

AVOCADO CULTIVATION

by

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Common Name: Avocado
Scientific Name: *Persea americana* L.

Introduction

Avocado belongs to the family Lauraceae which is composed of 50 species. It is an evergreen tree found in tropical and subtropical areas. Cultivated species of avocado are native to Mexico, Central America and South America. There are three horticultural races of avocado that reflect the centre of origin i.e. the West Indian race native to West Indies (Central America and Northern part of South America); Guatemalan race; and the Mexican race. It is an ancient fruit and constitutes part of the diet in the countries of origin. The fruit spread to North America in the 18th century and the old world in the late 19th century.

Climatic and soil requirements

In the tropical regions, avocados can be grown at an altitude of about 1500 to 2100 meters a.s.l. The tree has very low frost resistance and as such it will not grow where frost is likely to occur. The Mexican race and its hybrids. The West Indian varieties and their hybrids (Tonnage, Simmonds, Booth 7 and 8) are suitable for hot and humid coastal lowlands

Rainfall

Rainfall should not be less than 1000 mm and should be well distributed. High moisture content and light showers at the time of flowering and fruit set will ensure good yields. Where supplementary water is through irrigation, it should be light and frequent and not more than 50mm at a time.

Temperature

The West Indian race (Hass) requires an optimum temperature of 25 –28 °C

Soils

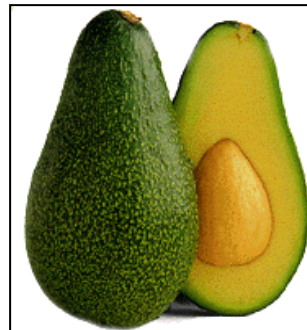
The avocado grows successfully in many types of soils provided the soil is deep, permeable and

free draining. The soil should have adequate moisture retention and a pH of 5.5-6.5. Waterlogged soils favor the development of root-rot caused by the fungus *Phytophthora cinnamomi*. The tree has very low salinity tolerance.

Varieties:

Table 1. Commercially important cultivars in Kenya and their characteristics.

Cultivar	Production	Remarks
Fuerte – (A hybrid between <i>Guatemalan</i> and Mexican races)	Fruit matures 6-8 months after flowering.	It is the most popular cultivar for export in many parts of the world. Fruits are green, slightly pebbled with good flavour. Skin is thin and the seed is medium and conical.
Hass (<i>Guatemalan race</i>)	It matures 8-9 months after blossoming.	A vigorous upright tree and is a consistent bearer. The fruit is green at early stages and then brown on maturity. Very slightly pebbled, pear-shaped. Skin is thin and leathery.
Nabal (<i>Guatemalan race</i>)	It matures 8-9 months after blossoming.	Fruit is green, smooth, almost spherical or slightly oval. Flavor is good. Bears in alternate years.
Puebla (<i>Mexican race</i>)	It matures 5-7 months after blossoming	A spreading, dark green tree. Fruit is deep maroon purple, smooth, glossy and roundish. Seed is medium sized and somewhat conical. Flavor is good. In this country, Puebla fruits are sold locally and the seedlings are used as rootstocks for most cultivars.



A

B

Figure 1. A=Hass and B = Fuerte (The two most important commercial varieties)

Nursery Propagation

Rootstock

Avocado should preferably be propagated by grafting onto rootstocks that are resistant to *Phytophthora* root rot, and are tolerant to saline and calcareous soils. Select healthy egg sized seeds and plant them in boxes or seedbeds with adequate drainage. Plant the seed with the broad side down. Immediately after germination (takes 3 to 4 weeks) transplant the seedlings into 6' x 9' tins, pots or polythene bags. Water them until they attain a pencil size thickness at which stage they should be grafted.



Grafting

Many methods including cleft or side wedge grafting, whip and tongue can be used but the top wedge-grafting method is the most successful one. Grafting should be done at the point where the rootstock is soft and tender. The scion should be dormant at the time of grafting and should match the size of the stock. Wrap firmly with a polythene strap to exclude water from the graft union. Keep the grafted material under shade.

Grafted seedlings have the following advantages:-

1. Come into bearing 3 years earlier than ungrafted ones.
2. Tends to spread out as compared to ungrafted ones, which tend to grow upright.
3. Tend to be shorter and thus easier to harvest or spray.
4. Maintain the desirable characteristics of the mother plant e.g. fruit quality.

