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Codes of Practice for Mango Farming & Processing



**A guide book to help address the critical control points along the supply chain
for enhancing competitiveness and exports**

Disclaimer

This guide book to address the critical control points along the entire mango supply chain has been developed based on the research carried out by Mango Research Station (MRS) and University of Agriculture Faisalabad (UAF) and practical implementation of their research outputs at the pilot farm clusters and pack houses under the overall guidance and monitoring by the EU funded TRTA II National and International Experts.

The main objectives of these guidelines is to enhance the competitiveness and exports of mango and are in line with those developed by FAO for similar produce. These guidelines also support the overall strategy to strengthen the horticulture sector in Pakistan

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The guide book has been jointly developed by the European Union (EU) funded Trade Related Technical Assistance (TRTA II) Programme, implemented by UNIDO, in association with ITC and WIPO, and the Australia-Pakistan Agriculture Sector Linkages Programme (ASLP) funded by Australian AID.



European Union



United Nations Industrial
Development Organization



International
Trade
Centre



Preface

Food security and nutrition are the foundations for human and economic well-being. Without this people would experience poor health that would lead to low productivity and stymied economic growth. However, the effects of food insecurity go beyond human and economic well-being. It is imperative that the poor and vulnerable are not trapped in the vicious poverty cycle, food insecurity, and malnutrition; instead, they should benefit from and contribute to a country's rising prosperity. Innovative solutions are necessary to break this poverty cycle, as the growing threat of climate change is expected to hinder production of staple foods in regions of high vulnerability.

Pakistan is blessed with a climate that supports the growth of premier quality Mangoes and Kinnow mandarins. The country produces almost 2 million tons each of Kinnow and mango every year and can earn a lot of foreign exchange by developing the value and supply chains of these fresh fruits.

Improving the quality and consistency of the fresh fruits that are available to consumers is an important goal of The Punjab Agriculture Department. Providing outstanding-quality fruit in the market that consumers will want to purchase again and again requires a commitment to quality by each and every stakeholder involved in the mango and Kinnow production and handling.

Every step in the handling of fresh fruits contributes to the delivery of good quality and enhances shelf-life. Therefore, attention to detail is required at each step of the preparation and distribution. This manual outlines all the steps involved in the Kinnow and mango handling and distribution and addresses the common problems and recommended best practices that will ensure delivery of the best quality mangoes to both domestic and international markets. The manual also includes the quality-control procedures used when monitoring the maturity and quality of mangoes in commercial handling operations.

Market oriented production trends across Asia and the Pacific region, spurred by growth in the food service, supermarket and export sectors, rising living standards and growing consumer awareness, necessitate a shift toward improved handling practices in fresh produce supply chains. Within the post-harvest system, the packing-house serves as a control point where quality management can assure a reliable supply of quality produce. Packing houses also serve as sites for the effective implementation of strategies designed to eliminate or minimize microbial, chemical, physical and pest contamination. Well-designed packing house facilities that conform to the principles of HACCP/Good Hygiene Practice (GHP) and which are equipped with an appropriate level of post-harvest technology are, therefore, a critical and important component of the infrastructural base to support value addition, quality and safety management along the fresh produce supply chains.

The development of Codes of Practices (CoPs) and formulation of the guidelines to address the Critical Control Points along the entire Kinnow and mango supply chains was a very good initiative of the European Union funded Trade Related Technical Assistance (TRTA II) Programme implemented by United Nations Industrial Development Organization (UNIDO) in association with International Trade Centre (ITC) and World Intellectual Property Organization (WIPO). Further more, the Punjab Agriculture Department also acknowledges the work done by FAO and ASLP in this sector which has been referenced in the guide. The department also appreciates the collective efforts of MRS, CRI, UAF, PHDEC and TDAP in development of the CoP manual and CCP guide. Such programmes are greatly appreciated by the Government of The Punjab and acknowledged as being essential for the Pakistan's integration into the global economy.

This publication documents good practice in the design, management and operation of fresh produce packing-houses. The guide is intended to serve as a technical resource for extension specialists, planners, farmer organizations, clusters and cooperatives on upgrading their post-harvest operations. It is hoped that the guide will serve as a useful resource/tool to these key stakeholders.

Rashid Mehmood
Secretary
Agriculture Department
Government of the Punjab

Message by the EU Ambassador

Safe food is a basic right for every consumer and should be affordable and accessible to all. The European Union is supporting this goal through numerous initiatives like the Trade Related Technical Assistance Programmes, in Pakistan, implemented by the United Nations Industrial Development Organization, UNIDO in association with International Trade Centre, ITC and World Intellectual Property Organization, WIPO.

The main objective of the TRTA Programmes is to promote trade through the integration of Pakistan's economy with the global market. This entails strengthening of Pakistan's conformity assessment infrastructure, revamping the regulatory framework to address both Technical Barriers to Trade, TBT and Sanitary & Phytosanitary, SPS compliance measures and focusing on critical gaps along the supply chain of certain products that have a high-end value and marketability. This is to ensure that quality produce is made available to enhance market access.

One such intervention includes strengthening the capacity of the Pakistani mango farmers, processors and exporters through a collaborative effort of developing comprehensive codes of practice along the critical control points of the mango supply chain. Once the quality of the produce (mango) is assured, the TRTA II programme then establishes market linkages in order to sustain the exports and enhance profitability. This, in turn, will also allow the farm labourers to earn a more respectable income.

The production of this illustrated version of the Codes of Practice for the mango cultivation and post-harvest processing, in characterizing the critical control points, is a novel approach, engaging both the small and big farmers as well as the exporters. This will effectively allow the poorest farmers to have a greater voice in decision-making and increase their market share.

The European Union welcomes the successful production of this manual and acknowledges the involvement of Provincial and Federal Departments of the Government of Pakistan (PHDEC, TDAP), Research Institutions (CRI, MRS), Academia (UAF) and private sector associations, as well as the contribution from the other International Donor Agencies (FAO, ASLP), in sharing their expertise and information and adding value to this publication.

Lars Gunnar Wigemark
Ambassador
European Union Delegation to Pakistan

Foreword

Pakistan produces juicy, sweet and fragrant full mango fruit without the stringy fibrous tissue. The fruit matures in 90-140 days after flowering. Pakistan with the production of almost 2 million tons of mangoes each year is the sixth largest producer of mango in the world after India, China, Kenya, Thailand and Indonesia. In the year 2013 the country exported 98,920 tons of mangoes valued at US \$ 57,200,164. Every year Pakistan exports only around 5% of its production and almost 40% of the produce is wasted due to improper farming, harvest, processing, transportation, etc.

When viewed against the experience of many successful developing countries, Pakistan's export performance has been lackluster. Although the country is blessed with natural high quality mangoes, having inherent superior taste which is unique to this part of the world, liked all around the world, export performances have not been up to the mark. Pakistan can improve mango exports to earn substantial amounts of foreign exchange, by addressing the critical points along the mango supply and value chains.

