

MANGO CULTIVATION IN KENYA

Mango is one of the most important fruit crops in the tropical and subtropical lowlands. It is native to India, Bangladesh, Myanmar and Malaysia, but can be found growing in more than 60 other countries throughout the world.

The mango industry in Kenya has expanded considerably over recent years, not only in size but also in the geographical location of commercial and homestead plantings. No longer is commercial mango cultivation restricted to the Coast region, as significant plantings of improved cultivars now also exist in the Makueni county, Meru County, Murang'a County, Nairobi County, Nakuru County, Siaya County, Taita Taveta County, Tana River County, Tharaka Nithi County, Bungoma County, Kitui County, Embu County, Machakos County, Kiambu County among other regions. Basically, In Kenya 7 out of 8 provinces produce mangoes. But the generally arid eastern region produces 61 per cent of all mangoes, followed by Rift Valley at 30 per cent and Coast, which produces 28 per cent.

As a result of this expansion, the mango fruit is becoming more popular with the local population. Despite this increasing popularity, only a few consumers and potential growers are familiar with the characteristics of the many different cultivars of mango that are now grown and available in the country. These include Apple, Ngowe, Kent, Keitt, Tommy Atkins, Van Dyke, Haden, Sensation, Boribo, Sabine among others.

Main characteristics that differentiate varieties are the fruit shape, size, aroma, sweetness, colour, fibre content, taste, seed size and resistance to diseases. Proper selection of a mango cultivar for production has to take into account the following criteria:

- >> good adaptation to the local conditions (e.g. rainfall and dry periods)
- >> alternation of flowering and fruiting
- >> tolerance to pest and disease infections
- >> designated use and market requirements

The mango is best adapted to a warm tropical monsoon climate with a pronounced dry season (>3 months) followed by rains. However, information from other countries indicates that crops cultivated for a long time over an extended area show a high degree of diversity due to varied environmental influences.

Economic Importance of Mangoes

- Consumed as fresh fruits
- Source of income
- Source of foreign exchange
- Source of employment
- Combats nutritional disorders

Botany

The mango is a deep-rooted, evergreen plant which can develop into huge trees, especially on deep soils. The height and shape varies considerably among seedlings and cultivars. Under optimum climatic conditions, the trees are erect and fast growing and the canopy can either be

broad and rounded or more upright. Seedling trees can reach more than 20 m in height while grafted ones are usually half that size.

The tree is long-lived with some specimens known to be over 150 years old and still producing fruit! The mature leaves are simple, entire, leathery, dark green and glossy; they are usually pale green or red while young. They are short-pointed, oblong and lanceolate in shape and relatively long and narrow, often measuring more than 30 cm in length and up to 13 cm in width. New leaves are formed in periodic flushes about two to three times a year

The greenish-white or pinkish flowers are borne in inflorescences—usually placed terminally on current or previous year's growth—in large panicles of up to 2000 or more minute flowers. Male flowers usually outnumber the bisexual or perfect flowers.

Generally, flowering in Kenya lasts from about late July to early November, depending mostly on weather conditions. At the coast it is not uncommon to find individual trees flowering as early as February and March. Pollinators are usually flies, rarely bees or nectivorous bats. Pollen cannot be shed in high humidity or rain as this might prevent pollination and fruit setting. Mangos are self-fertile, thus a single tree will produce fruits without cross-pollination.

The fruit quality is based on the scarcity of fibre, sweetness and minimal turpentine taste. The flesh of the improved cultivars is peach-like and juicy, of a melting texture and more or less free from fibre. The single, compressed ovoid seed is encased in the white fibrous inner layer of the fruit.

