

*Green Africa*  
FOUNDATION



# MANGO

## PRODUCTION

### BOOKLET



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# Foreword



Mango production has significantly contributed to enhanced welfare of farmers in many parts of the world. Since its inception in the year 2000, Green Africa Foundation has been using Green Villages to enhance sustainability in Africa through our three known Greens;

- i. Treating people kindly through upholding ethics and training on life skills
- ii. Promoting good health, peace within communities and creating sustainable livelihoods and,
- iii. Actual environmental conservation through sound environmental practices.

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This booklet therefore forms part of the tools and mechanisms been used to capacity build the Mango farmers.

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In pursuing the above, Green Africa has realized the critical role that food security plays towards a Green Africa.

Through IGAD's funding, Green Africa has partnered with NETFUND to implement a project on sustainable utilization of mangoes. Through this unprecedented project, communities in Kitui County have been trained in sustainable production of mango fortification flour.

This reduces post harvest loss and increases revenue. Apart from training, three medium sized mango fortification flour processing plants have been established at Muumoni and Kyuso organization for Rural Development and Active Participation (MUKY-ORDAP) in Mwingi, Kitui Development Centre (KDC) in Kitui Central, and RISE- Kenya in Migwani.

This booklet shares some of the tools and mechanisms that have been used to build the mango farmers' capacities. The booklet provides information on the whole value chain of mango production, beginning from seed propagation to marketing and consumption. Whereas the booklet is a product of the project, it is projected to be of great use to farmers, extension officers, researchers, policy makers and any other development partners across the world.

Indeed, we believe that this booklet will help in making Africa greener.

Dr Isaac P. Kalua  
Founder, Chairperson Green Africa Foundation

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## Disclaimer

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# 1.0 Introduction

## Origin of Mangoes

- Mango origin can be traced from India in Indo-Burma around 4000 years ago. Cultivation of mangoes thereafter spread to other countries in the Southeast Asia including Philippines, Indonesia, Thailand, Malaysia and Sri Lanka.
- Introduction of the mango to East and West Africa and subsequently to Brazil is said to have occurred in the sixteenth century.
- The wild progenies are still available in India in the two indigenous species; *Mangifera indica* and *Mangifera sylvatica*, which have small fruits with a big stone, thin acidic flesh and long fibers.
- The knowledge of vegetative preparation gained in the sixteenth century made it possible to produce a large number of cultivars which were far superior to the wild forms.
- Mangoes do well in the lowland to upper midland zones. The most suitable areas for the cultivation of mangoes in Kenya are the Coastal areas, Lake Victoria region, Murang'a, Thika, Kajiado, Meru, Isiolo, Taveta, Lower Embu, Machakos, Kitui, Mbeere, Makueni and Kerio Valley.

## Ecology

- Mangoes (*Mangifera indica*) grow well from sea level upto 1800 meters above sea level with annual rainfall of between 500 to 1200mm.
- Soils that are deep fertile, well drained and devoid of water logging are preferable. The optimal temperature for mango cultivation is 20–30° c.
- A dry period of 40 to 90 days is important for flowering and commercial fruit production.
- While once established mangoes require little water, however some farmers induce early flowering and off- season fruiting through irrigation and application of farm yard manure
- While mangoes have no cholesterol, they have a high content of Vitamin C (around 70%) Vitamin A (around 20%), calcium (around 2%), iron (around 1 %) among other nutrients.

## 2.0 Mango Cultivars/ Varieties

### Indigenous/Local Cultivars

- These are the recommended cultivars for a root stock for the grafting purpose. The common and most recommendable varieties are Sabre and Peach.
- It is therefore necessary for every farmer to have one or more of the indigenous variety for good quality seeds for propagation

**Sabre;** It is long and slender, with a characteristics sigmoid shape. Bright red to crimson on the sun side, they are predominantly yellow on the shaded side. Their rich, sweet, and spicy flesh, dark orange in color, has considerable coarse fiber.