Sanitary and Phytosanitary (SPS) standards continue to hinder market access. Pakistan has limited SPS management capacity to address food safety, animal and plant health. Therefore it is imperative that Pakistan develops an integrated, coordinated SPS management and control system. Food safety has become a very significant issue, due the food concerns in Europe. Consumers now want to be informed about the food they are consuming through appropriate labelling and traceability schemes.

Farmers must adapt Good agriculture Practice to guarantee the safety and quality of produce. Farmers and processors need guidance to improve the quality of the production and reduce losses during the production process, post-harvest processing, storage and transport as well.

Maintenance of the mango orchard is necessary to produce good quality fruit. For example, pruning of mango trees has become an essential feature of mango farming. Mango trees usually assume a graceful dome shape, shading the main trunk. Currently minimum pruning is practiced. However, it is necessary that annually after fruit harvest, diseased, dried, broken branches and those touching the ground be pruned off.

To rejuvenate the orchard every 3-4 years it is advisable that 15-20% of old wood should be removed. Similarly biological control of fruit fly should be practiced to reduce fruit fly contamination. Judicious use of correct (scientifically proven) fertilizers must be ensured. In addition, appropriate harvesting, desapping and processing of mangoes for the local and export markets is also mandatory to improve the shelf life of mangoes.

As a member of the WTO Pakistan is committed to comply with the Sanitary and Phytosanitary Agreement and in order to protect its exports Pakistan should address the phytosanitary issues such as fruit fly infestation

UNIDO/TRTA II conducted detailed studies of the sector to identify the critical areas where improvements were required. In this connection detailed value chain analysis was conducted and critical control points along the supply chain were identified.

The programme, as a remedy, developed comprehensive guidelines to address the critical points along the entire supply chain. The programme also integrated the information already available in the form of manuals/guidelines/hand books, developed by other donors and stakeholders. Once developed and implemented, these COPs would enable both the farmers and processors, to get optimal income.

The idea of developing the Codes of Practice (CoPs) and Critical Control Points (CCPs) was conceptualized by TRTA II International Expert, Dr Mike Dillon and National Experts Mr Badar-ul-Islam and Dr Ali Abbas Qazilbash. Subsequently these CoPs were tested through implementation at pilot farm clusters for a period of 3 years.

I would also like to acknowledge the commendable efforts of the technical staff of Mango Research Station (MRS) led by Mr Abdul Ghaffar, Prof. Dr. Amanullah Malik (University of Agriculture Faisalabad - UAF), Mr. Kit Chan (TRTA II International Expert) and Mr Muhammad Aurangzaib Khan (TRTA II National Expert) in authoring, designing and streamlining the illustrated version for the remedies to the critical control points along the supply chain in a reader friendly manner.

This has all been possible due to the continued support of the European Union that has funded the TRTA II programme.

Bruno Valanzuolo
Chief Technical Advisor
Trade Related Technical Assistance (TRTA II) Programme

Message by the FAO Representative

Agriculture is the foundation of Pakistan's economy. The sector employs 45% of the country's labour force, generates approximately 21% of the country's Gross Domestic Product and is responsible for as much as 70% of all exports.

Pakistan became a member of FAO only three weeks after gaining independence in 1947. Subsequently, there has been a long and rewarding relationship; with FAO providing technical assistance to Pakistan over the years in the agriculture, livestock, fisheries and forestry sectors while experts from Pakistan have worked with FAO supporting development in many countries around the world.

Horticulture is of special interest to myself as I come to FAO with an agro-forestry background and have worked with fruit trees in many countries. Here in Pakistan, FAO has provided support to horticulture development over the past decades notably in Swat, Gilgit Baltistan and currently in Balochistan. Horticulture is very important for food security and income generation in many parts of Pakistan. Proper management and value chain development is critical to ensure maximum benefit to the producers. Public and private partnership is needed to open and develop overseas markets as well as branding for Pakistan products to ensure steady profits which will further stimulate development and expansion of the sector.

The quality of both Kinnow and mango produced in Pakistan is exceptional and should demand top prices internationally. The "Codes of Practice" prepared by TRTA II and their development partners, for both Kinnow and mango, address all aspects cultivation, management and post-harvest handling. These are valuable contributions to the sector and I hope they are fully utilized to improve and strengthen quality production and expand exports.

I congratulate TRTA II for the fine job on preparing these "Codes of Practice" and I express my gratitude to the European Union for their financial support to UNIDO/TRTA II for support to the horticulture sector.

As horticulture develops, it is the larger farmers who benefit first but let's keep the small farmers in mind and work to bring them along in the development process.

Patrick T. Evans
FAO Representative

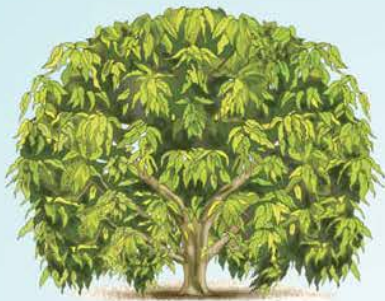
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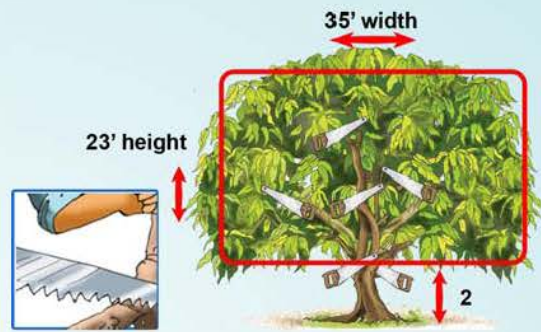
Canopy management to increase yield and improve quality

