

# Mango ripening manual



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The Mango quality assessment manual published by DAFF was used as a reference for descriptions and causes of common quality problems

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# