



Directorate Communication



National Department of Agriculture

## Cultivation of avocados

Avocados are rich in protein, carbohydrates, vitamins and minerals while the oil content consists of polyunsaturated fatty acids. One half of a Fuerte fruit supplies a considerable percentage of the daily nutrient requirements and makes an important contribution to a balanced diet.

### Buyer's guide

The quality of the trees grown in the nursery determines the success of an enterprise. Trees that received poor or incorrect treatment in the nursery will lag behind in the orchard, no matter how carefully the buyer tends them, and may die easily.



### ***Container and root development***

- The size of the containers in which the plants are grown, is important.
- The smaller the containers, the greater care will be needed after planting out the trees in the field to ensure their survival.
- The larger the container, the better the root system will have developed and the greater the chances of successful establishment.

## **Growth medium**

- A clay soil mix tends to clog the drainage holes in plastic containers.
- Lighter soil mixes improve drainage and stimulate the development of the root system.
- Where mixes are too light, the soil is washed out easily through the drainage holes, resulting in exposure of the roots.

## **Foliage**

- The foliage of a tree indicates its health status. A healthy tree has a glossy, dark-green colour.
- Deformed or discoloured leaves are an indication that the tree has not developed normally during the nursery period. It may also be a sign of disease.
- The leaves must be inspected for the presence of insect pests and any deficiency symptoms.

## **Graft union**

- Any graft union that exhibits excessive thickening at the union, or large differences between rootstock and scion thickness, indicates incompatibility, a poor rootstock or a diseased scion.
- A first-grade tree should exhibit a smooth union, with few or no irregularities on the stem, either above or below the graft union.

## **Climatic requirements**

The 3 best-known avocado races each has specific climatic requirements as a result of adapting to their original environment.

**West Indian cultivars** originated in the humid, tropical lowlands of Central America and are best adapted to continuous hot, humid conditions with a high summer rainfall. Like all avocado cultivars they are, however, extremely sensitive to drought and do not tolerate frost well (minimum temperature of 1,5 °C). The optimum temperature for growth is 25 to 28 °C. The humidity should preferably be above 60 %.

The **Mexican races** originated in the cool, subtropical highland forests of Mexico and mature trees can withstand temperatures of - 4 to -5 °C. They should not be planted in areas prone to frost in August and September, because flowers are damaged easily by frost. A humidity range of 45 to 60 % should suffice. The optimum temperature for growth is 20 to 24 °C.

**Guatemalan cultivars** originated from the tropical highlands of Guatemala and require a cool, tropical climate without any extremes of temperature or humidity. The trees can withstand light frost, down to - 2 °C, but the flowers are very sensitive to frost. High temperatures of about 38 °C, especially if combined with low humidity, could cause flower and fruit drop. A humidity level of 65 % or higher is required.

- The Fuerte cultivar, which is the most popularly grown cultivar in South Africa, is probably a natural **hybrid** between the Mexican and Guatemalan races and has a wider climatic tolerance (especially to cold) than the pure Guatemalan types.
- The minimum survival temperature is about - 4 °C, but no frost is tolerated during flowering.
- The optimum growth temperature is 20 to 24 °C, and high temperatures, especially during flowering, are not tolerated well.
- It is more sensitive than others to unfavourable weather conditions during flowering. Hot, dry conditions could result in low yields because of fruit and flower drop.

## **Temperature**

- Cool subtropical conditions with a mean daily temperature of 20 to 24 °C.
- Light frost can be tolerated, except during flowering and fruit set (August and September).
- For Fuerte, the daily mean temperature during flowering should preferably be above 18,5 °C, but definitely above 13 °C.

## **Humidity**

- A high humidity is desirable, because it decreases stress conditions (particularly high temperature), that play an important role during flowering and fruit set.
- The mist-belt areas of South Africa are especially suitable in this regard. The humidity should exceed 50 % at 14:00.

## **Rainfall**

All avocado cultivars grown commercially in South Africa are sensitive to water stress. An annual rainfall exceeding 1 000 mm is desirable, and it should be well distributed, with the only dry period in June and July. However, most of the suitable areas in South Africa experience a dry period during flowering, necessitating supplementary irrigation.