### Exotic varieties

#### “Apple”

- The fruits are medium to large, nearly round in shape and have a rich yellow/orange to red colour
- The skin is smooth and thin, and the juicy yellow flesh has excellent flavour and a melting texture virtually free from fibre
- Average Length:9.7 cm with a width of 11 cm
- Average Weight:280 – 580 g (mean: 397 g)
- Harvesting Periods: December to March
- Yields: medium
- Advantages: Early cultivar of excellent fruit quality, small/medium seed size, free from fibres
- Disadvantages: Susceptible to

Anthrachnose and Powdery Mildew, Alternate Bearing, range of altitude adaptation is limited



*Apple Mangoes*



*Ngowe Mangoes*

## “Kent”

- The fruits are large & ovate with a greenish-yellow skin, red or crimson blush shoulders and a rounded base shape
- The skin is thick and tough with small numerous yellow lenticels; the flesh is juicy, melting, deep yellow, fibreless and of a rich flavour
- Average Length: 12.4 cm with a width of 9.7 cm
- Average Weight: 545 g
- Good yields in the late mid-season
- Advantages: late maturity, fibreless and of excellent internal quality, fruits ship well
- Disadvantages: skin coloration is often inadequate, prone to storage diseases, may exhibit alternate bearing

## “Tommy Atkins”

- The fruits are medium to large, oval to oblong longer than broad, orange/yellow with a heavy red blush, numerous white lenticels and a broadly rounded base
- Highly resistant to diseases
- The smooth skin is tough and thick
- Average Length: 12.6 cm with a width of 9.9 cm
- Average Weight: 522 g
- Early to mid-season cultivar
- Advantages: very attractive fruits, excellent shipping and shelf-life qualities, consistent producer, good resistance to Anthracnose and Powdery Mildew
- Disadvantages: danger of internal breakdown (jelly seed) and the fibre content is slightly higher than average

## “Keitt”:

- It is large, ovate & plump, rounded base shape and without a beak. Average Length: 11.7 cm by 9.2 cm in wide. Average Weight: 456 g.

- Advantages: Late maturity, good marketing qualities and productivity and has fair resistance to Anthracnose

## “Van Dyke”:

- It is small to medium size, ovate shape a bright yellow ground colour with a heavy crimson blush and prominent beak. Average Length: 10.5 cm by 7.9 cm in width. Average Weight: 280 g.
- Advantages: Good resistance to Anthracnose and Powdery Mildew, and is a regular bearer

## “Sensation”:

- It is medium size, oval/oblique, and deep yellow colour with a prominent dark-red to purple blush. Average Length: 10.8 cm by 7.8 cm in width. Average Weight: 307 g.
- Advantages: Beautifully coloured, late cultivar, none to scanty fibres and is a heavy yielder

## “Sabine”:

- It is medium to large size, elongated, bright yellow colour with a dark red blush. Average Length: 14.2 cm by 6.6 cm in width. Average Weight: 435 g.
- Advantages: Only slightly affected by Anthracnose and Powdery Mildew, no distinct biennial bearing and has no fibres.

The above are some of the mango varieties out of the already existing hundreds. Others include Ngowe, Arumanis, Carabao, Haden, Gesine, Dodo, Kensington, Zill, Alphonso, Heart, Batawi, Boribo, Golek, Madoe, Chino, Matthias, Irwin, Smith, Parwin, Zillate among many others.



## 3.0 Nursery Establishment and Management



*Women participating during demonstration on Mango farm management at Katse in Mwingi*

### Propagation from seed (Tree nursery techniques)

Mangoes can be propagated from seed. This is important for production of rootstock.