Existing Practices

Recommended Practices



Uncontrolled tree size



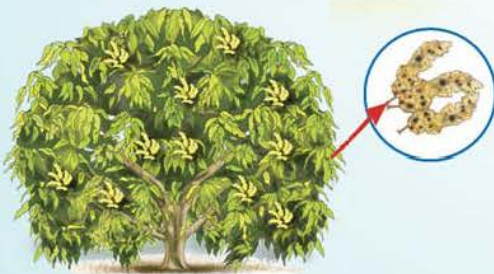
Controlled tree size



No light penetration through the tree



Light penetration through the tree



Less flowering and more disease



More flowering and less disease



Contaminated fruit



Healthy fruit



Less Income



More Income

Timely application of balanced nutrition

Existing Practices

Recommended Practices



Delayed / no fertilizer application



Application of Nitrogen, Phosphorus and Potash after harvest



Poor / no vegetative growth



Appropriate new vegetative growth



Delayed growth



Growth completed at appropriate time



Less flowering



More flowering



Irregular / Low yield



Regular / High yield

Impact of water stress during dormancy

Existing Practices



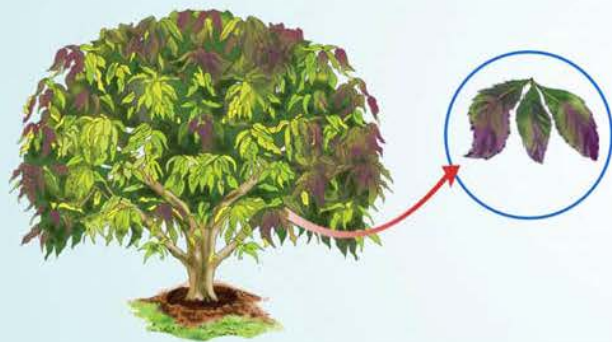
Recommended Practices



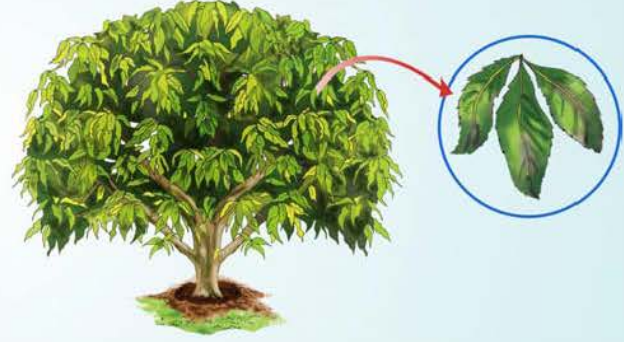
Irrigation during dormancy



No irrigation during dormancy



Resulting in new growth on plant



Resulting in no new growth



Resulting in less flowering



Resulting in profuse flowering



Resulting in low yield



Resulting in high yield

Paclobutrazole application to improve yield and quality

Existing Practices

Recommended Practices



No Paclobutrazole application



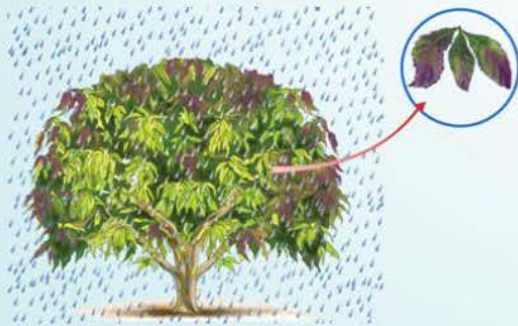
Application of Paclobutrazole



No Paclobutrazole application and irrigation



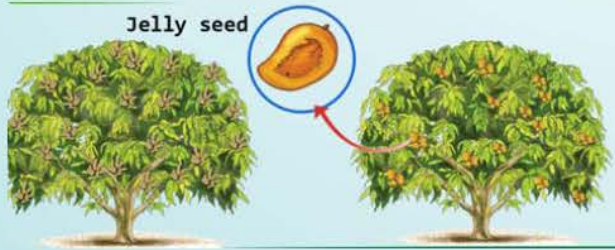
Irrigation after Paclobutrazole application



Unwanted vegetative growth during rains



No vegetative growth during rains



Poor flowering

Jelly seed formation



Healthy flower and fruit

Do not apply Paclobutrazole to following

X
Die-back effected plant



X
Salt effected plant



X
Plant with no new vegetative growth



Orchard sanitation to control diseases

Existing Practices

Recommended Practices



Pruning with hands



Pruning with saw



Small dried branches left on the orchard floor



Neat and clean orchard



Diseases growing on leftover branches



Removal of dried wood



Diseases effect flowering



Healthy flowering



Less fruit set / low yield



High yield



Fruit contaminated with diseases



Healthy fruit

Orchard floor management to control Insects

Existing Practices



Uncontrolled weeds



Weed control and removal of dry wood



Insects grow on weeds and dried branches



Weeds controlled and dried wood removed



Spray of pesticides to kill insects



Reduced pesticide spray



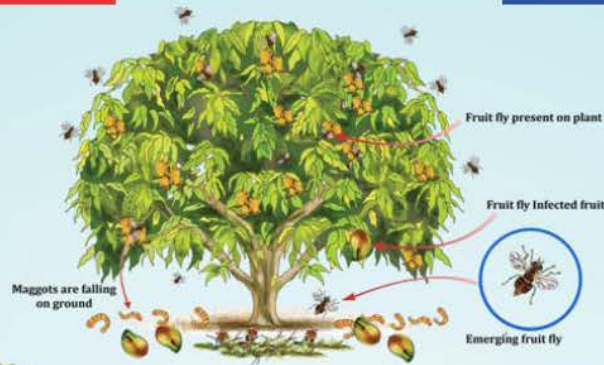
Less yield



High yield

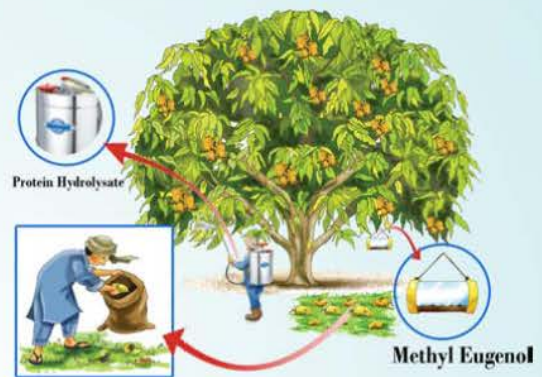
Fruit Fly Management

Existing Practices



No control of fruit fly

Recommended Practices



Sanitation, Spray of Protein Hydrolysate and placement of Methyl Eugenol traps



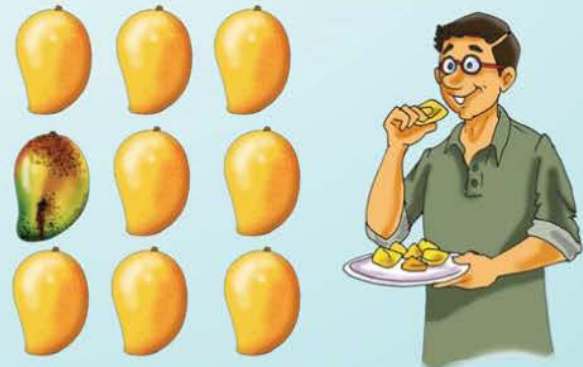
Pesticide spray to control fruit fly



Collection and removal of fallen fruit



More fruit loss, fruit (with higher pesticide residue) unsafe for health



Less fruit loss, safe and healthy fruit

Control of Inflorescence Midge

Existing Practices

Recommended Practices



Midge attacked pinnacles



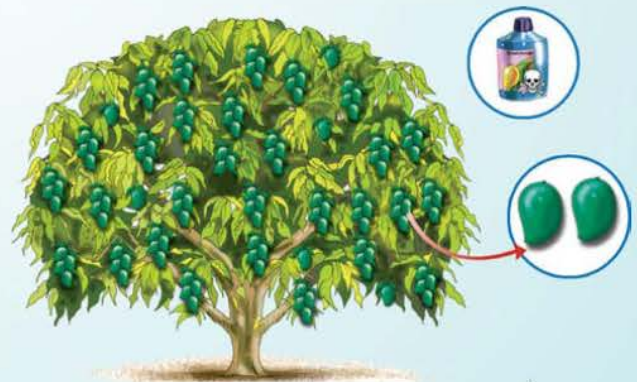
No irrigation - Midge emerging from soil