## **Wind**

Avocados tend to have brittle branches that are damaged easily by wind. The majority of blemishes causing a downgrading of fruit most probably also result from wind damage.

From a climatological point of view, the best areas for commercial avocado production are therefore the cool, subtropical parts of Mpumalanga and the Northern Province as well as KwaZulu-Natal where the rainfall is fairly high and mist occurs frequently.

## **Soil requirements**

A healthy avocado tree has a root system that can penetrate the soil to a depth of 1 m. Root rot (*Phytophthora cinnamomi*) can develop fairly quickly in poorly-drained soils. It is therefore essential to determine in advance the suitability of the soil for avocado production.

## **Methods of soil examination**

Soil can only be examined by digging profile holes at least 1,5 m deep in areas where there are different soil characteristics. Even if the soil on the surface appears to be fairly homogeneous, it is still advisable to dig at least one profile pit per hectare.

In hilly areas holes must be dug in different positions along the slope to get an indication of the drainage properties of the area. For example, it may be necessary to dig drainage furrows in the lower-lying areas to prevent water from accumulating above the restricting layers.

Aspects of concern when digging a profile pit are colour, texture, structure, patches, concretions and stones, as well as soil depth.

## **Colour**

- Only reddish-brown, red and dark-brown soils, particularly in the subsoil, are suitable.
- Temporary to permanent waterlogged conditions with concomitant root rot 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 could result in excessively acid conditions and aluminium toxicity.

### ***Texture***

Avocados do best in soils with a clay content of between 20 and 40 %. If the clay content is below 20 %, the soil has a limited water-retention capacity and unless optimum irrigation is applied, the trees will sometimes suffer temporarily from drought.

A too high clay percentage makes irrigation difficult because overirrigation and high rainfall lead to oversaturation of the soil. This means that water drains away relatively slowly, which promotes root rot.

### ***Structure***

In soils with a moderate to strongly developed block structure, such as soils that can be broken into hard clods when dry, root development will be restricted. Ideal avocado

soils display only small, fine cracks when a dry profile wall is examined.

### ***Patches***

If a light-coloured layer with many patches occurs within 1,8 m below the soil surface, root problems can be expected, especially with irrigation. Such a soil can be regarded as a moderate to high-risk avocado soil.

### ***Concretions and stones***

The same requirements concerning depth apply to black concretions (iron and manganese) in light-coloured soil. If concretions and stones occur as a type of gravel and form more than 30 % of the volume of a soil layer, the water-retention ability of that layer will be adversely affected, and irrigation practices will have to be adjusted accordingly.

### ***Chemical soil properties***

- Information on aspects such as pH (water), exchangeable quantities of sodium (Na) and the quantity of free lime present are obtained from chemical analyses of sampled soil from profile pits.
- The pH value (in water) of avocado soils should be between 5,0 and 7,0. Only at great cost and over a long period will it be possible to change pH values below 3,5 to make the soils suitable for avocado production.

## **Avocado cultivars**

Avocado growers should produce high yields of good-quality fruit, acceptable to the consumer. There is, however, no single cultivar that can fulfil all the requirements of the grower, the packer, the retailer and the consumer at the same time.

## ***Fuerte***

Good production potential

<b>Flowering and harvesting months</b>		
	<b>Warm regions</b>	<b>Cool regions</b>
Flowering:	June - September	July - October
Harvesting:	March - August	May - November

### **Tree characteristics**

- Tree growth habit: large and spreading
- Hardiness: tolerates temperatures as low as - 4 °C

### **General**

- Limitations: alternate bearing, sensitive to microclimate for fruit set
- Comments: fruit set increased by a pollinator
- Post-harvest storage: susceptible to physiological disorders during storage

## ***Hass***

Good production potential in cool areas. Fruit is smaller in warm areas.