Grafting Methods

Top wedge or cleft grafting

Procedure

1. Make a 3 cm wedge cut into the scion (Figure 2a)
2. Make a 3 cm cut into the rootstock. Ensure that all cut surfaces are smooth.
3. Fit the scion and rootstock and align scion and rootstock cambium (Figure 2c).
4. Tie and wrap the graft union with plastic wrap. A plastic bag may be used to cover the scion and graft to prevent desiccation.

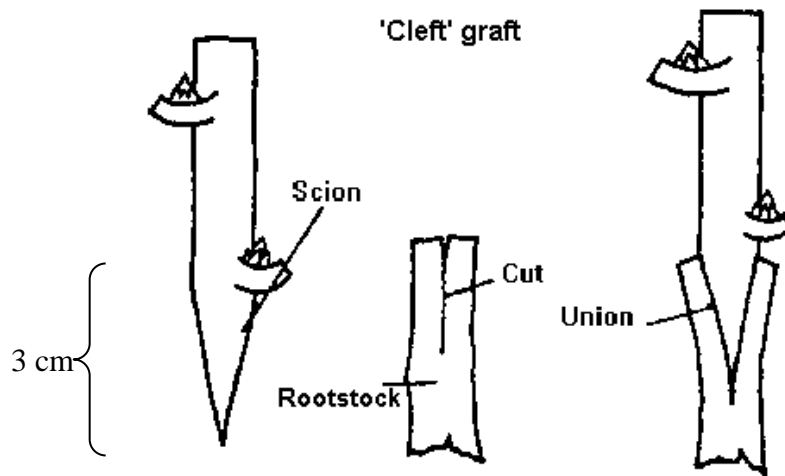


Figure 2c. Top wedge grafting of avocado.

Whip and tongue graft

Procedure:

1. Make a 1 to 2 inch slanting cut into the rootstock and a “tongue” cut 1 inch from centre of slant. Repeat this with scion (Figure 3a)
2. Fit the scion and rootstock and align scion and rootstock cambium (Figure 3b).
3. Tie and wrap the graft union with plastic wrap. A plastic bag may be used to cover the

scion and graft to prevent desiccation (Figure 3 c).