Irrigation - Midge trapped in soil



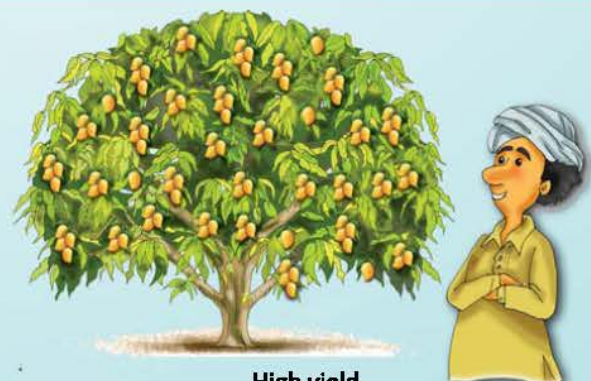
More spray and less fruit



Less spray and more fruit



Low yield



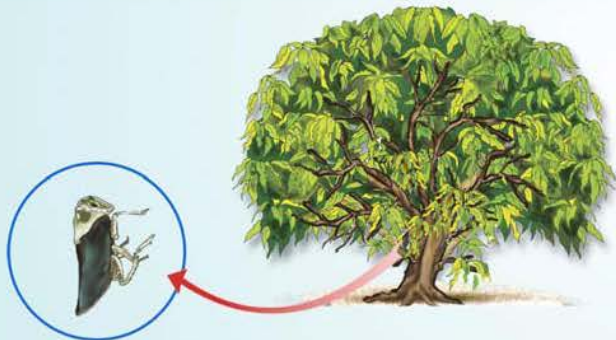
High yield

Stem cleaning and insecticide spray to control hopper

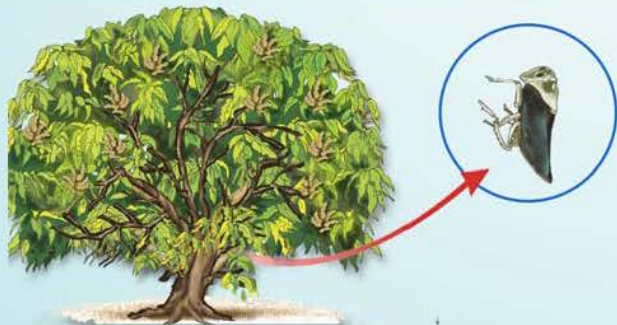
Existing Practices



Stem covered with leaves allows hopper to grow



Hoppers hibernate on leafy stem

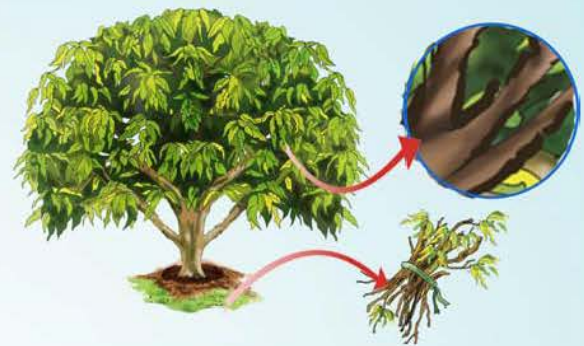


Hopper attacks on flowering



Low yield

Recommended Practices



Plants with cleaned stem



Insecticide spray on clean stem to kill hopper



No hopper attack and healthy flowering



High yield

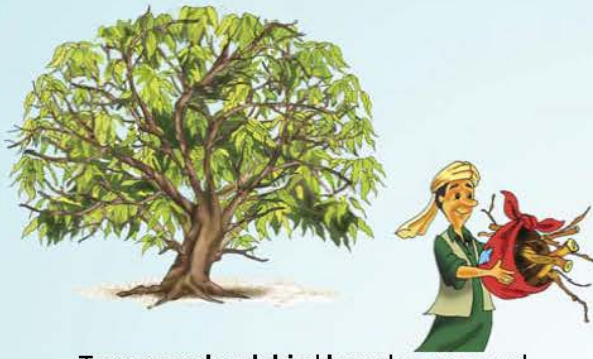
Control of Mango Die-Back by managing soil salts

Existing Practices

Die-back affected plant



Recommended Practices



Tree pruned and dried branches removed



Tree pruned and dried branches removed



Fungicide application to control disease



Preparation of trench to control movement of salts



Pruning and spray



Controlled irrigation in trench



Dying tree



Healthy tree

General Sanitation and Maintenance



Wash harvesting crates regularly by brushing and using a detergent solution with a pressurized nozzle, followed by rinsing in chlorinated water



- Harvesting tools must be cleaned by dipping in kerosene oil. Wipe with a clean cloth to dry, then dip in chlorinated solution for disinfection.
- Lubricate and air dry before use.



Keep the orchard floor clean by picking up all fallen fruits and plant debris from the ground and properly dispose / dump it



- Paint rusty ladders and desapping frames followed by drying under sun.
- Clean the desapping frames and ladders regularly.



Clean up the transportation vehicle and paint when required



Keep the pack house floor clean



Clean all machine parts in the pack house regularly



Regularly clean the tables on which packing or grading is done



- Clean cold store and disinfect it.
- Check for any gas leakage, refrigeration units, etc.

Maturity significantly influence fruit quality and shelf life

Existing Practices



Maturity is assessed on the basis of TAPKA "Initiation of natural fruit maturation"



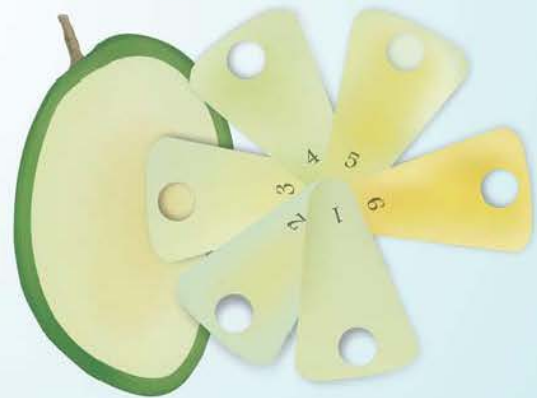
Harvested fruits lack uniformity at ripening due to difference in maturity

Recommended Practices

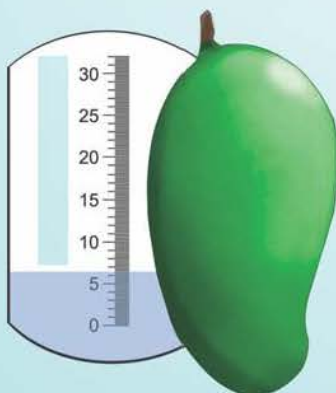
Maturity should be determined by external features (fruit size, surface, shape & shoulder development) and internal feature (pulp colour, TSS)



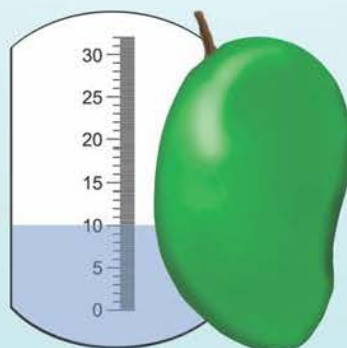
Harvest 10 fruits randomly from different trees for maturity assessment that ensures the samples uniformity, keeping the fruits size and type of harvest (block, flowering times, canopy, position) in mind