Common challenges to mango production in Africa

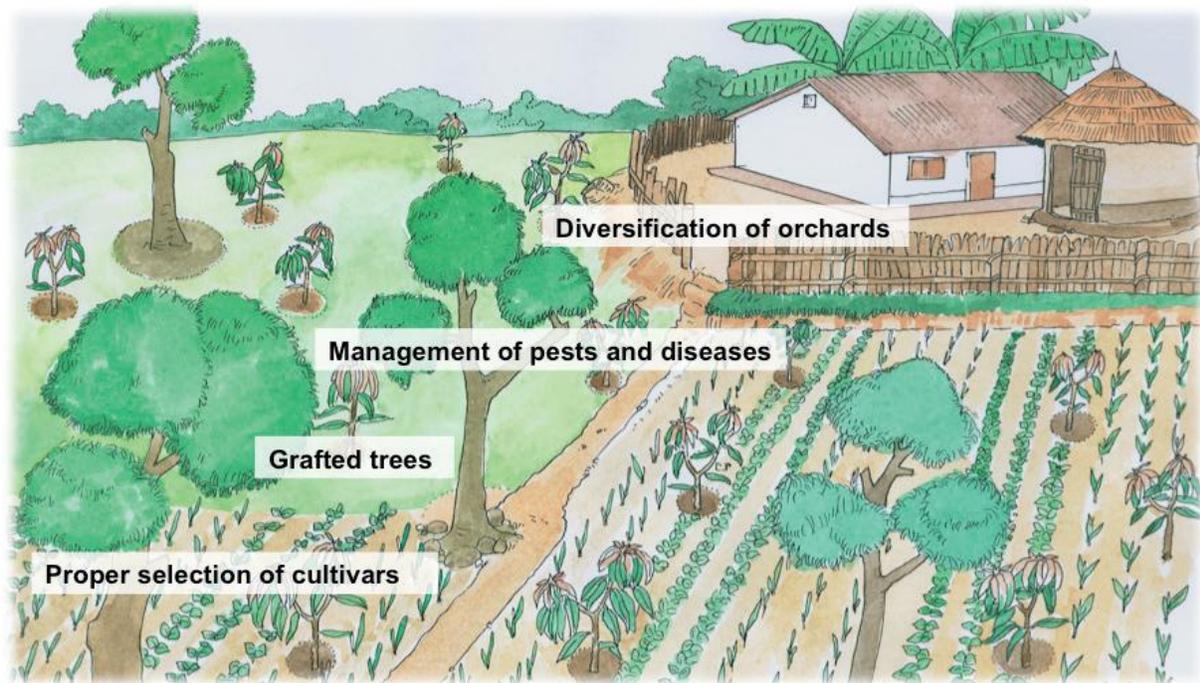
Many farmers in Africa invest in mango orchards. However, there are a number of production-related hindrances at farm level, including:

>> **Limited access to good quality planting materials** - There is a general shortage of grafted planting materials of improved and higher yielding varieties in many areas. Farmers often use inferior seedlings obtained by germinating mango seeds from indigenous varieties. Such ungrafted trees take much longer to bear fruit. Whereas grafted trees begin to bear fruit within 3 to 4 years, ungrafted trees will take at least 5 years to bear fruit, depending on the growing conditions.

>> **Pest and disease problems** - Mangoes have many devastating pests and diseases, which can result in total yield loss. Major pests include the fruit fly (*Bactrocera invadens*), seed weevil (*Sternochetus mangiferae*) and mealy bugs (*Rastrococcus invadens*). Diseases like anthracnose and powdery mildew are common in almost all mango growing areas.

>> **Poor orchard management** - In many areas, mango trees are left to grow so big that pest and disease management, harvesting and other field operations are difficult to implement. Except in big or commercial farms, mango trees are normally scattered around the gardens, ranging from 2 to 100 trees per household. This scattered nature makes mango a commonly neglected crop in terms of management, but becomes important only during the harvesting season.

Good management



- >> Good organic management of mango trees starts with selecting appropriate cultivars.
- >> Diversification of the orchard reduces disease pressure and promotes beneficial insects.
- >> Proper maintenance of trees and regular monitoring of pests and diseases contribute to better harvests and better fruit quality.

>> **Postharvest losses** - Fruit damage is a common problem as a result of poor pest and disease management and the poor harvesting practices. Also, a lot of fruit is lost after harvest, especially during the peak seasons due to the limited capacity to store and process fruit. This is further worsened by the poor roads and transport infrastructure to markets.

>> **Limited returns from mango production** - Mango is highly seasonal and harvest is only expected at certain times of the year depending on the local conditions. During this time, most areas are harvesting and so the local markets are saturated and, therefore, offer very low prices, which may not even cover transportation costs

Proper establishment of the mango orchard

i. Choice of the proper location and suitable varieties

The ideal climate for mango trees ranges from the humid tropical to the semiarid subtropical, wherever a dry period exists of at least 3 to 4 months and sufficient light to induce flowering. Once the trees are established, they can tolerate drought except during flowering and fruit setting. Mangoes can be grown successfully in a wide range of soils, but a healthy, high-yielding plantation is only possible on fertile, deep and well-drained soils.

Basically, Mango is successfully grown on a wide range of soils. The trees do well in sandy soils at the coastline as well as on loam, black cotton and even murrum soils at other elevations. **The essential prerequisites for good development of the trees are deep soils (at least 3 m), appropriate rainfall (500-1000 mm), good drainage, suitable altitude (0-1200 m) and preferably a pH value of between 5.5 and 7.5.** The tree itself is not difficult to grow and, once well established, is relatively tolerant of drought, occasional flooding and poor soil condition. Irrigation in the first years after planting promotes flushing (and suppresses flowering), so that tree size increases quickly. Irrigation also widens the scope for intercropping, for example, with papaya, banana, pineapple or vegetables, during the establishment phase. When the trees are big enough to produce a substantial crop, irrigation is stopped, or at least interrupted long enough to impose quiescence leading to flower initiation.

Among the various climatic factors, temperature, rainfall and humidity have a greater bearing on mango production than irrigation and soils. Furthermore, the production of high quality mango fruit does not depend so much on elevation but on the range of temperatures available. The two important considerations for mango cultivation are **a dry period at the time of flowering**—in Kenya mainly during the months of August to October—**and sufficient heat during the time of fruit ripening.** For optimum growth and productivity, 20-26°C is believed to be ideal. Temperatures exceeding 40°C may, especially in hot/dry areas, lead to sunburn of fruits and stunting of tree growth.

The amount of rainfall in a given locality is not as important as its intensity and distribution. Rainfall of 500-1000 mm at the right time of the year is sufficient for successful cultivation. However, the mango cannot do well in areas which experience frequent rains or very high humidity during the flowering period. Such conditions are not conducive to good fruit set and they increase the incidence of serious diseases like powdery mildew and anthracnose. Anthracnose can be a major problem as the same organism occurs on avocado, coffee and papaya. Powdery mildew is quite common when low temperatures accompany high humidity

Main characteristics that differentiate varieties are the fruit shape, size, aroma, sweetness, colour, fibre content, taste, seed size and resistance to diseases. Proper selection of a mango cultivar for an organic plantation has to take into account the following criteria:

- >> good adaptation to the local conditions (e.g. rainfall and dry periods)
- >> alternation of flowering and fruiting
- >> tolerance to pest and disease infections
- >> designated use and market requirements

Both local and exotic or improved varieties are commonly available. Improved varieties are usually grafted on the local varieties and are grown for both local consumption and for export. Examples of improved varieties include, Kent, Keitt, Tommy Atkins, Van Dyke, Sensation, Apple, and Haden. Local varieties vary a lot across countries, and although most of them have high fibre content and are thus unpopular for fresh consumption, some are commercially important. Examples in Kenya include Dodo, Sabre, e.t.c.

ii. Arrangement of the orchard

The method of planting (orchard design) is dependent on the field lay out. When mango is the main fruit in the orchard, a 10 m by 10 m planting distance is desirable where land is not all that fertile but normally, grafted trees are spaced at 8m by 10m or 10m by 12m, though at the Coast, seedlings require 2m by 14m. All the same, a spacing of as low as 3m by 4m can be utilized provided that the farmer will be able to put the necessary management practices such as essential pruning and control of pests and diseases. Overcrowding results in the production of fewer fruits which are apt to be poorly coloured and infected with diseases. Tall trees also present a harvesting problem and create difficulties during spraying and pruning because the trees tend to grow vertically, with minimal horizontal growth.

Since mango trees grow slowly, they can take a relatively long period (up to 5 years) before the trees cover the space in-between. During this period, there are several possibilities to use the available space as cropping area through proper diversification. Diversification in mango production offers the following advantages

- >> better use of underground and aerial space
- >> the yield risk due to alternate bearing can be compensated with the harvest of the companion crop, hence stable income to the farmer
- >> protects the soil from erosion
- >> improves the soil fertility, for example, when legumes are grown underneath the trees
- >> intercropping reduces the pest and disease pressure due to possible higher populations of beneficial organisms
- >> better weed management and provides space for pasture production for livestock.

Mango trees can be grown together with many other plants: as border trees on cultivated gardens, in intercropping within the gardens, in very diverse agroforestry systems or in silvi-pastoral systems (using small animals, such as sheep or goats).

a) Intercropping in mango plantations

If the area between the organic mango trees is to be used as arable land, an adequate crop rotation should be planned. During the young developing stages of the mango trees, a crop rotation with annual crops such as legume crops, vegetables, cereals and fodder crops can be grown in this case. If the local climatic and soil conditions are suitable, other fruit crops such as papaya (3 to 5 years cropping period) and pineapples (2 to 3 years) can be included in the intercropping system. Other possibilities to enhance the diversification in mango

orchards include leaving some spontaneous plant growths (bushes, flowers, etc.) on the borders or between the trees to create ecological niches.