- Collect fresh seed
- Peel off the outer husk and sow the inner seed to quicken germination.
- Plant seed in seed bed or sow directly into container.
- For on farm demonstration, plant quality seed and graft after two years
- After acquiring quality seeds place them on the already prepared seedbed

**While planting mango seedling on the farm, a pit of 60cm by 60cm is preferred. The pit should be prepared 2 months before planting.**

- The seedbed should be either raised or sunken prepared with soil, sand and manure at a ratio of 1:2:3
  - The sand ensures reduced chances of infection and also provides for easy transplanting
  - While planting mango seedling on the farm, a pit of 60cm by 60cm is preferred. The pit should be prepared 2 months before planting.
- Mango seedlings can also be collected/uprooted under the indigenous varieties after they sprout during the rain seasons. This should be done when the farmer is sure of no possibility of the seedlings having germinated from mango seeds from grafted varieties.



## Vegetative propagation (grafting techniques)

### Selecting rootstock for grafting

- Select healthy seedlings free of pests and diseases
- Select indigenous stock recommended varieties are the peach and sabre.
- Select the right stem size as scions to be used
- Rootstock should be planted on sand for easy transplant
- Avoid picking /collecting seeds in the market places to avoid getting seeds from exotic varieties
- Prefer to acquire seeds or seedlings from certified sources by KEPHIS and HCD.
- Use plants that show vigorous growth in the nursery
- Avoid crooked and multi stemmed rootstock



## Scion selection

- Select from desired cultivar which is preferably from the indigenous
- Select from healthy mother trees.
- Identify and pick similar size as rootstock
- Remove all leaves from selected scions
- Keep the scions cool during transportation to grafting site
- Collect scions of desired length (15 -20cm)
- Scions collected during dormancy perform better since this help in preventing premature flowering
- Label all collected scions accordingly

Mango seeds take around 10-14 days to germinate once placed in a seedbed. It requires around 3 weeks to transplant the seedlings after they germinate. Grafting should be done once the seedlings are 30cm of height. Seedlings should stay at the nursery for around 7-8 months after which they should be planted. If grafted on the nursery, they should take around 16 months before been planted on the farm





## 4.0 Mango Farm Management

### Orchard Sanitation

- Orchard sanitation plays a key role in pest and disease management.
- The debris from fallen leaves, flowers and fruits harbor pests and spores of diseases at different developmental stages.
- It should be a routine practice to get rid of the debris and burn it. Incorporating it in the soil especially for infected one is multiplying the inoculum for next infestation.
- Feeding infected crop material to livestock or incorporating it in the cattle shades to get organic manure is not advised as the spore and pest eggs are known to withstand extreme conditions for a long time and still be virulent.
- Orchard sanitation also plays a role in the postharvest quality of mango fruits as anthracnose attacks has been known to occur even after harvesting and during harvesting farmers are known to drop harvested fruits on the ground awaiting collection after the exercise is done with.
- Mango spacing is a very critical aspect that should be considered during planting in the orchard. In this case a farmer will consider the purpose of planting. It is recommended to give spacing of 8m by 8m when doing mono cropping (pure stand) and 12m by 12m when intercropping with some other crops.







## Weed management

### Importance of Weeds in Mango Orchard

In an orchard weeds are a major occurrences and their growth and vigor is a factor of spacing and soil fertility. Irrigation also plays a role in weed development as well as the rainfall. If not addressed weeds pose the following problems to mango trees.

- Compete with young trees for sunlight and nutrients, sometimes stifling them leading to stunted growth
- They drain the soil nutrients and cover up areas which can be utilized to grow food crops especially in young orchards
- Serve as alternative host for pests and diseases
- Attracts goats and cattle to mango orchards as weeds also serve as fodder in livestock
- Weeds if incorporated into the soil become a good soil source of organic matter increasing soil fertility
- Dry weed stalks encourage termites which are a major problem in mango orchard development

**They drain the soil nutrients and cover up areas which can be utilized to grow food crops especially in young orchards**