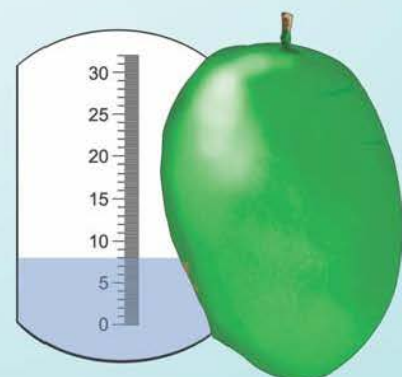
Cut and compare pulp colour with ASLP maturity testing guide



Sindhri



Samar Bahisht Chaunsa



Sufaid Chaunsa

Use refractometer for estimation of TSS which mainly confirms the level of sweetness in fruit

Use and maintenance of refractometer

Refractometer is used to check the Total Soluble Solids (TSS) of fruit Juice / pulp. It represents the sugar contents in the fruit juice giving a clear picture regarding the maturity status of fruit

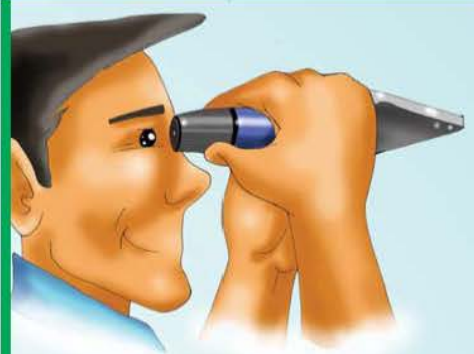
Analogue Refractometer



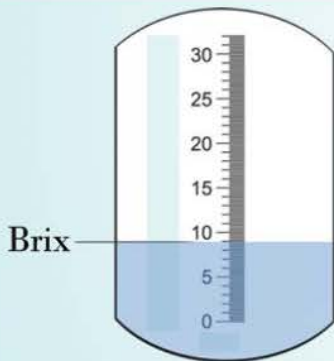
Cut longitudinal slices of fruit



Squeeze 2 or 3 drops of juice on the prism of refractometer



Close the lid and view the scale through the eyepiece



Turn the eyepiece to focus the scale indicating Brix



Clean the prism with distilled water and dry with a soft tissue to proceed with the next sample



- Do not immerse refractometer in water.
- In case of any damage, send it for service to the company

Digital Refractometer



Turn on the refractometer and ensure the reading is zero or clean sensor with water and press reset



- Fill the sensor with the juice sample and press start.
- A digital reading will be displayed which indicates the TSS of sample.
- Rinse sensor with distilled water and wipe with a soft dry tissue to proceed with next sample

Getting Ready for Harvest



Take a shower



Clean the tools



Take all necessary implements and equipment for harvesting

- 1) Harvesting kit / tools 2) Uniform / Gloves 3) Soap 4) Nail cutter



Trim finger nails



Wash hands with soap after using toilet



Use bandage to cover all wounds on body

Harvesting

Right time and the right procedure for harvest are key to a better post harvest life

Existing Practices



- Fruit harvested by pulling off the branches and use of inappropriate tools cause sap burn.
- Harvesting in the rain or when tree is still wet can cause bruising and pathogens contamination.

Recommended Practices



- Harvest fruits using secateurs or clippers that cut and hold fruit from the top.
- Do not harvest in rainy conditions.
- Harvest fruits early in the morning or late afternoon.



- Fruits that are harvested without pedicels are often sap contaminated.
- Sap burn causes skin blemishes



Harvest fruits along with 4-6 inch pedicels & carefully place in clean crates vertically. Longer stalk restricts sap



- Fruits are kept in traditional bamboo baskets which are usually not cleaned/washed.
- Grading is done on ground or unclean tarpaulin that can potentially contaminate fruit (food safety risks)



- Harvest fruits from the outer canopy facing towards the sun followed by the inner canopy after a few days.
- Always place fruits under shade and cover the crates to protect from heat injury.
- Use blue crates for processing while red crates for rejected fruits

Transportation (Farm to Pack house)

Smooth on-farm and off-farm transportation avoids fruit compression and other transit injuries

Existing Practices



- Field bins are rarely used or are mostly overfilled without covering them which may lead to physical injury.
- Bad handling leads to chances of fruit injury.

Recommended Practices



Make sure that bins are gently loaded and are covered to avoid dust accumulation and exposure to direct sunlight



Careless driving on bumpy farm roads can cause fruit injury



Drivers are instructed to drive at the correct speed to suit the road conditions to avoid bounding of bins and fruits on the top



Sometimes vehicles are unnecessarily stopped by the drivers. Fruits are kept too long in the field without proper covering



- Check air pressure in the tyres of vehicle regularly and keep it optimum/ balanced.
- Avoid unnecessary stays at road side with loaded fruits.
- Transport fruits from the field to pack house shed as soon as possible.

Receival at pack house and initial sorting

Existing Practices



Careless unloading or dropping crates onto the ground can lead to physical injuries

Recommended Practices



Unload the fruits carefully by gently passing over the crates. Keep traceability of the block from where fruit was harvested



Fruits for processing can get mixed with defected ones if sorting is not carried out carefully

Intact Pedicel/
Firm/Green
(Further
Processing)



Broken Stem/
Sap Damage
(Local
Market)



Colour Break/
Soft Beak
(Local
Market)



Disease/Insect/
Injury
(Dump in
Soil)



- Perform critical manual sorting to exclude defected, damaged and diseased fruits.
- Use separate crates when sorting.



Decayed fruits are left on the floor without proper disposal



Dispose infected fruits by digging a pit and covering with soil

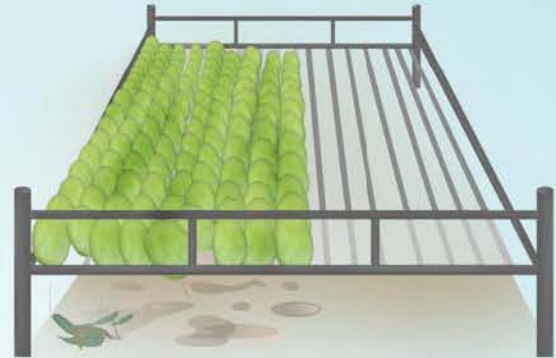
Methods for Sap management

When fruits are cut without pedicel, sap exudes causing sap contamination (refer to harvesting chart, Pic:2) Therefore, sap management is imperative to avoid sap burn

Method 1. Physical Desapping



Fruits along with pedicels are recut at about 1cm away from fruit and immediately placed on specially designed racks/desapping frames with the stem end facing towards the ground which allows sap to drain



- De-sapped fruits are kept on wooden, plastic or iron rack for 30-60 minutes.
- S.B Chaunsa has more sap and requires more time
- Secateurs need to be regularly cleaned during operation

Method 2. Lime Desapping



Fruits with attached pedicels are dipped in the lime solution (0.5%) and the pedicel is manually broken with the fruit dipped into the solution for about 2 minutes



- After desapping with lime, fruits should be washed in clean chlorinated water (150 ppm chlorine) and dried.
- Change lime water when oil layer builds up.