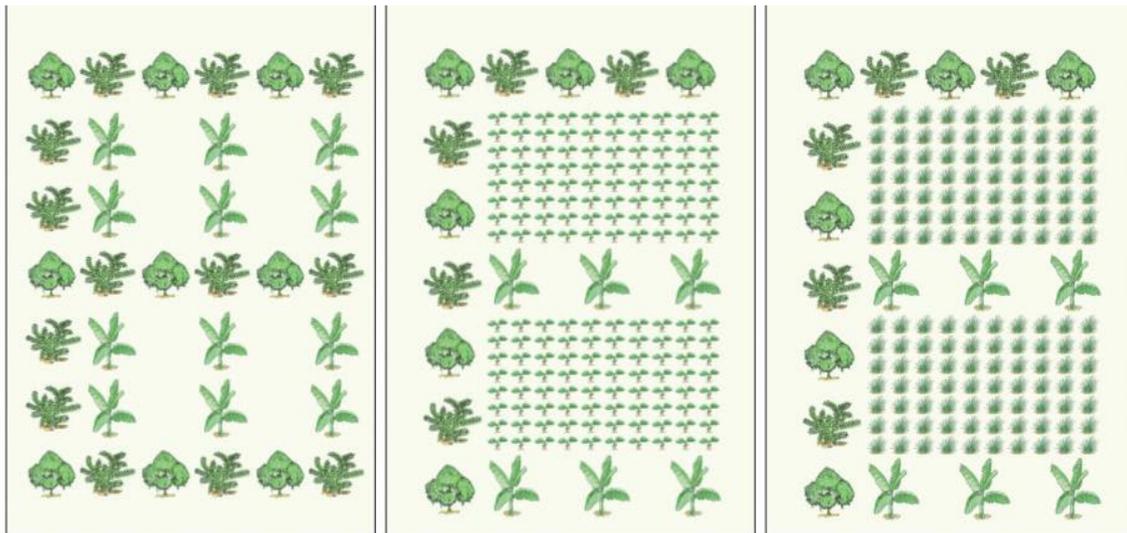
b) Mango in border areas of cultivated fields

Mango trees as border trees can improve diversification on the farm, it can protect the soil and other crops against wind and it can enhance the income of the farmer.

c) Mango in agro-forestry or Silvi-pastoral systems

Mango trees in agroforestry systems can include crops such as bananas, papayas, cocoa, etc. In silvi-pastoral systems, animals can be allowed to graze on pasture growing on the mango plantation. Windbreak trees are needed because mango trees are very susceptible to wind damage. Therefore, some trees are needed to protect from strong winds on the side of the prevailing winds.

Ways of integrating Mango



>> If mango is your main crop, plant the trees at a row and tree distance of 10 meters or your preferred distance with regard to land available.

>> If mango is not the main crop, increase the row distance and use the space between the trees for growing vegetables or other fruit trees such as banana, papaya or pineapples

>> You can also allow animals to graze on pasture growing between the mango trees.

>> Mango trees can also be grown as border trees around cultivated fields.

NOTE: in the diagram above, mango is indicated as being intercropped with other crops; planted as a border tree and finally grown with other trees or pasture.

iii) How To Plant Mango Seedlings

- Spacing of between 8 – 12 m² (ideal situation) or 10*10m (dry zones) or 5*3m or 5*2.5m or 3*2.5m or 2.5*2.5m (where high density planting is required)
- Depth of hole 1 x 1 x 1 m³ (in shallow & hilly soils) or 0.5*0.5*0.5m (in loamy and deep soils)
- Put the top soil aside when digging the hole.
- Mix top soil with manure and fertilizer as follows:
 - * 1 debe of manure per hole (in the ratio of 1debe manure to 3 debes of top soil)
 - * About 60g of a compound fertilizer (NPK) e.g. DAP, depending on the fertility of the soil.
- Return the mixture to the hole filling to about 2/3 (two thirds) of the hole
- Cut the polythene sleeve carefully so that the plant can be planted with the entire ball of the soil.
- Place each of the seedlings at the centre of the planting hole.
- Cover the seedling at exactly the same depth as it was in the polythene sleeve leaving it about 6 inches below the soil surface.
- Once the trees are established (about 3 – 6 months after Planting), start applying nitrogenous fertilizers e.g. CAN as follows:-
 - 1st year 50g CAN/tree
 - 2nd year 100g CAN/ tree
 - 3rd year 150g CAN/tree
 - 4th year 200g CAN/tree

NOTE: the nitrogenous fertilizers should be applied in splits to avoid leaching out.