### Methods of weed control

Several methods have been employed over time in controlling weeds. These include

- i. Use of hands; where weeds are uprooted by hand. It is good method when practicing minimum tillage and only effective on sparse weed population.
- ii. Weeding; weed elimination using a hoe which is economical when there is an intercrop with a food crop. But it's recommended to use the fork Jembe to avoid interference with the root hairs.
- iii. Slashing; most effective in mono-cropped orchard.
- iv. Herbicides: effective on a mono-crop orchard.
- v. Mulching; a well mulched orchard has no weeds as the mulch discourages weed growth and it is environmentally safe



## Relationship between weeds and pests/diseases

Weeds play a major role on pest and disease management in the following ways;

- They serve as alternate hosts for pest and diseases
- During chemical applications pests migrate to the weeds and return to the mango once the chemical effect has diminished.
- Weeds serve as breeding ground for pests as they are below the mango canopy where they are shaded from direct sunlight
- Under tree canopies weed transpiration creates a microclimate ideal for disease development especially Powdery mildew

## Weed and Integrated pest Management

- Weed control is one of the pillars for integrated pest management under strict pest management strategies
- Weeds harbor beneficial insects what is referred to as farmer friend. It is recommended that farmers develop insectaries around their orchards to host these beneficial and pollinating insect like bees.
- Weeds lead to pesticide wastage as application should also be done on them to achieve meaningful control the alternative being a re-infestation if they are not treated
- Plant nutrition is a major factor in pest management and weed infested field leads to weak trees due to competition and uneven placement of fertilizers
- Especially climbers, they affect spray coverage on target trees thus leading to uneven coverage of spray mix



## Flower Induction

### Classification of mango cultivars according to maturity seasons in Kenya

Season	Cultivar
Early cultivars (November to mid January)	Arumanis, Apple, Carabao, Ngowe, Haden, Gesine, Dodo, Kensington, Zill
Mid-season cultivars (mid January to late February)	Alphonso, Heart, Batawi, Boribo, Golek, Madoe, Peach, Sabre, Sabine, Tommy Atkins, Chino, Matthias, Irwin, Van Dyke, Smith
Late cultivars (late February to April)	Parwin, Sensation, Kent, Zillate, Keitt

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 late cultivars pick good market prices but are also highly vulnerable to diseases and pests.

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 cultivar which is listed as an early cultivar for Coast region will definitely be in mid-season in Central region. Still this cultivar is an early one for the relevant region.

- According to the HCD, most mangoes in Kenya are available from November-April (sometime to July). Because of less competition better prices are fetched in Europe and the Middle East between November and December.
- Many techniques have been used in other countries to improve productivity and to alter the cropping season.
  - a) Smudging (moist organic material-

grass, leaves etc- is slowly burnt under the tree canopies and the resulting smoke induces flowering) is an old technique reported from the

Philippines for enforcing off -season flowering, but this has largely given way to chemical induction.

- b) The application of potassium has been commercially accepted. The reasons are obvious: to have an altered earlier harvest, to take advantage of the good market price, to fill the gap of under supply and to have flowering during dry spell with little or no fungal diseases.
- The readiness of tree to flower is an important factor for successful operation. For best results, choose trees with leaves that are dull green or greenish- brown and brittle when crushed by hand. The trees should have an appearance of suspended growth or be dormant. It is easier to induce mango trees to flower towards the dry season, and older trees respond better than young ones.
  - It is recommended that a one percent potassium nitrate solution mixed with a sticker agent (adhesive) be sprayed on the tree, totally drenching its terminals and

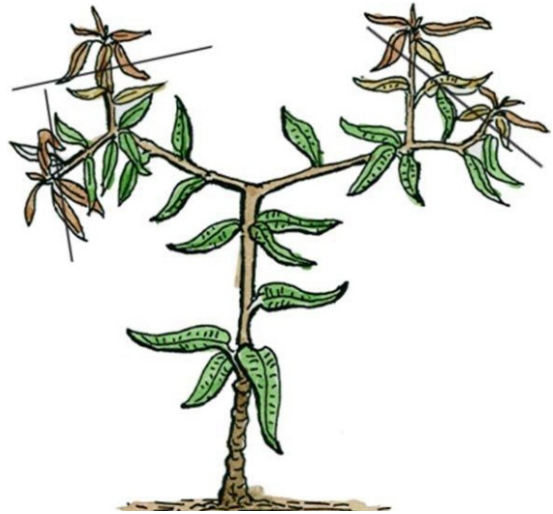


leaves. Make sure a knapsack sprayer has no residue herbicide in it before beginning to spray. If the timing is right, flowers will emerge 10-14 days after application. Tentative trails have been successfully implemented in Kenya.

