored for 40 or 50 days at 10 °C. Waxed Fuerte avocados stored for 2 weeks at

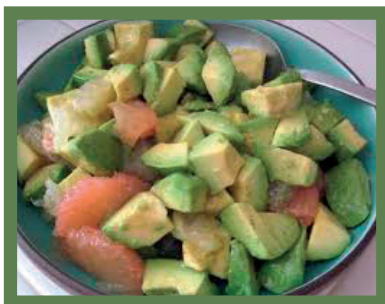
5 °C and ripened at 20 °C ripened only 1 day later than non-waxed fruit; however, waxing does reduce weight loss.

## PRODUCTION SCHEDULES

Activities	January	February	March	April	May	June	July	August	September	October	November	December
Soil sampling	X											
Soil preparation							X	X				
Planting	X	X	X						X	X	X	X
Fertilisation			X				X					
Irrigation	X	X	X	X	X	X	X	X	X	X	X	X
Pest control	X	X	X	X	X							
Disease control	X	X	X					X	X	X	X	
Weed control	X	X	X	X	X	X	X	X	X	X	X	X
Topping	X	X	X	X	X							
Leaf sampling			X									
Harvesting				X	X	X	X	X	X	X	X	X

## UTILISATION

### Food uses



Avocados are primarily served as salad vegetables, merely halved and garnished with seasonings, lime juice, lemon juice, vinegar, mayonnaise or other dressings. Often the halves are stuffed with shrimp, crab or other seafood. Avocado flesh may be sliced or diced and combined with tomatoes, cucumbers or other vegetables and served as a salad. The seasoned flesh

is sometimes used as a sandwich filling. Avocado, cream cheese and pineapple juice may be blended as a creamy dressing for fruit salads.

The flesh becomes bitter if it is cooked because of its tannin content. Diced avocado can be added to lemon-flavoured gelatin after cooling and before it is set, and chunks of avocado may be added to hot foods such as soup, stew, chilli or omelettes just before serving. A ripe avocado is placed on the table when a hot dish is served and the diner scoops out the flesh and adds it just before eating.

### Avocado oil

Oil expressed from the flesh is rich in vitamins A, B, G and E. The oil has excellent keeping quality. This oil is used as hair-dressing and is employed in making facial creams, hand lotions and fine soap. It is said to filter out the tanning rays of the sun, is non-allergenic and is similar to lanolin in its penetrating and skin softening action.

The pulp residue after oil extraction can be used as stockfeed.



### Medicinal uses

The fruit skin is antibiotic; is employed as a vermifuge and remedy for dysentery. The leaves are chewed as a remedy for pyorrhoea. Leaf poultices are applied on wounds. Heated leaves are applied on the forehead to relieve neuralgia. The leaf juice has an antibiotic activity. The aqueous extract of the leaves has a prolonged hypertensive effect. The leaf decoction is taken as a remedy for diarrhoea, sore throat and haemorrhage; it allegedly stimulates and regulates menstruation. It is also drunk as a stomachic. In Cuba, a decoction of the new shoots is a cough remedy. If leaves, or shoots of the purple-skinned type, are boiled, the decoction serves as an abortifacient. Sometimes a piece of the seed is boiled with the leaves to make the decoction.

The seed is cut in pieces, roasted, pulverised and given to overcome diarrhoea and dysentery. The powdered seed is believed to cure dandruff. A piece of the seed or a bit of the decoction, put into a tooth cavity may relieve toothache. An ointment made of the pulverised seed is rubbed onto

the face as a rubefacient to redden the cheeks. Oil extracted from the seed has been applied on skin eruptions.

### Other uses

The seed yields a milky fluid with the odour and taste of almond. Because of its tannin content, it turns red on exposure, providing an indelible red-dish-brown or blackish ink which was used to write many documents in the days of the Spanish Conquest. These are now preserved in the archives of Popayan. The ink has also been used to mark cotton and linen textiles.

Large quantities of avocado wood are available when groves are thinned out or tall trees are topped. The wood has been utilised for construction, boards and turnery. An Australian woodworker has reported that it is suitable for carving, resembles white beech (*Eucalyptus kirtonii*); is easy to work, and dresses and polishes beautifully. It has been made into fancy jewel boxes. It probably requires careful seasoning.

Honeybees gather a moderate quantity of pollen from avocado flowers. The nectar is abundant when the weather is favourable. When unmixed by pollen from other sources it produces a dark, thick honey favoured by those who like buckwheat honey or sugar-cane syrup.

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Further information can be obtained from

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