Method 3. Short Stemming



Fruits are recut above the flush node which prevents sap flow and are carefully placed into boxes with short stems
Short stemming is a better option for domestic market and air freight export

Washing/hot water dip treatment

Removal of dust and other residues from fruit skin are necessary for cleaning of produce

Existing Practices



Careless loading of fruits can cause injury

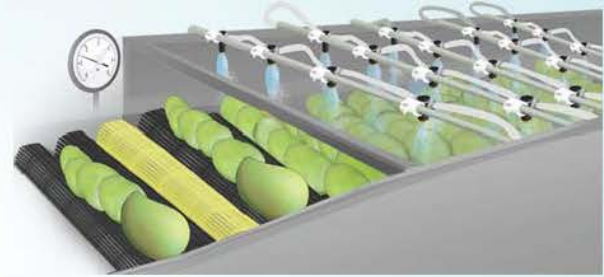
Recommended Practices



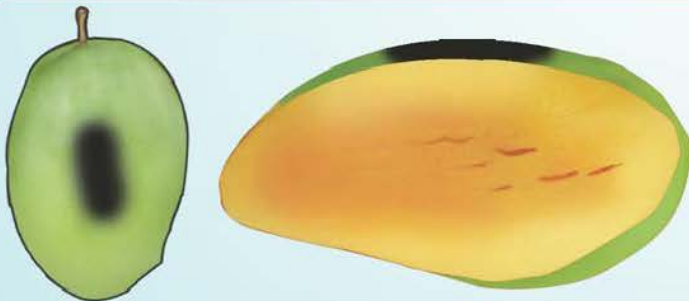
Place the fruits gently on the conveyor



- Uneven water pressure and spray of nozzles.
- Washing is not done in the traditional system because fruit prices are perceived to drop in the local market.



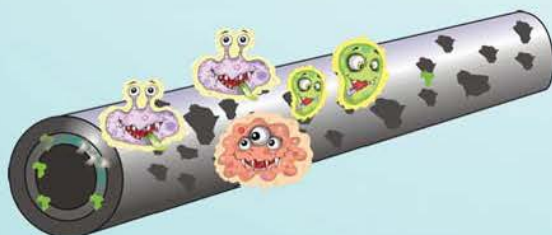
- Wash & brush the fruits sufficiently at a controlled RPM only to remove foreign matter (dust, chemical residues) with measured and equal pressure of water. Monitor cleanliness of brushes and water regularly



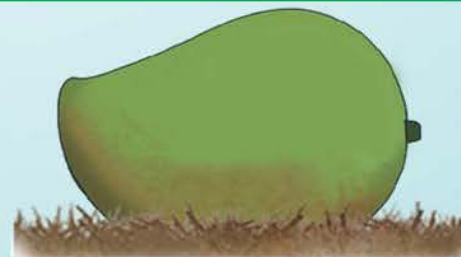
- Sometimes temperature and treatment duration is not maintained during hot water treatment or temperature sensors are not calibrated.
- High temperature can lead to development of pulp cavity especially in less mature fruits and hot water injury.



- Calibrate the temperature in the hot water dip system
- Temperature and duration of hot water treatment for fruit fly disinfection is according to the requirement of the importing country China: 48°C for 60 min, Iran: 45°C for 75 min
- Hot water fungicidal dip: 52°C for 5 minutes



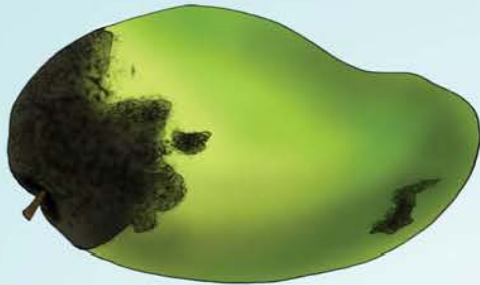
Sometimes fruits get excessively brushed & worn out brushes are used



Do not brush fruits for more than 30 seconds and use soft (horse tail /nylon) brush

Post-harvest chemical treatment helps in reducing losses due to decay by controlling the disease casual pathogen

Existing Practices



- No chemical treatment is given in the traditional system.
- Chemicals are not applied, handled, stored or disposed properly

Recommended Practices



- Fruits should be given fungicidal treatments correctly in terms of methodology, temperature, dose and duration
- Measures the tank volume accurately
- Use gloves, boots, and a mask for safety whenever dealing with chemicals



- Chemicals having high MRLs or use of such chemicals which have not been approved for use in the import country
- Equipment is not cleaned effectively and residues on equipment contaminate fruit



Extremely Toxic



Highly Toxic



Moderately Toxic



Considerably Toxic

Use only approved chemical products within the permissible limit and check the expiry dates