<b>Flowering and harvesting months</b>		
	<b>Warm regions</b>	<b>Cool regions</b>
Flowering:	July - September	August - October
Harvesting:	June - October	August - December

### **Tree characteristics**

- Tree growth habit: fairly upright, slow grower
- Hardiness: tolerates temperatures as low as - 2 °C

### **General**

- Limitations: fruit becomes too small with age and in warm regions
- Comments: susceptible to environmental factors
- Post-harvest storage: good

## ***Pinkerton***

Consistent heavy bearer.

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Flowering and harvesting months		
	Warm regions	Cool regions
Flowering:	September - October	
Harvesting:	June	July

### Tree characteristics

- Tree growth habit: moderately spreading
- Hardiness: tolerates temperatures as low as - 1 to - 2 °C

### General

- Limitations: flowering and fruit set over extended period
- Comments: fruit may develop internal disorders if picked when overmature
- Post-harvest storage: pick at optimum maturity stage to avoid post-harvest problems

## Ryan

Good production potential; bears heavily and fairly consistently

Flowering and harvesting months		
	Warm regions	Cool regions
Harvesting:	September - December	November - February

### Tree characteristics

- Tree growth habit: fairly upright, medium grower
- Hardiness: frost tolerant

### General

- Limitations: poor quality, fruit sometimes does not become soft
- Comments: suitable for planting in drier inland areas
- Post-harvest storage: average

## Soil preparation

It is important to examine the soil for suitability regarding depth, drainage and compacted layers (see Methods of soil examination).

A representative sample of the proposed orchard must be taken for soil analysis. It is desirable to take the soil sample at least 9 months, but preferably 12 to 24 months prior to planting. This gives the farmer enough time to prepare the soil thoroughly, particularly if large quantities of lime are required.

### Soil sampling

It is important that a sample represents a soil of homogeneous characteristics, i.e. where no visible differences in the soil occur. If there are differences regarding colour and texture in such a land, the land must be subdivided accordingly and separate samples taken of the different parts.

A soil auger or spade can be used for taking samples.

### ***Depth of sampling***

This should be from 0 to 0,3 m for topsoil and 0,3 to 0,5 m for the subsoil sample.

### ***Number of samples***

A sample must be made up of at least 10 subsamples (preferably more). The area represented by the complete sample should not exceed 3 ha.

### ***Mixing and packaging***

- The subsamples from a particular land must be pooled in a clean container (not a fertiliser bag) and mixed thoroughly.
- A 2-kg sample is taken from this, placed in a clean plastic bag or other suitable container and submitted for analysis.
- Every sample must be marked clearly. The name of the sender, number of the land and depth at which the sample was taken, must appear on the label.
- Attach the label to the outside of the container.
- The analysis results will supply valuable information regarding fertilisers to be applied before planting. If required, lime or phosphate should be thoroughly worked into the soil before planting.

### ***Method of soil preparation***

- The soil must be loosened as deep as possible before planting. In this case it will not be necessary to make large planting holes.
- If the soil is very acid, heavy lime applications may be necessary. About two-thirds of the recommended agricultural lime must be distributed over the entire area 12 months before planting, mixed into the topsoil by disking and ploughed in as deep as possible.
- Calcium (lime) moves very slowly in the soil, and should therefore be worked into the future root zone of the trees.
- A cover crop can then be planted and ploughed in 6 months later to increase the organic-matter content of the soil.
- The remaining lime and all the required phosphate must be applied and lightly worked in simultaneously. The trees are planted 3 months later.
- If soil samples have not been taken early enough to proceed as described, two thirds of the lime must be mixed with the soil and ploughed in deeply. Phosphate and the rest of the lime should then be distributed and worked into the soil lightly. If large quantities of lime are required, this must be applied at least 3 months before planting (as described), thoroughly mixed with the soil and then worked in deeply.
- If the soil depth is inadequate but still acceptable, it is recommended to make ridges of approximately 0,5 m high and about 3 m wide. The trees are then planted on these ridges.
- It is important not to fertilise recently-planted trees too soon. The trees must first become well

established and start to grow vigorously before any fertiliser is applied. In most cases it would be advisable to wait a year. These applications must be very light. The fertiliser must be applied evenly and should not come into contact with the stem of the tree. Immediate irrigation is required.