- The seedlings should not be allowed to dry hence the need for frequent watering and/or mulching.
- With a spacing of 3m * 4m or (12m² a plant population of about 300plants /acre and 800 plants/hectare
- **Planting regions: Coastal regions, Eastern province, Lower parts of Central province, Lake regions and drier parts of Rift Valley e.g. Baringo**

Proper maintenance of mango trees

Mango trees need continuous attention in order to ensure continued harvests and to improve the lifespan of the orchard trees.

i) Pruning

The form and height of a mango tree needs to be controlled to guide the tree and to facilitate harvesting at a later stage.

>> Formative pruning - is done in the first years of the young tree to guide the tree into the desired shape. In the first year, when the trees are about 1 m from the ground, cap the seedling in order to encourage side branches (3 to 4 well branches). Thereafter, every second flush of leaves should be removed.

Advantages:

- Fruit is produced on the outside of parts of the tree
- Fruit hold to maturity on the trees
- Open tree structure allows for easy harvesting
- Tree produces larger fruits
- Crops can be grown under the trees
- Tree benefits from natural conditions of sun and wind movement. This helps in reducing relative humidity within the canopy and also creating environment less conducive to disease development.
- It controls tree height and prevents excessive spreading of limbs.

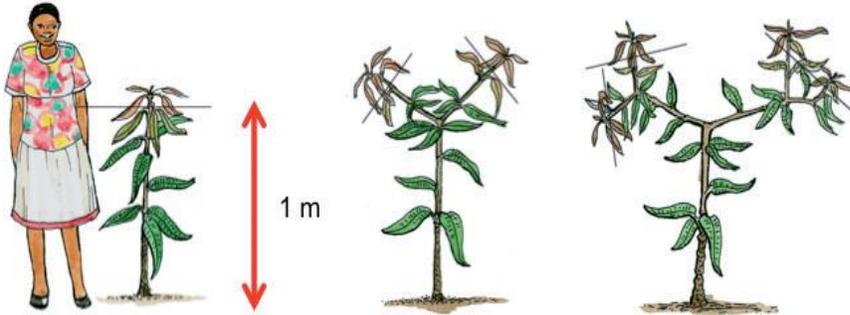
>> **Structural pruning** - should be done for proper maintenance of the trees and should be done mostly after fruit harvest. The height of the trees should be controlled to about 3.5 m in height and at this stage, all branches at knee level (about 0.5 m) should be pruned (skirt pruning). Any dead branches and sucker branches should be removed to allow more sunlight through the canopy to the ground under the tree. This should be done every year in order to maintain the tree at 3.5 m and develop a suitable canopy density.

Improve fruit production by:

- Keeping the orchard area clean
- Removing all ripe fruit and weeds from around the tree
- Removing 1/3 of fruit after fruit set to get better size of remaining fruit.

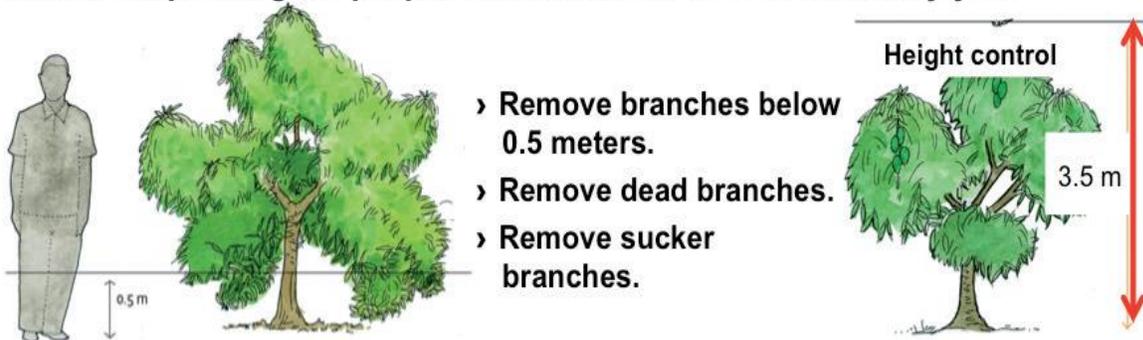
Proper pruning

Formative pruning to achieve the desired shape



Note: Make sure to prune before the node; if you prune after the node, too many shoots will arise

Structural pruning for proper maintenance, to be done every year



Flowering and fruit formation

- >> In the first four years pluck all flowers to encourage tree development.
- >> Smoke moist organic material under the tree (smudging) towards the dry season to induce flowering and reduce insect pressure.
- >> Encourage the formation of larger fruits by removing up to one third of the undersized fruits

ii) Improving flowering and fruit formation

Young grafted trees may flower within two years, but fruit formation should be avoided as it can considerably affect the growth of the trees. All blossoms should be plucked away until the fourth year when flowers should be permitted to develop. It is further recommended to keep the orchard area clean by removing all ripe fruit and weeds from around the tree. In addition, up to one third of undersized fruit should be removed after fruit set in order to encourage a larger size of the remaining fruit.