MRL website: http://ec.europa.eu/sanco_pesticides/public/index.cfm


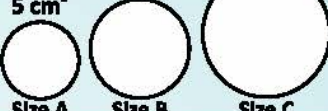


Eating with unwashed hands after chemical treatment can lead to poisoning

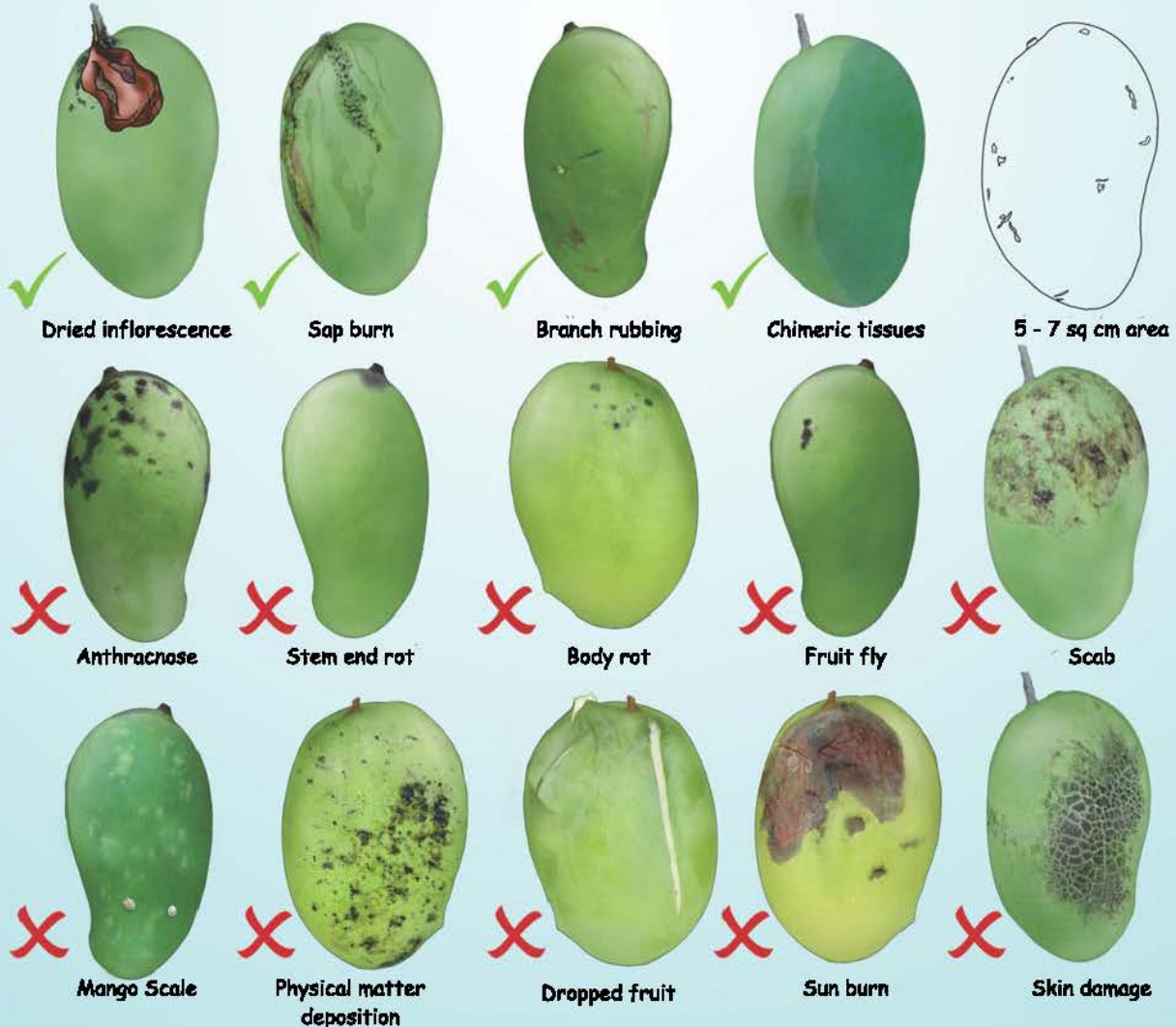


Wash and scrub hands, arms and areas exposed to chemical with soap before eating food

Proper fruit grading helps in uniformity and increase market return

	Extra Class	Class I	Class II
Quality	Mangoes must be of superior quality & free of defects, with the exception of very slight superficial defects	Mangoes must be of good quality with slight defects	Mangoes which do not qualify for inclusion in the higher classes but satisfy the minimum requirements
Skin Defects	No or very slight superficial defects that do not effect the fruits quality or appearance Size A = 200-350 g Size B = 351 - 500 g Size C = 551 - 800g	Slight skin defects due to rubbing, sunburn, suberized stains & healed bruises 3 cm ² 4 cm ² 5 cm ²  Size A Size B Size C	Defected skin with superficial healed skin alterations is allowed 5 cm ² 6 cm ² 7 cm ²  Size A Size B Size C
Shape Defects	Shape is typical of the variety with no defects in shape	Slight defect in shape	Fruit has defects in shape 40% yellowing by sunlight without sign of necrosis is allowed
Tolerance	5% by number or weight of Class I is allowed	10% by number or weight of Class II is allowed	5% by number or weight not in class but deterioration free

✗ Unacceptable ✓ Local Market



Packaging is the key customers attraction and helps in easy handling and transportation of fruit

Existing Practices



Wooden boxes are used for packing are overfilled

Recommended Practices



- Pack fruit in corrugated boxes tight enough to be held together but not to press each other. Some markets like
- China prefer mesh sleeves
- Use labels with food grade glue



- Sometimes, fruit size vary in box
- Incorrect package labeling/branding by untrained staff



- Always use new boxes that are strong enough to withstand collapsing during handling and follow size grade.
- Traceability must be ensured on the package along with clear specifications



Weak cartons collapse leading to poor alignment in pallets

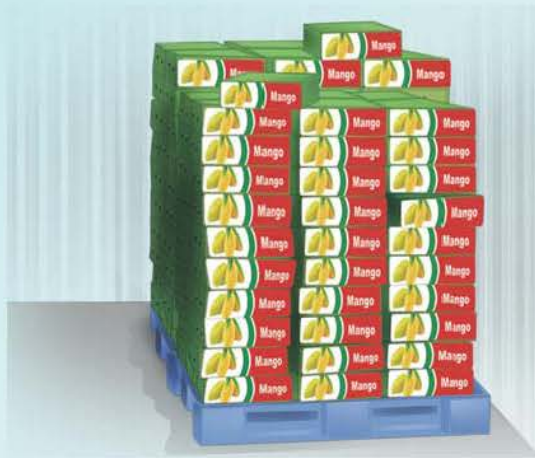


Align boxes in pallets properly

Precooling storage

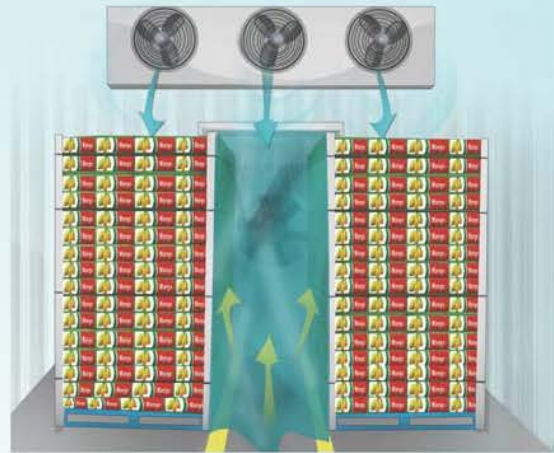
Optimum conditions during pre-cooling & storage are crucial to extend mango shelf life

Existing Practices



Cooling is delayed or not done properly and boxes are unpalletized without spacing which leads to a limited shelf life. Room cooling is used instead of forced-air

Recommended Practices



Cooling capacity in storage rooms should be sufficient to maintain uniform product temperature with adequate air circulation



- Blast chillers can lead to chilling injury
- Temperature fluctuations & poor maintenance of cold storage rooms.
- Excessive air leakage around pallets on forced-air cooler from incorrect placement of pallets & tarpaulin



- Load the room in such a way that air passes uniformly through all of the pallets
- Stack boxes with aligned ventilation holes

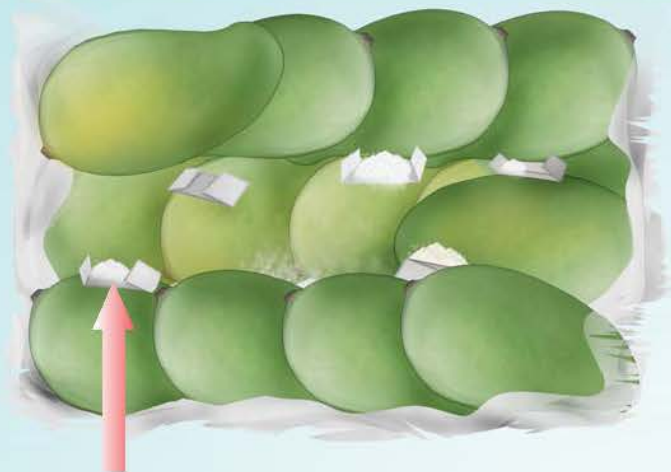


During storage, regularly monitor temperature, ethylene and CO₂ gas. Ventilate exhaust stores if necessary



