Cultivation of mangoes

Mangoes are grown over a wide area in South Africa. However, the main production areas are in the Northern Province with the Letsitele valley/Tzaneen, Hoedspruit/Phalaborwa, Letsitele/Lower Letaba and the Trichardsdal/Ofcolaco areas accounting for 60 % of total production. In Mpumalanga the Onderberg/Malelane region is the most important mango-production area.

Climatic requirements

- Mango trees can tolerate a wide range of climatic conditions.
- The crop is successfully cultivated under conditions which vary from very hot, very humid to cool and dry, to very hot and arid.
- The trees can survive in swampy conditions for an extended period of time, but will also survive in areas with an annual rainfall of less than 300 mm and temperatures as high as 45 °C.

Temperature

- The average minimum temperature during the winter should preferably be above 5 °C.
- Low temperatures when the trees are in full bloom, can cause the fruit to develop to approximately golf-ball size, turn yellow and then be aborted. Large numbers of these fruit result in a reduction in yield.

- Mango trees will grow and produce well in areas with very high temperatures (45 °C). However, when the maximum temperature exceeds 46 °C vegetative growth ceases, especially if it is accompanied by low humidity.
- For optimum growth and production, the average maximum temperature should be between 27 and 36 °C.
- Certain cultivars are less tolerant to high temperatures and low humidity, and the fruit will show symptoms of sunburn (Sensation, Edward, Isis, Fascell and Keitt). Cultivars with a high tolerance include Neldica, Tommy Atkins, Irwin, Lilley, Lippens, Chené, Kent, Ceriese, Kensington, Jubilee, Palmer and Zillate.

Humidity and rainfall

In South Africa the average relative humidity should preferably be 55 % or less, from October until the fruit is harvested.

The rainfall should also preferably not exceed the following:

September: 50 mm	October: 85 mm
November: 110 mm	December: 140 mm
January: 140 mm	February: 140 mm

The relative humidity and rainfall described here are ideal for the development of disease-free fruit, but unsuitable for optimum production. Where mangoes are produced under such low-rainfall conditions irrigation is of vital importance.

Wind

- Wind (even moderate winds) could cause scratch marks on fruit. Harmful fungi and bacteria can enter the fruit through these wounds. Fruit with such marks are unacceptable for marketing.
- Stronger winds will cause fruit loss, resulting in lower yields.
- Certain cultivars, such as Zill, Haden and Kent, are prone to a greater extent to fruit loss under windy conditions than others.
- Damage by wind can be minimised by:

- Avoiding very windy areas.

- Establishing windbreaks such as artificial structures or fast-growing trees on the upwind side of prevailing winds. It is advisable to establish mango orchards in such a manner that the rows run diagonally to the prevailing wind direction to avoid creating a funnel effect.

- Prune the non-bearing flower panicles as soon as it is evident that these will not bear any fruit, because when they become dry and hard, they cause scratch marks on the fruit.

Elevation

In the tropical and subtropical regions, mangoes grow well at altitudes ranging from sea level to 1 200 m. However, production decreases at higher altitudes. In South Africa it is generally accepted that mango production above altitudes of 600 m is not commercially viable.

Soil requirements

Mango trees grow and produce well on various soil types. The tree often develops a fairly strong taproot shortly after planting. This taproot can continue growing until it reaches the soil water-table, and under favourable conditions can penetrate the soil to a depth of 6 m. However, most of the roots responsible for nutrient uptake are found in the top 500 mm of soil, with the largest concentrations in the top 250 mm. Depending on the conditions under which the mango is grown, i.e. dryland or under irrigation, the response to the soil type will vary.

Soil requirements for cultivation under irrigation

Drainage

- Mango trees grow best on a slight slope which enables runoff of excess water and prevents waterlogging. Depressions or basins are poorly drained and plantings on these sites should be avoided. The roots will turn black and become desiccated in oversaturated soils as a result of a lack of aeration. Under such conditions the parts of the plant above the ground will wilt and show symptom of chlorosis.
- Mango trees do not grow and produce well in soils with impermeable layers (mottled layers usually with a light grey of white colour, hard banks, compacted layers of stratified rocks).
- They also do not thrive on very steep slopes because excessive drainage in this case could lead to water shortages and soil erosion.

Soil depth

Under irrigation, mangoes grow well in soils with an unimpeded depth of more than 1 m.