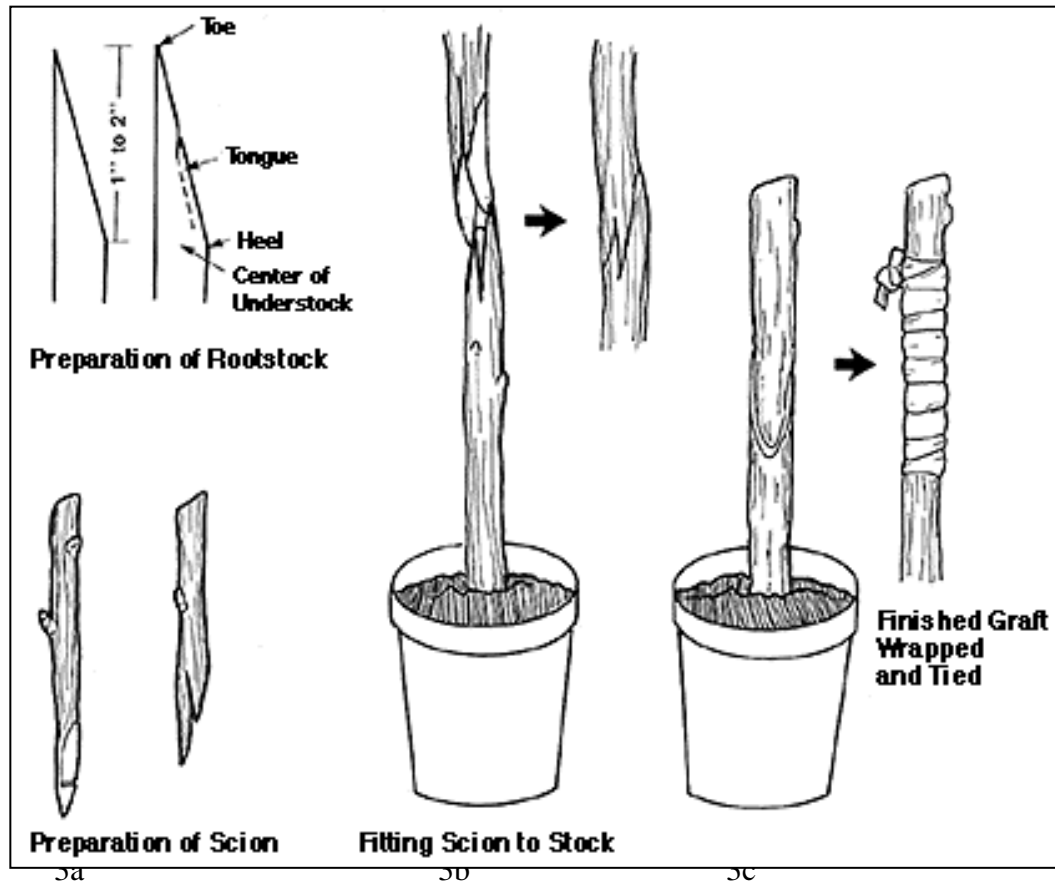


Figure 3c. Whip and tongue graft of avocado.

Side wedge graft

Procedure:

1. Make a 5 cm sloping cut on one side of the scion (Figure 4a)
2. Make a 5 cm cut into the rootstock exposing the cambium (Figure 4b)
3. Fit scion and rootstock (Figure 4c)
4. Tie the union tightly with a grafting tape.

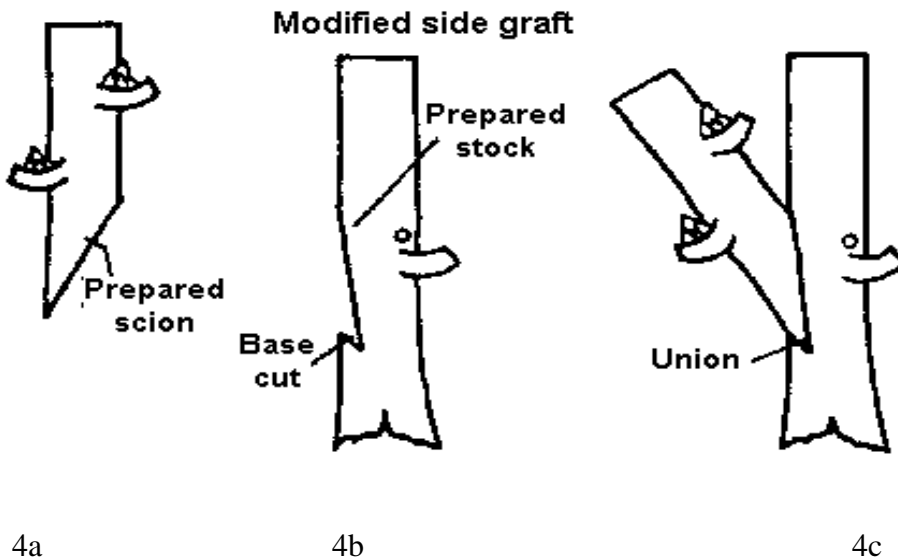


Figure 4. Side wedge grafting

Orchard establishment

Grafted plants should be hardened for two weeks under direct sun before planting. Dig holes 60 cm x 60 cm x 60 cm (length x width x depth). Mix 30 kg (2 debe) of decomposed manure and 120 g of TSP with the topsoil. Fill the hole with the mixture. Carefully remove the plant from the container with the soil intact and place it at the center of the hole and firm the soil around the plant. Water the plant immediately after planting.

NB: Cover crops (legumes or grain) can be planted a year before the orchard is established to increase the organic matter content and to minimize soil erosion and root rot.

Spacing

Spacing of trees depends on the variety, types of soil and climatic conditions. Generally the recommended spacing for Fuerte varieties is 9 x 9 meters (123 trees per hectare). Varieties with upright growth habit such as Bacon may be spaced at 8 x 6 meters (208 trees per hectare).

Wind break

A windbreak should be established a year before planting the trees to protect the plants from the wind. The windbreak protects the plants from leaning over to one side and also from the wind

damage such as shedding the leaves, fruit drop and bruising of fruits.

Fertilization

Nitrogen is the controlling factor of avocado yields. At the onset of each long and each short rains remove mulch and scatter manure and fertilizer (Table 2).