## Layout of orchard

An avocado orchard should be profitable within 7 to 10 years.

There are 3 patterns according to which trees can be arranged in an orchard:

- Rectangular (which leads to hedge-type tree rows)
- Square (which leads to a change of direction when thinning diagonally)
- Diamond-shaped (which also results in a change of direction of tree rows with every thinning).

If trees are spaced in such a way that no thinning will be necessary during the lifespan of the orchard, only slightly more than 50 % of the land is utilised. Effective land use therefore, means that the trees are initially spaced close together, to be thinned systematically and selectively at a later stage.

There is, however, no proof that any specific layout is the best. The choice of planting distance and the pattern of planting depends on the following factors:

- Cultivar
- Location of orchard (e.g. north or east facing)
- Soil type and depth
- Expected short and long-term production
- Access for machinery, depending on orchard practices
- Thinning practices.

The final decision must be based on economic principles, because each of the aspects mentioned has an influence on the ultimate economic value of an orchard.

### ***Planting distance and planting pattern***

The choice of a planting pattern (rectangular pattern discussed here) depends on the management practices followed.

- Early yields are maximised by planting trees close together in the row.
- Hedge-type tree rows are more suitable for installing a permanent irrigation system.
- Where implements are constantly used in orchards, the hedge-type layout is more suitable because access to the orchard is possible for a longer period of time than it is in a square layout. Traffic is also always moving in the same direction in such an orchard—an important point in orchards planted on a slope.
- The hedge-type tree-row layout minimises the effects of the loss of branches and trees in a row.

### **Interrow spacing**

Economic considerations and access for implements determine interrow spacing of trees. Final distances of less than 10 m will necessitate thinning before the orchard is 10 years old. High-density plantings can therefore be planted at less than half the "final" distance on the understanding that trees



in the semipermanent rows are removed timeously.

## **Planting and early care**

- Avocado trees bought from a nursery should already have been hardened off.
- Plant the trees as soon as possible; if kept too long they may become root-bound or suffer from nutrient deficiencies.
- Do not place the trees in the sun because the containers will become hot and the roots could be burnt even before planting.
- Support the young trees with sturdy props as soon as possible after planting. Make sure that the stems are whitewashed.
- Remove the nursery tags and surplus graft strips after planting to prevent girdling.

### ***Planting hole***

- If the soil has been well prepared, big planting holes are unnecessary.
- If it is not possible to prepare the soil properly, a planting hole of 1 x 1 x 1 m should be made.
- A well-prepared orchard does not require extra fertiliser in the holes. The addition of especially poultry manure could easily burn the roots.
- Plant the trees to the same depth that they were in the planting bag.
- The trees should preferably be planted in a slightly-raised position so that water cannot collect in the basin.

### ***Irrigation***

- Young trees must be irrigated to ensure a uniform stand.
- Overirrigation is just as harmful as too little water.
- Examine the soil moisture content of the subsoil regularly to prevent overirrigation.
- Avocados are sensitive to moisture stress. In the nursery the trees would have been accustomed to regular water applications and still have a limited root system as a result of the small bag. It is therefore essential that the water reaches the limited and shallow root system.
- A small basin around the tree will ensure that the roots get enough water.
- Apply frequent light irrigations: 50 l/tree/week and 100 l as soon as the subsoil starts drying out, and then resume watering at 50 l/week/tree.

### ***Shade***

- Where hardening off has been inadequate (in the nursery) temporary shade should be provided.
- Remember to whitewash the stems.
- Erect a frame covered with grass or shadenetting over the trees to protect the leaves. Remove the frame as soon as the leaves penetrate the grass because then they have become hardened off and need no further protection.
- Structures erected to protect the trees against animals, also provide shade.

### ***Protection against animals***

- Trees are often damaged by wild animals at night. A screen that will keep the animals out can be made by covering poles with chicken wire and building a tent-like structure around the trees.
- Termite control will be necessary during droughts.