If irrigation scheduling is well planned, there should be no problem on soil with a depth of 750 mm, provided that any soil or rocky layers that restrict root growth to a depth of

750 mm allow excess water to drain easily. If not, a temporary shallow soil water-table could develop above this layer, with resulting damage to the trees.

Texture

The ideal soil texture for mango cultivation under irrigation is a sandy loam or loam (with a clay content of 15 to 25 %), but soils with a clay content of up to 50 % are also suitable.

Soil structure

- The ideal soil has a fairly loose, brittle, crumbly structure.
- Compact or strongly-developed soil structures prevent effective water infiltration and root penetration. These soils are normally associated with a high clay content in the subsoil.

Water

- Allowing the soil to dry out for 2 or 3 months before the flowering stage will promote good flower formation. This phenomenon is attributed to a simultaneous stimulation of vegetative growth during the autumn months which, in turn, influences flower formation in spring.
- Fruit drop as well as the size and quality of mango fruit seems to be influenced by irrigation at certain times. Irrigation during the developmental stage of the fruit is essential to prevent fruit drop and to promote the development of young fruit. Additional irrigation from fruit set to ripening results in a considerable improvement in both fruit size and quality.

Soil requirements for cultivation under dryland conditions

In some areas moisture losses through transpiration and evaporation are so low (because of humidity, temperature and rainfall conditions) that the soil remains moist enough throughout the year to prevent wilting of the trees. Mangoes can then be grown under dryland conditions, provided the soil has the ability to retain moisture that can be available to the plants in drier periods. These soils have a depth of at least 600 mm and a clay content of between 15 and 30 %. Soils with a lower or higher clay content will not be able to supply sufficient moisture to the plants.

Suitability of soil types for mango cultivation

Hutton, Clovelly and Oakleaf are suitable for cultivation under irrigation.

Hutton, Bainsvlei, Clovelly, Avalon and Oakleaf are suitable for dryland conditions.

Chemical requirements

Soil pH

Mango trees grow best in soils with pH values of 6 to 7,2. If the soil-exchangeable aluminium (Al) is not more than 30 ppm, soils with a pH of 5,5 or higher may be used.

At pH values lower or higher than 6 to 7,2 the trees may suffer trace-element deficiencies, especially phosphate and potassium.

Trace elements

- A minimum calcium content of 200 ppm is desirable.
- The ideal potassium status is from 80 to 200 ppm.
- A phosphate content of at least 20 ppm is required.

Soil preparation

Proper soil preparation is very important because it will last for the lifetime of the plantation.

The most important advantages are:

- Better root development
- Improved soil drainage and reduced runoff
- Improved water penetration (rain and irrigation)
- Better utilisation of nutrients
- Greater tolerance towards diseases
- Larger fruit size
- Increased yield
- Prolonged economic lifespan.

Components of soil preparation

- The most important components of soil preparation are:
- Proper examination of the soil (physical and chemical)
- Supplying lime and phosphate into the root zone
- Deep plough or rip cultivation
- Construction of ridges if necessary.

Soil examination

This process determines the most effective way to prepare the soil.

A soil examination should supply the following information:

- Soil type
- Soil strength (compaction)
- Soil texture
- Soil depth
- Drainage capacity of the soil.

A chemical analysis is necessary to determine lime or phosphate requirements. Soils where mangoes are to be planted should be sampled at least 9 months prior to planting.

Supplying nutrients

- Calcium and phosphate move very slowly downwards in soils. If there is a shortage of one of these elements, especially in the subsoil, it should be incorporated into the soil during soil preparation because there will not be a chance to plough it in afterwards.
- If it is necessary to rip the soil, lime should be ploughed in beforehand.

Buying nursery trees

The prospective buyer should have a close look at the trees and select only those of good quality by inspecting the foliage and flowers, internodes, graft unions as well as soil mixture and root system.

Foliage and flowers

- The foliage of a nursery tree should be glossy and green, giving a general appearance of good health.
- If the trees are flowering in the nursery, make sure that there are no symptoms of blossom malformation.

Internodes

- Long internodes are an indication of a vigorous, healthy tree.
- Avoid plants with compressed internodes and a rosette of leaves at the shoot apex, because it is an indication of a zinc deficiency.