Table 2. Fertilizer requirements¹ of avocado.

Age in Years	CAN (g)	Triple Super Phosphate	Muriate of Potash	Manure (kg)
1-3	125	225	-	15
4-5	225	450	-	15
6-7	450	650	225	30
8-9	650	650	450	30
10-14	900	1000	635	
15+	1300	1200	650	

¹ per avocado tree

Table 3. Some minor elements of importance in avocados

Deficiency	Symptoms	Correction
Zinc	Zinc deficiency causes mottled leaves with light yellow areas between the veins and abnormal development of growing shoots. In a more severe stage, stunted and misshaped leaves and twigs are observed. At this stage tree growth, may be retarded and fruit production reduced. In Fuerte, for instance, fruits may become round rather than the normal pear shape.	The deficiency may be corrected either with 0.5% Zinc Sulphate (ZnSO ₄) plus 0.25% Hydrated lime (Ca (OH)) or 0.2% Zinc oxide or by application of 250g Zinc sulphate for each year of age, upto maximum of 4.5kg. The application should be done in a 60cm strip around the drip of the tree.
Manganese	Leaves have light coloured spots that sometimes become necrotic. Areas between the smallest veins turn chlorotic and in advanced stages only	Manganese deficiency is controlled by foliar spray of manganese sulphate. As with the Zinc, spray when the leaves are young.

	the larger veins remain green.	
Iron	Iron deficiency causes chlorosis of the leaves.	Iron deficiency is corrected by application of Iron Sulphate at the rate of 250gms per 10 litres of water. In acid soils Iron-Chelate at the rate of 360gm per tree will correct iron-deficiency.
Chlorine	High concentrations of chlorides in the soil may cause scotching of the leaf (leaf-tip-burn). The roots are also damaged by high concentrations of chlorides.	Avoid high chlorinated water

NB: Soil analysis to determine the type and rate of fertilizer to be applied must be done before any fertilizer use recommendation is given. Quantity of manure and fertilizer application is dependent on the fertility status of the soil and the age of the trees.

Pruning

Formative pruning is needed in avocados to shape the tree. Growing tips of young plants should be pinched to promote a more compact tree. Lower branches should be removed if they interfere with irrigation or general field hygiene. Vegetative and reproductive growth should be avoided from occurring at the same time. Avocado should be allowed to continue increasing in size to be more productive. However, internal branches and dead twigs should be removed. The tree is very susceptible to the sunburn and for this reason it is not advisable to prune too severely. Heavy pruning is only used to reduce the size of the tree after many years of growth.

CROP PROTECTION

Diseases

Root Rot

This disease is caused by the fungus *Phytophthora cinnamomi* Rarels. The fungus thrives best in soils with excess moisture. Seed infection may occur if the fruit is allowed to remain for several days on soil infested with the fungus. Spread to new areas is infected seed, infected soil and container plants. The host range of the fungus includes Acacia, Eucalyptus and Grevillea.

Symptoms

Trees of any size from nursery trees to large, out trees may be affected. Longitudinal, distinctly sunken strips, of yellow or sometimes reddish colour appear on smaller stems and on fruits. The dead brown leaves hang for a long time and affected tree may suddenly collapse. More commonly, the tree yield gradually decline; leaves become smaller, and paler

yellow-green, then drop. The twigs and branches die back. Feeder roots are necrotic, black and brittle.



Figure 5. Trunk rot caused by *Phytophthora* on avocado

Control

- Improve soil drainage to avoid excessive moisture in the soils.
- Remove and destroy all infected trees
- Prevent movement of soil from diseased to non infested areas
- Use cultivation equipment in disease free areas before the diseased areas
- Carefully select ornamental crops to avoid alternative hosts
- Seeds picked from the soil should be treated in hot water (50⁰C for 20 min).
- Use a resistant variety as rootstock eg. Puebla

Chemical

- Used melalaxyl (Ridomil) at the rate of 20-35g per m² of canopy area as a soil drench at monthly intervals in newly infected trees

Fruit spots and Rots

These three diseases, scab, cercospora spot and anthracnose are caused by the fungi; Scab (*Sphaceloma Perseae Jenkins*, *Cercospora spot (Cercospora purpurea Cke)* and anthracnose (*Colletotricchum gloeosporioides Peenz*). Although all the above tree diseases also attack the leaves their prime importance lies in the damage done to fruits and only this aspect will dealt with.