Initially pre-cool mangoes at 17°C for 5 hours and gradually to the required temperature with good RH (85-90%)

1. Inappropriate practices



Carbide



Calcium carbide is used for ripening which has been banned internationally due to health hazards (carcinogenic) effects

2. Recommended Practices



Use ethylene gas produced by catalytic generator for uniform ripening and premium quality. Check the level of ripening concentrate in the reservoir and add accordingly (<2.5 Liters)



- Plug in generator in the ripening room
- Give shots of ethylene gas (100 ppm) after every 6-8 hours at the optimum varietal ripening temperature for 24-48 hours



Measure ethylene and CO₂ concentrations (gas detector tubes or portable gas analyzers) Vent the ripening room by opening the door for 10 minutes before each shot of ethylene to remove toxic CO₂ levels

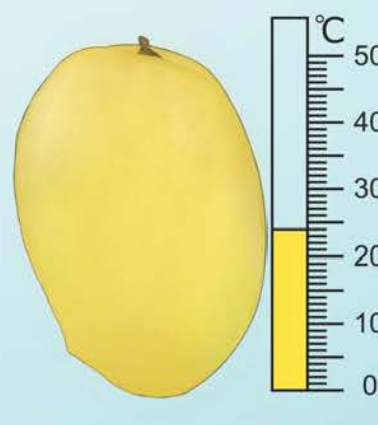
3. Recommended ripening temperature



Sindhri



Samar Bahisht Chaunsa

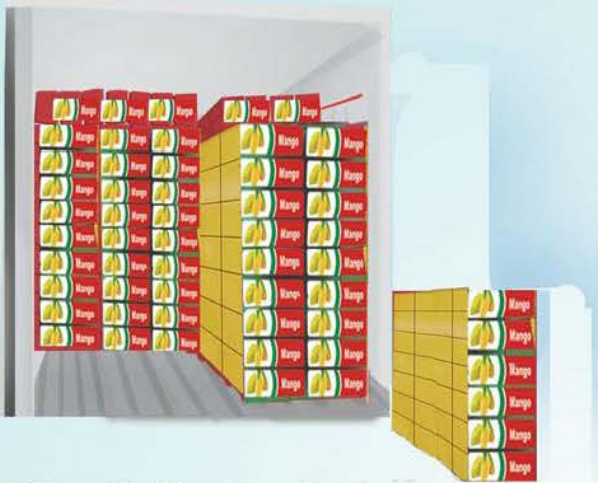


Sufaid Chaunsa

Loading and reefer transport

Proper loading techniques & an optimum reefer environment is essential for successful shipment of fruit

Existing Practices

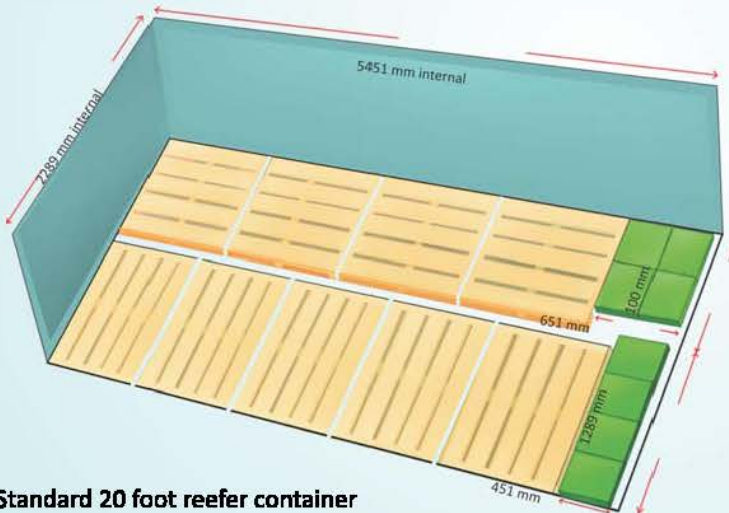


Shifting of fruit boxes to reefer after exposing to normal air temperature (condensation)

Recommended Practices

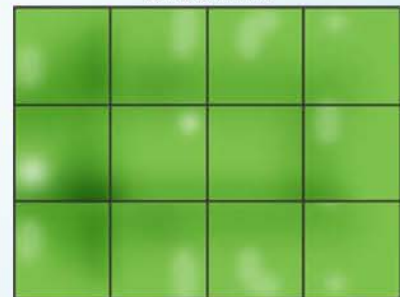


- Sea containers should be cleaned, sanitized and pre-cooled to the desired shipping temperature (12°C is recommended) prior to loading.
- Sea container reefer units should be turned off during loading to avoid icing of the evaporator coil, inferior cooling & the transfer of unwanted hot or cold ambient air.



Standard 20 foot reefer container

1200 mm



1000 mm

Trays on Euro pallet = 12/layer

Internal height to load line = 2157 mm

Door opening = 2290x2212mm

Pallets in container = 9



During transport / shipping, Ventilation for a 40 ft container should be 37m³/hr while for a 20 ft container, it should be 19m³/hr



During transport (from farm / pack house to port) use clip on generator to maintain proper temperature of mango

Food Safety is the Key consumer concern, preventing contamination is the best way to ensure it



Related Reading/References

The authors of these guidelines developed to address the CCPs along the entire Kinnow supply chain have benefitted from the work done by FAO and other international agencies. For further reading these sources may be referenced:

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<http://edis.ifas.ufl.edu/pdf/HS/HS118500.pdf>
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<http://ucce.ucdavis.edu/files/datastore/234-1450.pdf>
3. **Addressing marketing and processing constraints that inhibit agri food exports. A guide for policy analysts and planners. FAO Agricultural Services Bulletin.**
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5. **Fertilizer use by crop in South Africa, Land and Plant Nutrition Management Service, Land and Water Development Division, Food And Agriculture Organization Of The United Nations, Rome, 2005.**
<ftp://ftp.fao.org/agl/agll/docs/fertusesouthafrica.pdf>
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11. **PINEAPPLE: Post-harvest Operations, Food and Agriculture Organization of the United Nations, 2005.**
http://www.apo-tokyo.org/00e-books/AG-18_PostHarvest/AG-18_PostHarvest.pdf
12. **Good Agricultural Practices (GAP) on horticultural production for extension staff in Tanzania. Training manual. Food And Agriculture Organization Of The United Nations, Rome, 2010.**
<http://www.fao.org/docrep/013/i1645e/i1645e00.pdf>
13. **Training Manual For Management Of Citrus Greening (Huanglongbing) And Its Insect Vector The Asian Citrus Psyllid (Diaphorina Citri) In Jamaica. Prepared under The Citrus Greening FAO TCP Project**
http://www.moa.gov.jm/PlantHealth/data/Training%20Manual_Citrus%20Greening.pdf



Standard orchard



Nutrition application zone



Skirting



Paclobutrazole application



Placement of fruit fly traps



Desapping

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