Alternation of flowering and fruit formation (fructification) is still a problem in mango production, especially in humid areas. This problem is characterized by the alternated production cycles of abundant flowering and fructification in one year, with low flowering and fructification the next year. The alternation of flowering and fructification in mango trees is caused by many different factors. For example:

>> **Biological factors** - varieties differ on the grade of alternation (e.g. varieties that flower regularly in one region can have a strong alternation in different regions and the age of the plant makes a difference in that younger plants tend to have more alternation).

>> **Environmental factors** - mango trees are sensitive to climatic variations (e.g. reduction in sunlight causes alteration in mango flowering and fructification, low temperatures during the night and a dry climate improve flower formation, while high rainfall coupled with good soils favour excessive vegetative growth). Strong winds on the other hand, may cause loss of flowers and fruit.

Smudging is the practice of smoking moist organic materials like grass or leaves under the tree canopies, either in a smoking heap or in cans, in order to induce flowering. Smudging is commonly done towards the dry season when mango trees are ready to flower (i.e. trees with leaves that are dull green with dormant shoots). Older trees are known to respond better than younger ones. For best results, a good supply of water—through irrigation or watering—is required.

The practice helps to have an altered earlier harvest in a period of undersupply for a better market price. On top of improving fruit setting, mango smoking also reduces insects. The smoking material can be mixed with aromatic herbs like lemongrass or lantana leaves to produce a repellent smoke that chases away insects from the tree.

iii) **Pegging heavy branches**

With some mango varieties, the tree branch may become so heavy with mango fruit that it eventually breaks. The farmer can thus intervene to save the harvest by pegging the heavy branches with wooden poles.

Improving soil fertility

Farmers need to implement proper management strategies to improve the fertility of the soil in the orchard. The following management strategies for soil protection and weed management in organic mango production can be recommended:

>> Planting cover crops especially in mango orchards before fruit production starts. A more permanent cover crop can be established and managed by slashing and weeding out of undesired plants that may compete with the cover crops or mango trees. The vegetative organic material left on the soil surface provides a mulching layer that protects the soil and positively influences the water retaining capacity of the soil.

>> Mulching, especially in the young mango trees.

>> Weeds can also be controlled by using small animals like goat and sheep to graze on the pasture under the mango trees. The farmer must be careful not to overgraze and to monitor the animals to avoid damaging the mango trees.

i) **Application of organic fertilizers**

The nutrient requirements of mangoes are dependent on the stage of growth. Mangoes especially require a good supply of nutrients during the active growth stage until about 4 years when they start fruit production and thereafter, more nutrients are required, especially during flowering and fruit formation.

The following general nutrient supply measures can be adopted:

>> During the early development of the mango tree (during the first four years), a regular supply of compost and green manure is provided to improve the foliar development.

>> As soon as the mango tree produces fruit (from the 4th year on), application of organic fertilizers (compost made of farm yard manure or other organic material) should always follow the flowering, so that enough nutrients are available for fruit formation and fruit development.

Mango trees under optimal conditions can achieve yields between 10 to 30 tons per ha and year. The yield varies per tree from 50 to 500 kg depending on the planting system, size of the tree and variety.

Maturity and Harvesting

A mango plantation will supply its first commercially marketable amount of fruit around 4 to 5 years after being planted, and are in good production after eight years reaching full maturity at some 20 years of age. One tree should produce 200 to 500 fruits per year and varieties like "Dodo" and "Boribo" can produce 1000 fruits per year. Most varieties show biennial tendencies in production and a poor harvest may follow a good one. Selection should be based on varieties showing annual bearing tendencies.

Depending on cultivars and environmental conditions it takes 90 to 160 days after flowering for Kenya mangos to reach maturity. Not all fruits on one tree will ripen at the same time. A great problem is to determine precisely the stage at which the fruit is ripe for picking. Fruits harvested too early will be of inferior quality after storage; however, fruits picked when too ripe cannot be stored for any length of time and may give rise to problems such as jelly seed. The fruit will have its best flavour if allowed to ripen on the tree. None of the tests (acid, sugar content or specific gravity) used to determine ripeness, however, are fully reliable.