## Cover crops

- During the early years of an orchard a cover crop will protect and maintain the soil until the trees start providing shade.
- A cover crop must not, however, compete with the trees and must be restricted to the strips between the tree rows.
- The drip area of the tree must be free of grass and other weeds and, if possible, this area should be covered with an organic mulch.
- Plastic covers are suitable for young trees, but irrigation management must then be very effective and accurate to prevent overirrigation.

## Leaf analysis

Leaf analysis indicates the nutrient status of an orchard. The trees can be fertilised accordingly. Soil analysis, in addition to leaf analysis, increases the reliability of the recommendations made.

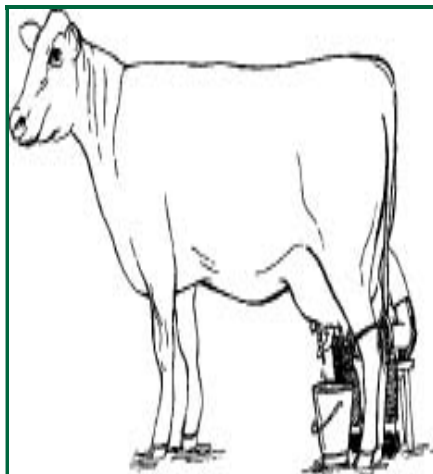
The following aspects of leaf sampling must be followed strictly:

- Samples of 6 to 8-month old avocado leaves must be taken during February to April. If they are not taken during this period, the fertilisation recommendations will not be reliable.
  - The correct leaf must be sampled (see figure).
  -
- When a leaf sample from a particular orchard is submitted for the first time, it must be accompanied by a soil sample. Thereafter, it would also be advisable to submit soil samples annually.
- When making fertilisation adjustments, the analysis results of both the soil and the leaf samples have to be considered.
  - Only leaves from healthy trees must be sampled. They must not show any signs of sunburn, deficiencies, insect damage or disease.
  - A leaf and soil sample must not represent an orchard of more than 3 ha. Should soil variations be apparent in such an orchard, separate leaf and soil samples must be taken.

Sample

New growth

Old growth



## Sample the correct leaf

The sampling method is important:

- Select approximately 20 healthy trees well distributed throughout the orchard, homogeneous in appearance and representative of the orchard.
- Exceptionally good or poor trees must not be sampled.
- The trees must be marked clearly, e.g. with paint, so that both the soil and leaf samples can be taken from the same marked trees every year.

To obtain a meaningful fertilisation programme for a particular orchard, leaf samples must have been analysed for a period of at least 5 years.

It is not always possible to rectify deficiencies, excesses, or imbalances within one season because it is a gradual process.

## Fertilisation

- Do not fertilise young, transplanted avocado trees too soon, preferably only after one year. The trees must first become well established and grow vigorously.
- Never apply fertiliser against the stems of young trees. It must be spread evenly about 0,2 m from the stem to approximately 0,5 m outside the drip area of the tree.
- Each fertiliser application must be followed by a light, controlled irrigation.
- Fertilisers must not be worked into the soil.

### Quantity of fertiliser per year per tree according to age (guidelines)

Age (years)	LAN (28 % N) (or equivalent) g	Superphosphate (11,3 % P) g	Potassium chloride (50 % K) g
1	150	200	150
2	300	400	300
3	450	600	450
4 - 5	600	900	600
6 - 7	800	1 200	800
8 - 9	1 000	1 500	1 000
10 - 12	1 200	1 800	1 200
Maximum	1 500	1 800	1 500

## Time of application

### Nitrogen and potassium

If fertiliser is applied in the first year, nitrogen (N) and potassium (K) must be divided into at least 4 applications and applied during the warm months. Thereafter the application times are as follows:

- N and K: 3 equal applications in July, December and April.
- P: December.

## Zinc

Most soils are either naturally low in zinc or the zinc is not available. The following quantities should therefore be applied annually:

- Zinc oxide at 200 g/100 l water, or
- NZN at 150 ml/100 l water.

## **Boron**

Many avocado orchards are also low in boron and the trees should be sprayed every year with 100 g borax or 75 g Solubor/100 l water.

## **Irrigation**

Avocado trees are very sensitive to waterlogged conditions as well as to drought stress.