## Mango Pruning

Mango plants should develop into strong well-shaped trees within the first 4 years and do not require pruning unless there are excessive branches or the shape is unusual. Depending on the cultivar and growth pattern selective pruning of branches may be required to encourage growth of lateral branches and to ensure development of good tree architecture for future fruit bearing.

- Any branches on the trunk lower than one meter from the ground should be cut. In later years, pruning is done mainly to remove diseased and/or dry branches or those touching the ground or crowding others.
- Grafted trees tend to flower from the first year, and the formation of fruit on year-old mango trees is nothing exceptional. Flowering at this early stage and especially early bearing weakens young trees and often damages them severely. Therefore early flowering has to be avoided by removing the inflorescences; only from the third or fourth year should trees be allowed to bear fruits.
- Mango pruning should be done immediately after planting and after harvesting (immediately before flushing) and this should be kept a routine. In Eastern Kenya it is recommended in the periods of February-March.



## Fertilizer Application

A general criterion regarding mango nutrition is that care must be taken not to apply excess fertilizers thereby promoting vegetative vigour at the expense of flowering and fruit set.

- This is particularly true for nitrogen application since trees are subject to fertilizer burn.
- Correct fertilizer requirements can only be determined by means of leaf and soil analyses taken in different agro climatic regions.
- With trees in fruit, proper timing

is critical and it is recommended that fertilizer be applied just after harvesting, during the rains.

- In general, a tree at full bearing age (7 years and older) needs about 1,5 to 2,5 kg of Calcium Ammonium Nitrate (CAN) (26%); 2,25 kg superphosphate and 0.75- 1.5 kg Potassium chloride per year or the equivalent inputs from manure or compost for small-scale farmers.
- These quantities can be supplied either at one time or may be split into two doses administered with a two-month interval between them.

### Pest and Disease Identification-Scouting

Before any control or preventive measures are taken against any pest or disease, farmers must be able to identify the problem in what is called scouting. This is achieved by walking through

the orchard and examining the mango trees.

- Orchard inspection should begin for the young trees to the old ones as the disease and pest infestation increases with age. Un-coordinated scouting leads to dispersal of fungal spores especially mildews and anthracnose.
- For diseases given their severity a single incident is adequate to initiate control measures regardless of the age and stage of the mango tree or fruits. However with a constant monitoring of weather and climatic conditions it is prudent to initiate preventing measures when it is anticipated a weather change favorable for disease development.
- Wet humid conditions favor disease development so is a flush of new growth. After pruning the wounds that occur are entry points to disease causing micro organisms thus need disinfection.



*Farmers during a session on disease and pest management in Kathukini-Kitui County*



## 5.0 Major mango pests and their management

### Mango fruit fly

It has a yellowish colour on body and wings

On the sides and posterior of thorax there are black spots

The tail end is yellow with two black spots

Has a wing span of 4-6 mm



### Life cycle

Eggs hatch in 2-3days

Lava stage takes 5-15days

Pupa stage takes 9-12days

Adult stage 41 days

At 5days adults starts laying eggs and continue up to 7weeks

One fruit is normally infested with 50 larvae of the fly.



