

Handling and ripening mangoes in export markets

Training for supply chain members



Trainers notes

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Workshop background

Introduction

Correct handling and ripening of Australian mangoes is essential to deliver the best quality mangoes to the consumer. This training package will provide key staff with an understanding of how mangoes ripen, recommendations for best practice and the reasons why the recommendations must be followed.

Target audience

- Mango supply chain participants (exporters, importers, wholesalers, distribution centre operators, retailers and transporters)
- Consultants and extension personnel

Purpose and scope

- To provide an understanding of the participants' role in managing the handling and ripening processes.
- To improve participants' understanding of the physiological processes occurring in mangoes after harvest and how mangoes need to be handled through the supply chain.
- To improve participants' understanding of where quality can be lost along the supply chain and how quality can be improved and losses minimised.
- To provide participants' with guides on how to handle and ripen mangoes and how to identify quality problems.

Learning outcomes

- All participants have an understanding of how mangoes need to be handled along the supply chain and the information available for their area of responsibility in the mango supply chain.
- All participants are able to identify quality problems and where and why they can occur along the supply chain.

Course duration

- 1.5 hours

Materials required

- Power point presentation (can be provided to participants in notes format)*
- Training guides
 - Mango defect guide*
 - Mango skin colour guide*
 - Mango handling guide*
 - Mango ripening guide*
 - Mango handling systems guide*

- Trainer's notes*¹
- Computer, data projector, screen, extension cord, power board
- Samples of mangoes showing a range of quality problems (if available)

*¹ These documents can be downloaded from www.dpi.qld.gov.au/..... Additional information or questions can be addressed to sci@dpi.qld.gov.au.

Workshop outline

Section 1

Understanding mangoes

What changes occur after harvest?

Slide 2

Presentation

- Four processes occur during the ripening of mangoes
 - Skin colour changes from green to yellow
 - Starch is converted to sugar
 - Firmness decreases
 - Acidity decreases
- If mangoes are ripened under the correct conditions, the skin colour at eating ripe will be yellow, the firmness will be soft to firm depending on the variety, and the flavour sweet with little acidity present.

Mangoes are still alive

Slide 3

Presentation

- It is important to understand the nature of mangoes to understand why some defects occur.
- Even though mangoes have been harvested from the tree they are still alive and respiring.
- They require oxygen to continue to respire and for the ripening to occur.
- Mangoes have a very high respiration rate. As mangoes ripen and starch converts to sugars a large amount of heat and carbon dioxide (CO₂) is generated. If this is not removed then quality can be lost.
- Ethylene from the external atmosphere (mechanical equipment) or introduced through an injection system can speed up the ripening process.

Respiration rate varies with produce

Slide 4

Presentation

- The respiration rate of mangoes is high and similar to other highly perishable fruit and vegetables, and considerably higher than fruit like apples, pears and citrus which are stored for long periods.
- Fruit and vegetables with high respiration rates generate heat even in cool rooms and refrigerated transport.

Respiration rises during ripening

Slide 5

Presentation

- Respiration rises as mangoes ripen to sprung stage and then falls.
- Ethylene triggers ripening and a rise in respiration.

Temperature affects respiration

Slide 6

Presentation

- An increase in temperature will increase the rate of respiration.
- Increasing the temperature from 20°C to 25°C will almost double the respiration rate.

Ethylene sensitivity and production

Slides 7 & 8

Presentation

- Mangoes are among the most sensitive fruit and vegetables to ethylene present in the atmosphere surrounding fruit. Ethylene speeds up respiration and the ripening process.
- However, mangoes only produce very low levels of ethylene. Common sources of ethylene in the atmosphere are ripening fruit such as bananas, exhaust from equipment such as petrol fuelled forklifts, and ethylene injected into ripening rooms.

Activities and questions

1. Discuss why it is important to know what products mangoes can and cannot be stored with.

Presentation

- Explain that loss of saleability is when mangoes lose quality and have to be sold at discounted prices.
- The following quality problems can cause loss of saleability:
 - Incorrect ripeness (too ripe, not ripe enough, mixed ripe)
 - Fruit rots
 - Poor skin yellowing
 - Sapburn and skin browning (abrasion)
 - Lenticel spotting
 - Chilling injury
 - Bruising and cracking
 - Incorrect grading
- These quality problems can occur during production and packing but improper handling in the distribution system can also cause quality loss.
- Point out that chilling injury, fruit rots, incorrect ripeness, poor skin yellowing and bruising and cracking are all defects that can be caused from improper handling and storage after mangoes have left the packhouse.
- It is important to correctly identify the factors which reduce saleability. Common names of quality defects can be found on the mango defect guide.

Activities and questions

1. Identify the quality problems on the sample of mangoes provided. Use the mango defect guide to assist in identifying the problems.
2. Using the mango defect guide generate a list of quality problems encountered at other times that are not in the sample of mangoes.
3. Generate a list of the main quality problems you have found in mangoes.

Presentation

- Mangoes can be too ripe for retail, having no or little shelf life.
- Mangoes can be not ripe enough for retail and unsuitable for purchase by consumers.
- Mangoes can be mixed ripe in a single carton which usually occurs when mangoes are allowed to ripen naturally. This means resorting may have to be done before retail to meet product specifications.
- Ripening of mangoes can be affected by temperature and ethylene in the external environment or injected into the ripening room.