Graft union

- An abnormal graft union indicates incompatibility, a poor rootstock or a diseased scion. A first-grade tree should have a few leaves on the rootstock below the graft union.
- Trees should have a uniform appearance and should all be grafted at approximately the same height.

Soil mixture, container and root system

- Soil mixture and container size play important roles in the production of high-quality trees.
- A mixture with a high clay content limits drainage and results in limited root respiration and growth.
- Small containers cause the trees to become prematurely root-bound. The tree may appear healthy, but restricted root growth in the nursery will adversely affect growth in the orchard.
- The bark or growth medium should be a mixture of well-rotted compost, sand and loam which will provide good drainage and allow strong root growth.
- Containers of at least 175 x 150 x 450 mm (about 10 l) are recommended for use in mango nurseries.

Cultivars

Important characteristics include time of ripening, internal quality, external appearance, fruit size, resistance to bacterial black spot and other diseases, tree size and consistent yields. None of the existing cultivars is totally resistant to bacterial black spot.

Tommy Atkins

- Early cultivar.
- Large fruit (450_700 g) with an ovoid to slightly oblong shape and an attractive skin colour.
- Shelf life is good and the cultivar is tolerant to bacterial black spot and anthracnose.
- Trees are of average size and produce regular high yields.
- Fruit is not entirely fibreless, has a watery taste and is susceptible to internal breakdown, jelly seed and stem-end rot.
- Because of its attractive external appearance good prices are realised on both local and export markets.
- The cultivar is recommended for planting in all production areas.

Zill

- Early cultivar which tends to produce low yields.

- Fruit is fibreless, of good quality, medium sized, with a mass of 230 to 400 g and an oval to ovate shape. The fruit develops a good colour only under very hot conditions.
- Trees are large and grow vigorously.
- Zill is susceptible to physiological disorders such as jelly seed and does not store well.
- Main advantages are: an early cultivar and good taste.
- It is recommended for planting in early areas.
- Zill can be marketed locally or exported from areas where external colour develops well.
- New Zill orchards are no longer being established on a large scale.

Kensington

- Early midseason cultivar with little support in South Africa.
- Good resistance to bacterial black spot.
- Trees are vigorous and give consistently high yields.
- Fruit size is medium to large (> 450 g). Fully-ripe fruit has an unattractive yellow colour with slightly orange cheeks.
- Shelf life is good.
- Physiological disorders such as jelly seed are rare.

Irwin

- Early midseason cultivar but not suitable for all the production areas.
- Trees are dwarfed to some extent and give consistently good yields.
- Fruit is elongated, of average size (340_450 g), with an attractive colour and can be stored for long periods, but is slightly fibrous.
- Irwin is highly susceptible to black spot and the fruit tends to split in areas with high humidity.
- Recommended only for hot, dry areas.

Neldica

- Early cultivar which ripens at the same time as Zill and Tommy Atkins.
- Fruit shape is slightly elongated and round. Skin colour is a very attractive red, pale red and yellow. The fruit is large (400_500 g) with limited fibres around the seed.
- It shows great tolerance to bacterial black spot at Messina but not at Nelspruit. It is not susceptible to scorch.
- The trees are moderately vigorous.
- Recommended for hot, dry areas and is suitable for both local and export markets.

Kent

- Trees are large and give consistently satisfactory yields.
- Harvesting period is classified as late midseason.
- Fruit is large (500_700 g) with a rounded base, fibreless and the internal quality is very good. The skin colour in cooler, humid areas, is often poorly developed.
- Kent is considered as one of the best tasting mangoes.
- Highly susceptible to bacterial black spot and is only recommended for hot, dry areas.

Heidi

- Late cultivar.
- Fruit size varies from medium to large (450_600 g). The fruit is round, slightly elongated with flat sides. The skin colour is very attractive and appears purple, red and yellow when ripe.
- Excellent taste and the fruit is fibreless.

- Good tolerance to black spot, even under conditions of moderate to severe disease prevalence.
- Trees have a compact growth habit and are slightly dwarfed.
- Leaves are typically long and very narrow.
- Widely recommended although susceptible to sunburn in hot, dry areas.
- Fruit size can be reduced to some extent in very hot regions.
- Suitable for both local and the export markets.