The aim of irrigation is therefore to maintain the soil-moisture content between these two extremes, except in June and July when a drier period is required to stimulate flowering.

The purpose of avocado farming is to obtain optimum yield and reduced vegetative growth from an orchard.

By applying half the calculated volume of water per tree after the moisture-stress period (June/July), new growth is retarded, competition with the young fruit is restricted and fewer fruit will abort.

After fruit-set full irrigation is applied to encourage a flush for fruit growth.

No fertiliser should be applied during flowering and early fruit-set, because it would also encourage vegetative growth, which competes with the young fruit for nutrients and water.

### ***Irrigation systems***

Light, frequent irrigations are necessary. A flood irrigation system is therefore not suitable. A sprinkler system, particularly dragline, is more suitable, especially if capital is limited. The best type for avocado orchards is undoubtedly one of the daily-flow types, preferably microjet irrigation.

## **Weed control**

Weed control can be done by either mechanical or chemical methods.

### ***Mechanical***

There are 3 types of mechanical weed control:

#### **Hand or mechanical slashing**

Care should be taken when hand slashing is used not to cause injuries to the tree trunk. In time mechanical slashing will lead to compaction and ripping will have to be considered to promote root growth.

#### **Disking**

This method is not recommended as feeder roots are continually damaged and soil is compacted just below the depth of cultivation.

## **Ploughing and ripping**

Both methods loosen the soil, especially heavy soils. These should, however, not be practised at intervals shorter than 2 years, because root growth will be arrested too often. Ploughing displaces the compacted layer to just below the depth of the plough while ripping can break up compacted layers if it is done when the soil is relatively hard and dry.

## ***Chemical***

Herbicides that control the entire weed spectrum in an orchard must be used. Therefore, the weed species and their relative abundance in the orchard should be determined before selecting a herbicide.

## **Cover crops and mulching**

Cover crops are temporary crops, grown for the purpose of improving the soil, either as soil protection or to be disced in as green manure.

The summer crop reduces soil temperature, thereby promoting avocado root growth. It also produces a mulch for winter and controls weeds.

A cover crop prevents erosion and the loss of plant nutrients.

A leguminous cover crop enhances the nitrogen content of the soil.

Decayed cover crops increase the humus in the soil.

The time of planting a cover crop depends on the needs of the tree and the supply of available moisture. In seasons where good rains are experienced, the cover crop should be planted early, but in periods of drought the trees will need all the available moisture in the soil, and planting should therefore be delayed.

In young orchards it is possible to plough and prepare a seedbed between the tree rows, but as the trees grow older hand planting becomes the obvious method.

## ***Kinds of cover crops***

Cover crops can be divided into leguminous (nitrogen-fixing) and nonleguminous crops. Leguminous crops include various types of beans, while rye, oats, barley and buckwheat are examples of nonleguminous crops.

The following crops can be considered:

Conditioning the soil before orchard establishment: velvet beans, soya-beans, sunnhemp, ration beans, lupins\*, medics\*, cowpeas.

Planting after orchard establishment: velvet beans, soya-beans, ration beans, cowpeas, lupins\*, medics, wheat, rye, barley, teff, vetches, desmodiums, groundnuts, buckwheat.

\* requiring winter irrigation

## **Avocado pests**

Avocado producers must be familiar with the insects that occur in orchards as pests. Most of these are controlled by natural enemies. The injudicious use of agrochemicals on avocado trees could, however,

allow minor pests to develop into major economic risks.

## ***Fruitflies***

This pest has only recently gained economic importance in avocados. When the fruit is picked before it is ripe, the larvae never reach maturity. However, if the fruit remains on the tree for extended periods, as in the home garden, fruitflies may occasionally develop to maturity.

## **Symptoms**

The Natal fruitfly attacks both young and older fruit.

It lays its eggs just under the skin surface.

When the fruit is about golfball size, a sting lesion appears as a slight puncture mark surrounded by white powdery exudate. As the fruit develops the lesion becomes dry and distinct star-shaped cracks in the skin surface occur.