### Control

- Ensure orchard sanitation i. e remove and destroy fallen fruits
- Spot treatment
- Use of certified efficient pesticides (consult extension officers)
- Use of mango fruit fly traps (most recommended)



*Affected mango fruits by fruit fly-Source: Journal of Agricultural Science and Technology (2014)*



## **Mango Seed Weevil (*Sternochetus mangiferae*)**

- The presence of mango seed weevil reduces market options
- Fruits infected by mango seed weevil cannot access markets in Western Australia, China, Korea, USA, UAE and South Africa.
- Weevils move between orchards in infested seed and can spread through by flying
- Unmanaged trees and fruit dumps are an additional sources of weevil infestation

### Monitoring for Mango Seed Weevil

- Adults are hard to find
- Check for adults under bark during winter
- Check for feeding damage on new flushes
- Look for the presence of eggs on fruit
- Cut fruit and seeds at harvest to look for larvae

### Control Options

- Remove all fruit from orchards
- Destroy reject fruit; remove from farms
- Mulch fallen fruit and prunings before weevils emerge
- Target adults with chemical controls during emergence flushing, fruiting and on trunks
- Target emerging larvae on fruit with systemic chemicals

Adults are active at dawn and dusk feeding on new flush. Adults shelter under rough bark on the trunk and the main leaders. Egg of the weevil hatch and larvae enter the seed.



*Affected mango fruits by fruit fly-Source: Journal of Agricultural Science and Technology (2014)*



## Mango Gallfly

### Identification:

- The gall midges are small insects measuring about 3 mm in length
- Adults which are mosquito-like in appearance prefer to lay eggs on young leaves
- The larvae mine the leaves producing galls or swelling tissues
- Under heavy infestations, the leaves wrinkle and remain yellow
- Dark green, circular galls randomly distributed on the leaves blade

### Control

- Spray the whole canopy before or at the onset of flushing using systemic sprays
- Use certified efficient systematic chemicals (consult with extension officers)
- **Farmers are advised to be aware of the active agents in the chemicals to ensure right pesticides and fungicides**



## Mango Scales

### Identification:

- Small round reddish brown to white insects
- Usually found in clusters which are immobile
- Insects can be 1 – 7 mm long while the cluster can be 2 cm in diameter
- Clusters found on upper surface of leaf, branches stem and fruit
- Females are circular in

appearance, have dark spot on one side, have neither wings nor legs

- Adult males have two wings

### Control

- They are easy to control just as aphids. Use of certified efficient pesticides
- Natural methods like birds are also applicable



## 6.0 Major mango diseases and their management



*Anthracnose symptoms on;*  
 a) Single lesion on ripen fruit  
 b) Lesion allover fruit surface  
 c) Tear-stain pattern  
 d) Leaves and,  
 e) Early infection on a panicle

### Anthracnose

- Wet humid warm after flowering encourages disease development on flower panicles. The disease attacks papaya, mango, avocado, passion fruits and coffee among other trees and crops.
- On leaves it starts as small angular black and brown spots that coalesce into large extensive dead areas
- On panicles it starts as small black and brown spots that coalesce and kill flowers before fruiting
- On green fruit infection remains latent and invisible until after ripening
- On ripe fruits sunken prominent dark brown decay spots develop before or after picking. A tear stain on fruit is a sign of infection. Other visible signs include an alligator skin effect superficial cracking and wide cracking on epidermis extending to the pulp. Lesions on stems and fruits which produce a pinkish orange spore mass.
- Fruits may drop from trees prematurely.

### Dissemination

- Infectious spores spread through rain splash or irrigation water. Infection sites are panicles, leaves and branch terminals.

### Reproduction

- Sticky masses of conidia are reproduced in fruiting bodies during moist rainy humid conditions. The pathogen survives between seasons on infected defoliated branch terminals and mature leaves

### Control

- Spray using efficient certified fungicides. The spraying should be done in 7-14 day interval depending on the intensity of manifestation.

## Powdery Mildew

It is a fungal disease whose major predisposing factor is wind.