Sensation

- Late cultivar and a consistently good producer.
- Fruit is fibreless with an attractive colour. Fruit size is small (200_350 g). If left on the tree until it develops a yellow colour, it tends to develop jelly seed.
- Trees are dwarfed and can therefore be planted at higher densities than most other cultivars.
- Grown for both the local and export markets.
- In late areas there is the benefit of good prices realised at that time.
- Trees should receive nitrogen fertiliser immediately after harvest to ensure an adequate post-harvest flush.
- A disadvantage of this cultivar is that the fruit ripens unevenly, which necessitates selective harvesting. In very late areas Sensation tends to bear alternately.
- The cultivar shows tolerance to bacterial black spot and is recommended for all areas.

Keitt

- Keitt is the latest of all the recommended cultivars.
- The fruit size is medium to large (400_500 g). The fruit is fibreless, oval with rounded base. Skin colour often poor. The fruit has an exceptional keeping quality and can be left on the trees long after normal harvest time without the risk of jelly seed developing.
- The trees are of medium size and the growth habit is characteristically open and appears somewhat disorderly with slender ranky branches.
- The cultivar is highly susceptible to bacterial black spot and is only recommended for very hot and dry areas.

Orchard planting

Tree spacing

Guidelines for mango planting distances

Cultivar	**Standard semi-intensive planting (a degree of manipulation manipulation is still necessary)** **(m)**	**Intensive planting (for specific training system, manipulation techniques, rootstocks and soil types)** **(m)**
Sensation	5 x 2,5	5 x 1,5
Tommy Atkins	6 x 3	5 x 2
Heidi	6 x 3	5 x 2
Keitt	6 x 3	5 x 2,5

Kent	6 x 3	5 x 2

Rootstock, soil and climate must be taken into account and adaptations made accordingly

Planting time

Although mango orchards are planted throughout the year (especially in the warmer production regions) the best time is August to September after the risk of cold weather has passed.

Planting procedure

- After proper soil preparation the holes for planting should be large enough for the bag containing the tree to fit inside. Cut the bags open before planting to ensure that the trees have well-developed root systems and the roots are undamaged.
- Irrigation systems should already be installed before planting the trees.
- As soon as active growth is observed after planting, each tree should receive 4 applications of 25 g LAN at intervals of 6 weeks, i.e. a total of 100 g for the first year.
- A groundcover should be established in the work-row between the tree rows just after planting.

Irrigation

Mangoes are to some extent drought resistant, but will not achieve optimum growth if they do not receive sufficient water (especially during the fruit-developing phase). Correct irrigation is very important for maximum production in most mango-producing areas of the country.

Water requirements

The annual water requirement (with no rainfall) of mature mango trees is 11 000 m3/ha/year. Some degree of stress during flower bud development (May to July) is, however, advantageous. Water usage of trees subjected to water stress during flower-bud development is 9 500 m3/ha/year.

The seasonal water usage of trees not subject to water stress, varies from 20 to 44 m3/ha/day from June to November respectively.

Liming and fertilisation

Preplant preparation

Soils to be used for cultivation of mangoes should be sampled at least 9 months prior to pr"nting. The correct quantity of lime should be applied according to soil analyses.

Established orchards

Recommendations for macronutrient fertilisers differ for trees under irrigation and those grown under dryland conditions. However, application of micronutrients, (generally foliar), are the same for both conditions.

Macronutrients for mangoes under irrigation

During the first 4 years, nitrogen (N) can be applied as 4 equal instalments in July, October, January and April. Thereafter, with fruit-bearing trees, N application will depend on cultivar and climatic variables which influence the seasonal stage at which the fruit is ready for harvest, i.e. early, mid or

late season (December/January or February/March respectively). An orchard may, however, be ready for harvest at various stages in different seasons. Depending on the season of bearing, general times and rates of fertilisation are given in the table.

Application after August may induce excessive vegetative growth to the detriment of fruit set and development and is therefore undesirable.

Time and rate of N application

Proportion of N to be applied			
Harvesting time	**After harvest**	**March**	**May to August (1)**
December/January (early season)	$^1/_2$	$^1/_4$	$^1/_4$
February/March (mid/late season)	$^3/_4$		$^1/_4$

1 Stage at which flower panicle begins to shoot

Application time of other macronutrients (primarily K and P) is not as critical as N. However, to minimise the risk of rootburn these nutrients should be applied in between applications of N. Potassium (K) fertilisers, because of their high solubility, should be split into the same number of applications as N. Phosphorus (P) sources, on the other hand, have comparatively low solubilities and can all be applied at the panicle stage, as can additional lime or gypsum.