When the surface layer of skin around the lesion are removed with a pocket knife, the underlying tissue will appear bruised and, on further dissection using a 10 x magnifying lens, longitudinal white eggs, about 0,5 to 1 mm in length, should be found clustered together.

## **Control**

The few natural enemies of the fruitfly cannot control the problem effectively. There are 2 methods of control, namely:

### **Eradication of unwanted host plants**

The Natal fruitfly also infests other host plants, such as bugweed or bugtree, bramble and wild-growing guavas which often constitute a significant proportion of the indigenous bush surrounding avocado orchards. These plants should be eradicated in an area of up to 200 m or more around the orchards. They should be cut down to 200 mm above the ground. A suitable herbicide should be applied as soon as the plants have regrown to about 0,5 m.

### **Baiting**

Using poisoned bait to lure the flies should be considered if damage exceeds 5 %. The chemicals used in this process are, however, detrimental to the parasitoid-predator balance in the orchards.

## ***Heart-shaped scale***

This insect grows to about 3 mm and has a reddish-brown colour. A white, woolly edge can be seen at the rear end of the adult female.

The female lays cream-coloured eggs which are kept underneath the body in the white, woolly secretion. More than 200 eggs have been counted underneath one female at a single count.

The young scales, known as crawlers, eventually become permanently fixed in one spot. In this way the new leaves become infested. There are 2 generations per year. The summer generation lasts 5 months and the winter generation 7 months. Crawlers are produced mainly during November and April.

The scales occur on the back of avocado leaves where they suck the sap from the leaves.

Fruit is never attacked, but the scales secrete considerable quantities of honeydew, landing on the leaves, branches and fruit on which sooty mould grows, causing a black discoloration of the plant and fruit and interfering with photosynthesis.

Dust blown from dirt roads alongside avocado orchards settles on the trees, creating conditions that are unfavourable to the natural enemies of the scale. Therefore greater numbers of scales occur in such areas.

The heaviest infestations occur on trees of the Hass cultivar.

Wasps, ladybirds, larvae of a lacewing and a fly species (Cecidomyidae) play an important role in the biological control of this scale.

As a result of the many natural enemies, chemical control is usually not necessary.

## Avocado diseases

### Phytophthora root rot

Root rot, caused by *Phytophthora cinnamomi* occurs worldwide. Locally it is one of the most important avocado diseases and is found in all production areas, as well as home gardens. The severity of infection varies, but the potential loss is very big if no control measures are taken.

### Symptoms

- When infected, the entire tree assumes a bare appearance.
- Leaves are smaller, paler in colour, turn yellow, wilt and then drop off.
- Tree growth is retarded and the fruit tends to remain small, showing symptoms of sunburn, as a result of a lack of foliar shading.
- Infected feeder roots turn black and become brittle as they die off.
- Where the disease is severe, virtually the entire feeder-root system may be destroyed and the tree dies as a result of water stress.

### The pathogen

Dispersal of the pathogen requires free-moving water. It is therefore important to avoid planting avocados on soils that are prone to waterlogging. The fungus has a very wide host range, which includes papaya, granadilla, macadamia and various ornamental species. If possible, planting of avocados on lands previously used for alternate hosts should be avoided.

### Control

Avocados should not be established in areas where waterlogging is a problem.

Planting material should be disease free.

Irrigation should not leave water standing on the soil surface, particularly around the trunks. Sprinklers and microjets are therefore preferred to flood irrigation. Avoid overirrigation.

### Stem canker

This is another form of *Phytophthora* infection, but it may be caused by *P. citricola*, *P. cactorum* and *P.*

*cinnamomi*.

## Symptoms

- Discoloured bark, close to ground level. The brown discoloration extends into the wood.
- Infected trees normally pine away slowly, but may die off suddenly.

## Control

Do not cause injuries to the stems near ground level and avoid constant wetting of the stem.

Where lesions occur, remove dead tissue and cover with a bituminous sealant.

## **Anthracnose**

This is a pre as well as a post-harvest problem and can cause serious losses. It is present in most, if not all, production areas of the world.