Presentation

- High and low temperatures during ripening of mangoes will affect quality.
- High temperatures (above 22°C) reduce skin yellowing resulting in blotchy green, soft fruit and increase rot development.
- Low temperatures (below 18°C) also affect skin yellowing resulting in the skin being a pale yellow colour when ripe. More rots will also develop and flavour will be poor.
- Mangoes must be ripened between 18 and 22°C for optimum appearance and eating quality.

Activities and questions

1. Introduce mango handling guide with this slide.
2. Consider where you can store mangoes when they are ripening to ensure temperature is between 18 and 22°C.

Presentation

- Using ethylene to control ripen mangoes increases the rate of ripening and ripens mangoes uniformly.
- Increasing the amount of time mangoes are exposed to ethylene will increase the uniformity of ripening. To ripen mangoes, hold fruit under ethylene for 2-3 days.

Presentation

- To store Australian mangoes for a period of time before or after ripening, they need to be cooled to 12°C to put them to sleep.
- For best results mangoes should be moved through the supply chain quickly. Storage before ripening should be no longer than 3 days (after arrival at market) or 3 days after ripening.

Activities and questions

1. Use the mango handling guide and mango handling systems guide to illustrate these key points.

Presentation

- 10 to 12°C is the best temperature to store mangoes to stop them from ripening.
- Mangoes will start to ripen at 12°C if stored for long periods of time. The time this occurs will depend on the variety. For example, Kensington Pride mangoes will start to ripen after around 7 days at 12°C.
- Mangoes stored below 10°C will develop chilling injury symptoms (dull in appearance, pronounced lenticel spotting and water soaked areas).

- Mangoes stored above 12°C will soften, develop pale yellow colouring, have high acidity and develop rots

Activities and questions

1. Use examples of chilled mangoes to show what chilling injury looks like.
2. Use examples of soft green mangoes to show how high temperature affects ripening (yellowing of skin with soft mangoes).

What causes poor skin yellowing?

Slide 16

Presentation

- Orchard management, incorrect ripening temperature, high carbon dioxide (CO₂) and skin injury can reduce yellowing of the skin during ripening.
- If mangoes are not managed correctly during storage and ripening, they will generate a lot of heat and CO₂ (see slide 3) which will reduce skin yellowing. Ripening fruit at the correct temperature, 18-22°C is essential to maximise skin yellowing.
- Fruit handled correctly will ripen as they should as in the mango colour guide.

Activities and questions

1. Show the mango colour guide and discuss how mangoes change colour as they ripen.
2. Show the mango handling guide and discuss the importance of storing and ripening mangoes at the specific recommended temperatures.

High carbon dioxide reduces skin yellowing

Slide 17

Presentation

- High carbon dioxide (CO₂) levels of above 4% will reduce skin yellowing.
- High levels of CO₂ occur when mangoes are ripening and generating a high level of CO₂ and where holding conditions have inadequate venting.

Section 3 Best practice for handling, ripening, and storage

Managing temperature during ripening

Slide 18

Presentation

- Mangoes must be pre-cooled or warmed to 18-20°C. Use of forced-air is best to achieve a rapid result
- Forced air cooling every 6-8 hours is best during ripening to remove respiration heat.
- If forced air is not available leave space around each pallet for air circulation.

Controlling ethylene during ripening

Slide 19

Presentation

- There are two types of ethylene injection systems for ripening rooms:
 - Shot – inject 100ppm ethylene every 8-12 hours for 2-3 days
 - Trickle – inject 10ppm ethylene continuously for 2-3 days
- Injection systems can be manual or automated
- Ethylene is available as pure ethylene or Ripegas (7% ethylene). Ripegas is more commonly used as it is safer to use than pure ethylene (can be explosive at very high concentrations) and does not require precautions such as flame proof wiring and lighting.

Managing ventilation during ripening

Slide 20

Presentation

- Trickle ripening rooms require an inlet for fresh air and an outlet to remove stale air. The inlet is placed behind the cooling coil and the outlet should be on the opposite wall down low (CO₂ is heavier than air).
- Shot ripening rooms do not have any venting. These rooms must be vented manually by opening the door for at least 10 minutes every 8-12 hours (before each shot of ethylene).
- Some rooms used to hold mangoes following ethylene treatment have automatic venting, which can be set to vent fresh air into the room at set timing intervals.

Managing temperature during storage

Slide 21

Presentation

- Leave space around pallets to allow air circulation
- Position cooling coils to ensure even air distribution
- Monitoring of storage rooms has found fruit temperature to be 2°C cooler in pallets under the cooling coil.

Presentation

- This slide outlines ideal handling systems for mangoes in the supply chain.
- Use of controlled ripening with ethylene is recommended for best results.

Activities and questions

1. Use the mango handling guide to illustrate correct temperatures for handling.
2. Explain the ripening guide and its steps. Explain how it is important to control fruit temperature and ventilation during ripening.

Retail tips

Slides 23 & 24

Presentation

- Near ripe mangoes (stage 5) may soften during retail (storage at store and display) and therefore need to be handled carefully to avoid bruising and compression damage.
- Mangoes that show rots or other breakdown should be removed from the retail shelf.

Activities and questions

1. Only work through these slides ideas if working with retail managers and staff.