The fruits are generally picked when they begin to change colour. This may occur first in a small area or the change will cover most of the fruit's surface. However, one destructive maturity test that can be applied even before the external colour break starts is to examine the colour of the flesh around the seed. When this begins to change from green-white to yellow or orange, it indicates that the fruit is beginning to ripen and may therefore be picked. Also the greater the swelling of the shoulders above the stalk attachment, the riper the fruit is likely to be.

Pick fruit by hand. Clip them off with a long stalk of about 2 to 3 cm and pack the fruit in a single layer with the stalks facing downwards in the box or crate. It is important that the latex dripping from the stalk drops onto an absorbent material (for example tissue paper placed at the bottom of the container). Although mature mangoes ripen fairly rapidly, they have a poor tolerance to temperatures below 10°C, especially when freshly picked. Ripe fruits can, however, be stored as low as 7 to 8° C without developing chilling injury.

Yield. 15 tons/ha per year can be achieved from the 7th year onwards if proper husbandry is followed.

Classification of mango cultivars according to maturity seasons

- Early cultivars (November to mid-January) - Apple, Ngowe, Haden, Dodo, Kensington, Zill
- Mid-season cultivars (mid-January to late February):- Boribo, Peach, Sabre. Sabine, Tommy Artkins, Matthias, Irwin, Van Dyke, Smith
- Lite cultivars (late February to April): - Sensation, Kent, Zillate, Keitt

Remarks:

Off-season fruits are common in all regions and especially at the Coast where a distinct second cropping season occurs during the months of May to August.

The above classification is more or less valid for the early, mid-season and late mango cultivars. The months mentioned are a yardstick since—depending on location—the picking season for a certain cultivar which is listed as an early cultivar for Coast Province will definitely be in mid-season in Central Province. Still, this cultivar is an early one for the relevant province.

Pests and Diseases

Although the mango in Kenya is spread throughout all feasible agroclimatic zones it has relatively few major problems with pests and diseases. These problems can be significantly reduced through a number of management decisions, for example:

- selection of proper orchard site
- selection of cultivars
- controlled fertilizer application
- timely spray application programmes
- orchard sanitation
- timing of irrigation

However, even when implementing these decisions there is no guarantee that some of these stubborn pests/diseases will not occur. Trees should be examined frequently to check for any infestations so that control measures, particularly for export fruits, can be applied before extensive damage can occur.

i) Mango fruit fly

Different types of fruit flies are known to attack ripening mangos in almost all mango producing areas. Yield losses of more than 50% have been reported. *Ceratitis cosyra* followed by *C. rosa* and *C. capitata* have been found to be the major pests of mango.

The females lay their eggs under the surface of the fruit skin. After hatching, the maggots penetrate the flesh and destroy the fruit from inside. The infested part becomes mushy and causes premature colouring of the already useless fruit. Fruits of some cultivars are more susceptible to attack than those of others.

Photos of Fruit flies



Fruit fly *Bactrocera invadens* male enlarged 800 times



Infested mango fruit full of maggots

ii) Mango seed weevil

The weevil, *Sternuchus mangiferae* (F), is a common pest in Kenya and can be found in all local mango-growing areas. It is spread mainly by transportation of infested fruits since the weevil develops within the mango seed and can therefore be transported easily from one locality to another unnoticed. The mango weevil does not usually damage the fruit and consequently is not a serious pest as far as local consumption of the fruit is concerned. However, this pest hinders the development of a fresh fruit export market because the leading import countries in the Middle East and other places maintain strict quarantine regulations.

Infestation symptoms are most obvious within the seed where the weevil largely completes its life cycle. Here all stages of the insect development—larvae, pupae and adults—can be found. Externally the affected fruits appear normal, but very often are rotting from inside.

The female usually lays her eggs over a period of 5—6 weeks on fruits before these are half-grown. The hatching period is 3—5 days. The young larvae penetrate the fruit and eat their way

to the seed where they feed and develop into adult weevils. These emerge from the stone by tunnelling outwards through the flesh and skin of the fruit, leaving an unsightly patch where rotting soon sets in. Once the weevils have left the fruit they search for a hiding place such as beneath loose bark of trees or in waste material under the trees where they spend the time of the year that is unfavourable for them.

Other pests include scales, termites and Leafhoppers but they are not of major economic importance.

Diseases of mangoes

i) Powdery Mildew

The disease powdery mildew, caused by the fungus *Oidium mangiferae*, is a serious problem in all mango-growing areas in Kenya. Infections can result in complete crop loss and defoliation of trees. The disease favours cool and cloudy weather but also occurs in warm and humid climatic conditions.