## Symptoms

- The most important symptom, economically, is fruit spotting.
- The lesions are brown in colour and may enlarge, coalesce and eventually cover large areas of the fruit surface. Such fruit often drops prematurely.
- The pulp beneath the lesions becomes soft and discoloured, rendering the fruit inedible.
- Where leaves are infected, a brown necrotic band spreads inwards from the margin, and in severe cases, it may spread through the petiole into the branch.
- Branches then show brown or purple lesions and may die off.
- Infected flowers turn red or brown and drop off later.

## Control

A registered post-harvest dip is available specifically for anthracnose control. It should be applied in the packhouse. Control of *Cercospora* spot should also give good control of anthracnose.

## ***Cercospora* spot**

This is a fruit-spotting disease, caused by the fungus *Pseudocercospora purpurea*.

## Symptoms

- Brown fruit lesions, 3 to 5 mm<sup>2</sup> but irregular in shape, develop initially. The lesions dry out and crack, creating entry points for secondary pathogens.
- Individual spots are small (1 mm<sup>2</sup>), brown and angular. They remain scattered or may coalesce.

## Control

Several chemicals are registered for use against this disease. These programmes will also help to control sooty mould.

Always consult product labels before any chemicals are applied.



Consult the latest issue of *A Guide for the Control of Plant Diseases* for information on chemical disease and pest control. It is obtainable from the Resource Centre, Private Bag X144, Pretoria 0001

## Handling avocados

### **Picking**

- While the fruit is on the tree, it remains hard.
- It becomes soft and edible only after picking.
- A mature fruit ripens evenly. The edible part acquires a smooth, buttery texture and the peel shows no sign of shrivelling.
- Immature fruit, that is fruit picked too early, will not ripen properly and the skin will eventually become shrivelled.

### **Picking maturity**

The maturity of the fruit is closely related to moisture content. The fruit is normally ready to be picked when it has a moisture content of about 80 % or less.

The following procedure may be applied to determine maturity:

- Pick a representative sample of fruit which has already attained the average mature size of the cultivar concerned.
- Store the fruit at room temperature until it ripens. An avocado is ripe when it yields slightly to light pressure applied on its entire surface.
- If these samples ripen within 8 to 10 days and do not shrivel, the fruit may be considered mature. Selective harvesting of similar fruit may then begin.
- If the fruit takes more than 10 to 12 days to ripen, the ripeness test may be repeated a week later.
- Experience is an important factor in determining the picking maturity. Not all the fruit on the tree will reach the same degree of maturity simultaneously.
- If there is any doubt, it is better to wait than to harvest prematurely.

### **Harvesting**

Always handle fruit carefully during harvesting and packing because avocados are bruised and scratched easily.

### **Precautions**

- Labourers should wear cotton gloves when harvesting fruit, to ensure that their fingernails do not scratch the fruit.
- The fruit should be cut off and not pulled 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 bags must be clean inside. No more than 10 to 15 avocados should be carried in such a picking bag at one time.
- Fruit high in the tree may be reached by a tripod ladder, while even higher fruit may be harvested by means of a picking shoot. Use of suitable equipment will prevent unnecessary damage to the

fruit, save labour, and will also be safer for labourers.

## ***Handling***

- Fruit should be taken one by one from the picking bag, by hand, and placed in the trays.
- Take special care when transporting fruit to the packhouse.
- Trays containing fruit and awaiting transport should be kept in the shade under the trees. If there is not enough shade, the fruit should be covered with empty trays, placed upside down.
- Do not spread a tarpaulin over the trays, because it will hamper ventilation and cause the temperature underneath it to rise.
- 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***

- It is important to take precautions against bruising.
- 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 sharp knife to a length of 6 to 12 mm.
- Grade fruit for export according to appearance. Fruit is suitable for export if it is virtually free of blemishes and has a regular shape. Fruit suitable for export is transferred to a different table.
- The fruit may now be treated with a suitable post-harvest fungicide and, after waxing, packed in a suitable box.

## ***Cold storage***

To delay ripening, fruit must be stored at a low temperature as soon as 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 slightly lower temperature.



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