Fruits are only susceptible to scab from flowering until about half size development. The fungus requires moist conditions for sporulation and infect so the fruits may escape infection when the conditions at fruit setting are dry and warm. Cercospora spot occurs under very humid conditions and when the temperatures are high humidity exists. Spores are essentially splash dispersed through under wet conditions they can wind borne. Infection is through lenticels, mature fruits are resistant. Symptoms are slow in appearing, often as much as three weeks after infection. (Figure



Figure 6. Lesion of scab on avocado fruit.

The anthracnose fungus lives saprophytically on twigs, rotten fallen fruits and dead or drying leaves but is generally unable to infect undamaged fruits. During wet weather when the fungus sporulates, the spores are spread by splash and infect only damaged fruits.

Anthracnose caused by *Colletotrichum gloeosporioides* is a very important fruit pathogen of avocado that also infects leaves.

Symptoms

Fruit rot begins as small, dark discoloration and slightly sunken spots (Figure 7). The disease rapidly spreads into the flesh.



Figure 7. Cross section showing fruit rot caused by anthracnose into avocado fruit.

Control

Use copper based fungicides e.g. Copper oxychloride and Kocide DF during fruit development.

INSECT PESTS

Systates weevil (*Systates pollinosus*)

This is a black insect that feeds on the leaves especially when the plants are young leaving characteristic indentations on the edge of the leaves. It feeds only at night and rests under the mulch or loose soil at the ground level in the daytime.



Systates weevil damage on Avocado leaves

Control

Cultural-Hand pick and destroy the insect

Chemical-Use Deltamethrine as recommended on the label.

Red Scale (*Aonidiella spp*) Soft brown scale

These suck the plant sap and in severe infestation cause complete distortion of the leaves with consequent drying and dropping off.



a



b

Figure 8. Red scales (a) on avocado fruit and Soft brown scales on avocado branch (b).

Control

Spray with Folimat + DC – Tron Plus (Caltex oil).

Important notice: *Read the label on the pesticide container carefully and use the manufacturer's recommended rate. This applies to all the above mentioned pest control products.*

Post-Harvesting handling and Utilization

The maturity indices of avocados vary according to varieties. For the Fuerte variety, the fruit remains green after maturation but glossy shine appearance disappears. The skin is smooth at the blossom end. For Hass variety, the fruit turns from green to purple and the skin gets rougher with cork-like spots on the peel. If the fruits are harvested immature they shrivel and rot during ripening and will lack the desirable flavour of more mature fruits.

Fruits are picked from the trees with a pole-picker (a knife attached to a pole) or using a ladder placed against the main trunk. Fruit on the ground branches can be picked from the ground. Dropping of the fruits on the ground should be avoided to prevent damage.

A section of the stalk (0.5-1.0cm) should be left on the fruit. Harvested fruits should not be exposed to direct sunlight. They should be kept in the shade at all times.

Diseased and bruised fruits should be removed. The fruits should be cleaned to remove dirt on the fruit. Avocado fruits are graded according to size and weight. They are all packed in a single layer in corrugated fibre board of 4kg. The boxes must have adequate ventilation for effective cooling and air circulation.

It is not easy to tell when the fruits are ready for harvesting especially with variety like Fuerte, which do not change colour on maturity. To determine whether the fruits are ready for picking, harvest a few fruits and keep them at room temperature. If the fruits soften within a week to ten days without shriveling then the fruit of that age should be ready for harvesting. Fruit should not be pulled from the stalk but be cut living 3-cm stalk.

Hot water treatment

The purpose of this treatment is to kill the fungal spores on and in the skin of the fruit. To this end, the avocados are immersed for three to five minutes in water heated to a temperature of 50 °C

Utilization

Avocado is eaten as fresh fruits in fruit salad, avocado juice and as a flavouring ingredient in ice-cream. Oil is extracted from avocados, which is used in industries to process perfumes and also for cooking. Avocado paste is also used in processing of avocado

salads.

Nutritive Value

Avocado fruit has high nutritional value. It is composed of 3% sugar, 1-2% minerals (potassium, P, mg and S), 2-4% protein, 5-50% oil and it is also rich in vitamin B and A and traces of C, D, and E.