- It is predominant in low rainfall areas. The strain that attacks mango is host specific meaning only mango trees are affected by it. Areas affected: panicles, fruits and leaves
- Whitish powdery growth on flowers and fruit turn brown and dry. Dead flowers crumble on one hand. Attack leads to flower and fruit abortion. Leaves curl up and become distorted while old leaves are resistant to infection.

### Symptoms:

- Appears as white powdery growth on leaves, flowers, flower stakes, and young fruits
- The white powdery growth turn black later in the season
- Grayish necrotic lesions/spots on leaves
- Infected leaves curl and become distorted
- Killed flowers turn brown and gray
- Infected young fruits have purplish haze
- Mature spores are easily blown away by wind and produce a fresh infection, or they may remain dormant during the unfavorable

season awaiting optimum germination conditions in the next season

### Control:

- Choice of resistant varieties e.g.) Sensation, Chino, Van Dyke, Tommy Atkins
- Cultural practices e.g.) spacing, pruning, sanitation etc.
- Observe plant nutrition
- Spray efficient and certified fungicides just before flowering/flower bud formation
- Spray baking soda mixed with water
- Spray 70 % Neem Oil

### Non-Chemical Control

- Site selection should be done to ensure there is enough air circulation in the orchard.
- If adjacent fields have mango trees or alternate host trees for pest or disease erect a barrier
- Select cultivars resistant to diseases predominant in your locality e.g Tommy Atkins is resistant to anthracnose
- Ensure you observe orchard sanitation
- Practice intercropping with agro forestry trees or other fruit trees
- Prune trees to ensure flowers are within range of spray equipment alternatively use extended nozzles while spraying

Other diseases include the Scab, leaf spot, gall, and the deficiency of Calcium among others.



*Stalk, young fruit, and leaves affected by Powdery Mildew*

## 7.0 Post harvest Handling

- Mango harvesting can either be done through fruit picking or tree shaking. Picking is preferred more to shaking which can highly compromise the quality of the mangoes
- 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 fruits surface. However, one destructive maturity test that can be applied even before the external color break starts is to examine the color of the flesh around the seed. When this begins to change from green-white to yellow or orange, it indicated 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. Mango fruit ripening happens 12-16 weeks from fruit set.
- During and after harvesting the highly perishable fruit must be handled with the greatest care. The fruit is removed from the tree by cutting the fruit stalk about 3-4 cm from fruit. This will prevent the latex (exuded from the cut stalk) adhering to the skin of the fruit, staining it and rendering it unattractive.
- Ladders or long picking poles with a cutter blade and an attached canvas bag, held open by a ring, are also in use.
- To avoid physical damage, the picked mangos should be carefully placed into clean wooden or plastic containers and never into gunny bags. If there is a delay in the transfer of the fruits to a store or packing shed they should be kept in a sheltered place to minimize sunburn, loss of moisture and accumulation of dust.
- Farmers/buyers when transporting the mango fruit either to the consumer or to the processing industry should take into consideration the transportation policy which directs use of the crates during transportation not polythene papers and also recommend covered trucks to open ones for transportation. . The mangoes should be placed in an upside down position in the crates and latex drained from the fruits.
- After sorting, grading, washing, fungicidal treatment and perhaps waxing, the fruits are ready for packing, preferably into shallow single-layered trays of 4-5 kg each.
- Because mangoes are harvested during the summer months, the fruit temperature may be as high as 35<sup>o</sup>C and more. This has detrimental effect on the shelf life of the fruit. It is therefore advisable to move the packed fruits into cold storage as quickly as possible to help them lose this inherent heat.
- The recommended storage temperature must, however, not drop below 7<sup>o</sup>C (range: 7-10<sup>o</sup>C) as otherwise cold injury may occur.
- Mangoes yields: 6 tons per acre from the seventh year.