Macronutrients for mangoes under dryland conditions

Producers are advised to apply half of the fertiliser following harvest and the rest in March, i.e. the rainy season. Potassium should be applied at least a month later after the postharvest N application, because simultaneous application with N could induce fertiliser burn. Phosphorus, lime and/or gypsum can be applied at the same time during the off-season winter months.

Micronutrients

Micronutrients are essential to all plants and include Zn, B, Mn, Fe, Cu and Mo. Soils suitable for mango production are generally low in zinc (Zn) and boron (B). It is therefore important to supplement these elements according to leaf analyses. Nutrients can be applied by means of foliar spray once a month after harvest while trees are flushing, at blossom break, at fruit set and once a month after fruit set up to 1 month before harvest.

Zinc and boron are compatible and can be sprayed simultaneously, preferably during cooler times of the day.

Lime and fertiliser placement

Requirements for mango trees of different ages are provided in the table below.

General fertilisation according to tree age in g/tree/year (in absence of leaf and soil analyses)

Year	Nitrogen (N)	Phosphorus (P)	Potassium (K)

1	70	25	200
2- 3	140	50	200
4- 6	210	75	250
6- 7	280	100	375
8- 9	350	125	500
10 or more	420	150	650

- Prior to planting, lime must be mechanically incorporated into the entire soil volume in which root growth is expected.
- In established orchards, mechanical incorporation is not practical and under such conditions, gypsum should be applied. While gypsum is not a liming material and has no neutralising power, it may lead to a significant reduction in Al in the subsoil.
- Following sufficient time for lime to neutralise soil acidity (preferably about 6 months), P can similarly be incorporated into the soil by ploughing or disking. Most soils in mango areas of South Africa do not, however, have P deficiency problems.
- Nitrogen and potassium fertilisers should be applied as topdressings once trees are properly established and growing vigorously, preferably after 1 year.
- Nutrients should only be applied to the drip/irrigated area of a tree. Fertiliser close to the roots could result in scorching.
- Plants cannot absorb nutrients from a dry soil.
- Boron deficiency results from excessive leaching, overliming and excessively dry weather. Deficiencies can be prevented by preplant soil application of 50 g solubor/tree (levels of 100 g could be phytotoxic).

Concentrations of micronutrients to be used for foliar applications to mangoes are presented in the table. A single spray should be used for minor deficiencies while 2 or 3 sprays should be applied where major deficiencies occur.

Recommended concentrations for foliar sprays

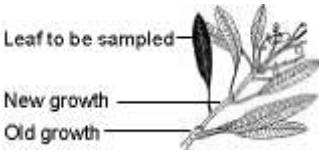
Deficient nutrient	**Treatment**
B	Solubor at 300 g/100 L water
Cu	Copper oxychloride at 200 g/100 L water
Fe	Fe-chelate/sulphate applied as specified
Mn	$MnSo_4$ at 200 g/100 l water
Zn	ZnO at 200 g/100 l or Nitro-zinc at 150 ml/100 l water or as specified

Leaf and soil analyses

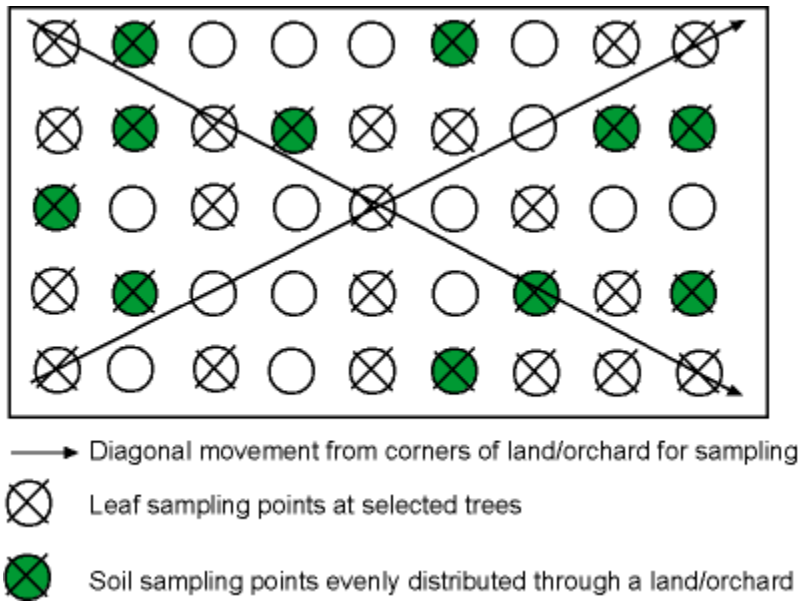
The aim of leaf and soil analyses is to determine the nutrient status of mango trees or suitability of a soil for the production of mangoes.