It attacks leaves, buds, flowers and young fruits. Infected tissues are covered with a whitish, powdery growth of the fungus. Mature spores are easily blown away by wind and produce a fresh infection, or they may remain dormant during the unfavourable season awaiting optimum germination conditions in the next season.

Spraying 3-5 times at 10-14 day intervals from the onset of flowering until fruit set can control powdery mildew.

All mango cultivars are susceptible to powdery mildew infestation to some extent. The range of resistance (with Sensation being the most resistant) could be: Sensation, Van Dyke, Tommy Atkins, Sabine, Kent, Keitt, Batawi, Apple, Ngowe, Haden.

ii) Anthracnose

Besides powdery mildew, anthracnose, caused by the fungus *Colletotrichum gloeosporioides*, is undoubtedly the most common and widespread fungus disease of mango and is a major factor limiting production in areas where conditions of high humidity prevail.

The fungus invades inflorescences, fruits, leaves and twigs. Substantial losses due to this disease are recorded every year not only at premature stages of the crop but also during storage after picking.

Humidity, rains and heavy dew during critical infection periods greatly increase the disease incidence. Most infections occur from the beginning of flowering in gradually decreasing severity until the fruit is about half-grown. Infections on the flower and panicle appear first as minute brown or black spots which slowly enlarge. Infected flowers usually wither and die before fruit set.

Young fruits are readily infected. Spots may remain as pinpoint latent infections or they may enlarge in wet weather. Wet weather also causes characteristic tear-stain symptoms due to the

spread of fungal spores by raindrops. The latent infections on young fruits cause much of the decay which occurs in mature fruits. Nearly mature to ripe fruits will have black spots of varied form which may be slightly sunken and show surface cracks penetrating deeply into the fruit causing extensive rotting or complete blackening of the fruit surface.

It is recommended to start spraying at the stage of flower-bud formation. During flowering/fruit set and until the fruits have developed to half their size, spraying should take place at fortnightly intervals. After this, it is sufficient to treat the trees once a month. It is very important to apply a full cover spray for the first two applications. Since this period is also the critical stage during which powdery mildew and the mango weevil attack, counteractions should be implemented using recommended fungicide/insecticide combinations.

All cultivars are to some extent susceptible to anthracnose. The range of resistance (with Tommy Atkins being the most resistant) is: Tommy Atkins, van Dyke, Sabine, Ngowe, Apple, Keitt, Kent, Sensation, Boribo, Haden.

There are several other diseases of mango fruits that have been reported occasionally. These include alternaria rot, mango scab, stem-end rot, algal leaf spot and sooty mould.

Common mango varieties grown in Kenya

1. Apple Variety:



This variety originated from the Kenyan coast. It has a rich yellow/orange colour when ripe, with medium to large fruits that are round in shape and smooth in texture and that do not have fibres. The tree is susceptible to anthracnose and powdery mildew.

Depending on location, harvesting seasons are from December to the beginning of March; the yields are medium.

2. **Tommy Atkins variety:**



The Tommy Artkins variety has become an important commercial variety. It has a firm, deep-yellow flesh, medium juice and moderate fibre and pleasant aroma. It is good for export because of its longer shelf life.

shelf life. It can also resist anthracnose and powdery mildew

3. **Kent variety:**



The Kent variety has a large-greenish-yellow fruit with a red or crimson blush on the shoulder. Its flesh is juicy, melting deep yellow and fibreless, with a rich flavour. The Kent tree is large and vigorous with a dense upright canopy. It is a late-maturing and is suitable for export.

4. **Ngowe variety:**



Ngowe is the most easily recognised of the local mango varieties. Ngowe mango trees are comparatively small and round in shape. The fruit is good for commercial production and export; however the tree is susceptible to powdery mildew.

5. Haden variety:



Because of its good quality, seeds from the Haden variety are used as parent for several other varieties of mangoes. It produces medium to large-sized fruit and is very juicy with a pleasant aroma. The Haden variety has an attractive appearance and is suitable for commercial production.

6. Sabine Variety

The medium- to large-sized, **elongated** but full fruits are of very good quality. Those developing inside the **canopy** are deep yellow while those exposed to the sun are bright yellow with a dark red blush. The yellow flesh is of medium texture, fibreless, pleasantly sweet, juicy and of a mild aroma. The average fruit dimensions are: length 14.2 cm, width 6.6 cm and weight 435 g (range: 360–520 g). The rounded **apex** carries only a small depressed **beak**. The seed is **mono-embryonic** and covered by a medium-sized woody stone (9.6% of fruit weight).