## 8.0 Marketing and Market Opportunities

- Given the small scale context of most mango farming in Kenya; farmer groups or cooperatives are encouraged to allow farmers benefit from economies of scale which involves been able to access farm inputs at relatively lower prices and increase their bargaining power for better output prices. This will also strengthen their capacity to access financial services like loans and in addition information.
- While mangoes are consumed raw and fresh at most local farmer and consumer level, these markets always face a challenge as a result of the fact that mangoes are highly perishable and that their shelf-life is quite short when fresh. Technologies have therefore been devised to improve the storage capacity of mango fruits and provide for value addition. Mango Juices and fortification flour are products of innovations towards this effort.
- Exploitation of export markets such as; Saudi Arabia and Russia will be important and shall play a very important role in limiting the chances of losses as a result of rotting and falling off before consumption. This calls also for development of several and high capacity industries to process mango fruits.
- In Kenya the availability of large companies dealing with fruit products is a market avenue for farmers.
- In Kitui County there are emerging small industries. There are about 4 both small and medium plants doing mango juice processing and the three previously mentioned emerging ones on Mango fortification flour. This also opportunities farmers can utilize and replicate wherever possible.
- Formation and strengthening of farmer groups and cooperatives will be important in increasing the bargaining power of farmers in the market.



*Mango being sold in a market: source [www.ssgadvisors.com](http://www.ssgadvisors.com)*



# 9.0 Record keeping and cost benefit analysis

There are 2 types of records in Mango farming:

### Individual Record

- Kept by individual farmers and include the cost of production and sales
- Useful in analyzing whether the farmer is making profit or losses in his farming enterprise

### Group Record Keeping

- Include activities such as group purchase of inputs, selling of produce etc.

### Mango Gross margin/ Profit analysis Sample Template

Mango farming benefits provides good profits if farmers do it as a business either in large scale of in farmer groups for small holder farmers. Records are very important to ensure farmers ability to estimate their income. The profits are as a result of the total mango sales less the total costs. The table below demonstrates a template showing farmer income from mango farming.

Per acre	Year 1	Year 2
Income:		
Mango yield (mangoes/ crates/ trays)		
Price per mango/crate/tray		
Total fruit mango sales		
Other income (salvage value)		
Total Income	Y	Y
Costs:		
Field costs		
Land and buildings, Plant and equipment etc		
Total capital/fixed costs	n	0
Variable Costs		
Labor		
Pesticides		
Manures/fertilizers etc		
Total variable costs	m	m
Total Costs	$n+m = x$	$m=X$
<b>Profits</b>	$\pi = Y- x$	$\pi=Y- X$

#### Where:

**Y** stands for total income from mango per year  
**N** stands for the total fixed costs  
**M** stands for the total variable costs and;  
 **$\pi$**  is the profit/ loss  
 Note that fixed costs appear only in the first year unless the farmer wishes to expand the farm or enhance technology.  
 Mangoes produce based on climatic conditions hence their availability is not only seasonal but also regional.

The below table demonstrates a Kenya regional mango calendar.

Area	Season calendar
Coast province (Kilifi, Lamu, Kwale)	November- February& June-August
Central ( Muranga and Maragua)	November- March
Eastern (Makueni, Machakos, Kitui, Larger Meru and Embu)	December- March- April



Mangoes after harvest: source [www.ssgadvisors.com](http://www.ssgadvisors.com)

### Challenges of Mango Business

- Lack of knowledge in trade and marketing information
- Inadequate management
- Language barrier between the farmers and buyers/market language
- Low export volumes
- Poor fruit quality- fruit fly infestations and mango weevil.
- Lack of specialized transport- refrigerated trucks
- High cost of inputs- packaging materials, pesticides, fertilizers and also labor
- Lack of organization stakeholder consultation and policy support

Farmers should target to grow 90% for export markets and categorize their mango into the following quality categories

- Top range- categorized to sizes 8, 10 and 12 and preferred for export markets.
- Middle range- local market
- Third quality for processing industry

Overall goal should be;

- To increase production and reduce post harvest losses
- Expansion of commercial orchards.
- Certification of Global GAP
- Introduction of common label seal of origin

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