Leaf sampling

A single leaf or soil sample should be representative of an area not greater than 3 ha. However, if there are soil variations separate leaf and soil samples must be taken and the orchard management adapted accordingly.



Sample 7-months-old fully developed hardened-off leaves from fruit-bearing twigs



Taking representative soil and leaf samples

- The time of leaf sampling as well as leaf position, is very important and is shown in the figure. Leaf analysis is only applicable for producing mango trees (normally a tree age of 5 years and older).
- Select about 20 healthy trees by walking diagonally from the corners through the orchard (see figure). The trees should be homogeneous in appearance and representative of the orchard.
- Exceptionally good or poor trees must not be sampled.
- The 20 selected trees must be clearly marked, for example with paint, so that both the soil and leaf samples can be taken from the same trees every year.
- Where possible, pick 4 leaves from alternate sides of the tree at about shoulder height. Eighty leaves per sample should be sufficient.
- Different cultivars should be sampled separately.
- Leaves sampled must be free of sunburn, disease and insect damage.
- Leaf samples should be collected in the morning, after the dew has dried off.
- Leaf samples should not be taken if trees are under stress i.e. drought or high temperatures. After a heavy downpour, wait at least 2 weeks before taking samples.

- After sampling, leaves should be placed in clean, perforated or open plastic bags.
- If samples cannot be delivered immediately (within 48 hours), they can be stored in a refrigerator and should be transported in a cooler bag. The sample must be accompanied by the relevant orchard information including previous production figures, tree age and fertiliser programmes of the past. Any problems concerning the specific orchard, such as small fruit, should be mentioned.

Soil sampling

Sampling depth:	Topsoil 0 - 300 mm
	Subsoil 300 - 600 mm

Number of samples

A sample comprises of a combination of at least 10 subsamples. A composite sample should not represent more than 3 ha. Samples from different orchards or lands should not be combined.

Distribution of sampling points

Take samples by walking diagonally from the corner through the orchard or land. In an established orchard, topsoil and subsoil samples should be taken at the same trees selected for leaf sampling. Soil samples must be taken under the canopy of trees in the middle between the stem and the drip area perimeter.

Method of sampling

Clear the soil surface of debris, leaves and fertiliser. A soil sample must not be taken too soon after fertilising because this will contaminate the soil sample and lead to an incorrect analysis. The top and subsoil samples are taken by removing a core of soil from the top 0 to 300 mm and then from 300 to 600 mm soil depth, respectively.

Packaging of samples

Subsamples from an orchard or land should be combined in the respective bucket (not a fertiliser bag) and mixed thoroughly. A sample of about 2 kg is taken from the composite sample and dispatched in a clean, strong bag.

Topsoil and subsoil must be packed separately and the depth of sampling, orchard/land must be indicated clearly.

Weed control

Weeds are usually controlled between rows in an orchard by means of mechanical mowing with a rotary cutter (slasher driven by a tractor).

Chemical mowing, where herbicides are used, can be applied at low concentrations as an alternative. The idea is not to kill all the weeds but to slow down growth. Chemical control is normally followed by mechanical mowing. The advantage of this method is that mechanical mowing is limited, resulting in less traffic in the orchard.

Diseases

Anthracnose

It is an important post-harvest fungal disease which affects all mango cultivars to varying degrees. Because the disease is rain-linked, the fruit will be less affected in warm areas where it matures early and where it does not hang on the trees throughout the rainy season.

Symptoms

Small brown-black spots appear on the leaves, which could later enlarge and coalesce to form large blackened irregular patches, usually with a faint yellow halo. The tissue will die and later fall out.

Control

During wet periods control measures are important, especially when the trees are in bloom, to prevent losses as a result of blossom blight and also during fruit development to reduce post-harvest problems. Specific sprays for anthracnose are not usually necessary because the fungus is controlled by the fungicide programme followed for powdery mildew and bacterial black spot.

Powdery mildew

This is a fungal disease found in all mango-growing areas and in the case of all cultivars. It is usually a lesser problem in areas with warm winters. If not controlled properly, it could cause crop losses of 80 to 90 %.

Symptoms

Infection starts as isolated white powdery patches on young tissue of the shoots, leaves, flowers or fruit. Once a certain stage of maturity is reached, the fruit is no longer susceptible.

Infected flowers fail to open and drop from the inflorescence without fruit formation. On small fruit (pea size), mildew causes skin cracking and corky tissue. Younger fruit will drop. After the fruit matures beyond marble size there are no longer a risk.

White powdery patches can occur on young leaves which then curl and become distorted. As the leaf matures and the fungus disappears, brown patches remain. Mature leaves are not susceptible.

Control

Various fungicides are registered for effective control.

Bacterial black spot

Symptoms

Bacterial black spot is a rain-related disease.

Fruit lesions begin as water-soaked spots which later become raised and black cracking open to exude a gum-containing bacterium. There is often a tear-stain pattern where the gum has washed down the fruit and started a number of new lesions. Infection of small fruit and especially the fruit stalk will cause fruit drop.

Control

Copper sprays are the only method of combating the disease and are not always successful when disease prevalence is high. One or two post-harvest copper sprays to cover the post-harvest flush and final stage of the rainy season are effective in reducing inoculum pressure during the following summer.

Malformation

It is a fungal disease which is spread by grafting and buying infected trees from nurseries. Blossom malformation is easy to control, but if left unchecked can devastate an orchard.

Symptoms

Affected flowers look like cauliflower heads. The axes of the panicles are shorter and thicker than normal, branch more often, and a profusion of enlarged flowers is produced. These panicles develop more slowly than normal, retaining their green colour but the flowers are mostly sterile.

Control

The disease can be eliminated by breaking off affected panicles and putting them in black plastic refuse bags and allowing these to `cook' in the sun for a day or two, or by burning. If this is done every year the incidence of the disease becomes insignificant.

Pests

Fruitflies

Mangoes can be severely damaged by female fruitflies laying eggs in the fruit and by the maggots (larvae) which then develop in the flesh of the fruit.

Control

Successful fruitfly control in mango orchards depends on a combination of the following:

Eradication of invaders (host plants such as bug tree and brambles).

Orchard and yard sanitation by removing on a regular basis all mangoes and other fruit that have dropped in the orchard or yard and destroying these immediately.

The use of traps to determine when a population build-up occurs. By making weekly counts of the number of flies in the traps, a sudden increase in the population can be detected and chemical control can commence.

Regular poison bait applications. Chemical control of adult fruitflies in mango orchards are based on weekly applications of a poison bait on the trees. The poison bait contains a mixture of insecticide plus a lure plus water.

Ingredients of a poison bait for fruitflies

Insecticide/100 l water	Lure/100 l water
50 g trichlorfon SP	250 ml protein hydrolysate (417 g/l) (Nasiman)
	or
175 ml mercaptothion EC	250 ml protein hydrolysate (500 g/l) (Buminal)
	or
300 g mercaptothion WP	Dilute 1:1 and use 400 ml protein hydrolysate (750 g/kg) (Hymlure)
	or
	400 ml protein hydrolysate (425 g/l) (Hymlure ready)

The poison bait is applied to the tree in the form of large-droplet sprays at a rate of 250 to 1 000 ml/tree, depending on tree size. It is not necessary to wet the whole tree; a section on one side of the tree will be adequate.

Apply poison bait as soon as fly counts in the traps show a sudden increase. Poison baits should be applied long before the fruit starts colouring. A 10-day safety period must, however, elapse between the time of final application and harvesting.

Mango weevil

The mango weevil is present in all the mango-producing regions of South Africa and is spread through the transportation of infested fruit. As the weevil develops inside the mango seed, it can be transported inadvertently from one place to another. No alternative host plants are known.


Mango weevil

Symptoms

The symptoms are most apparent in the seed. Infestation is also evident as small, dark marks on the fruit skin where the female weevil laid her eggs. With cultivars ripening towards the end of February and later, the weevil which developed in the seed, feeds through the fruit skin to the outside, resulting in an unattractive hole in the fruit. The pest status of the mango weevil has consequently increased.

Control

Dropped fruit in the orchard or discarded seeds left lying around are the major sources of infestation. Fruit should be buried at least 600 mm deep or finely chopped with a hammer mill. The most important period for orchard sanitation is during January and February as most weevils have by then become adults and could escape from the seeds.

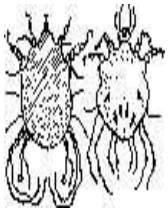
Tip wilter

Tip wilters can be a serious pest on young mango trees of up to 4 years old. They are black, about 25 mm long and live on plant sap. In mango trees, they concentrate on young, new flush, leaf veins or flower stalks. Plant tissue die off at the feeding points. Host plants include weeds, vegetables, ornamental plants, granadillas, citrus and also mangoes.

Tip wilters secrete a repugnant odour when disturbed. They can cause considerable growth retardation, but are of minor importance on large trees.

Control

Hand collection on a regular basis.


Tip wilter

Harvesting

Achar fruit

Many growers have peach mango trees or other fibrous types. The fruit is harvested while still relatively small. The seed should not be allowed to harden because this causes rejection by the factories. Fibreless types can be used for achar and this often comprises small fruit that would otherwise drop naturally, or fruit where pollination was unsuccessful and the fruit is seedless and likely to drop (mules).

Local market

If fruit is to be marketed locally, it can be allowed to mature for longer periods on the tree. This will give it a better colour and flavour. However, if the fruit is left on the tree for too long, it will drop in a process known as spontaneous ripening.

Export

Only the best-quality fruit is suitable for export, as it has to undergo transport and cold storage for 28 days in order to reach foreign markets by sea. Fruit picked too green will never ripen properly whereas overripe fruit will spoil as a result of softening and the development of various diseases. It is therefore important to start picking at the correct stage.

Maturity

Maturity describes the stage of internal fruit development. A fruit is considered mature when it has reached the stage at which, after harvest and ripening, its eating quality will appeal to the consumer. Mango fruit is harvested at the so-called mature-green stage. This is the stage of physiological maturity at which ripening will occur, while still allowing time for handling and marketing. Maturity can be measured by using a colour chart and must not be confused with ripeness.

Ripening

Ripening is the process which transforms a mature fruit into an attractive edible one.

Ripeness is quite distinct from maturity. A mango may be mature, but not ripe. It is only ripe when it is ready to eat.

A mature mango will ripen properly, whereas an immature one will not. The stage of maturity at picking will affect the speed of ripening, and the final quality of the edible fruit. When the fruit is removed from the tree several days before the onset of ripening, they are initially hard and green. The fruit progressively softens, changes colour and develops an aroma at a rate determined by the storage conditions and the maturity of the fruit at harvest.

If fruit in a carton is of mixed maturity, it will be difficult to recommend a suitable storage temperature.

Handling of mangoes (orchard to packhouse)

- Fruit should be handled with extreme care. Excessive tree height is a distinct disadvantage. Pickers should keep their fingernails short to prevent fruit damage. The use of linen-type gloves is not advisable because the stem-end latex exudation would later cause the gloves to become abrasive.
- Each picker should be provided with a soft rag which should be rinsed frequently in a bucket of water to which a detergent has been added. The rag is then used to wipe off and neutralise most of the latex (the juice exuding from the stem).
- Latex, under some circumstances, can cause severe scorch marks on the skin of the mango. Placing the fruit on the ground to drain off latex is not recommended, as this can lead to post-harvest diseases.
- It is wise to pick mangoes selectively for export by sea, because the fruit will only be reaching the consumer after a long time lapse. Because fruit size is all-important for export mangoes, pickers should be provided with rings fashioned from wire, to assist them in determining the minimum size.
- Fruit should be carefully placed in non-abrasive containers and attention should be given to the prevention of sunburn (keep lugboxes in the shade).

For further information contact the
ARC-Institute for Tropical and Subtropical Crops
Private Bag X11208, Nelspruit 1200
Tel (013) 753 2071
Fax (013) 752 3854

This publication is also available on the website of the
National Department of Agriculture at:
www.nda.agric.za/publications

ISBN 1-86871-077-7

2000

Compiled by Directorate Communication
National Department of Agriculture in cooperation with
ARC-Institute for Tropical and Subtropical Crops

Printed and published by National Department of Agriculture
and obtainable from Resource Centre, Directorate Communication,
Private Bag X144, Pretoria 0001 South Africa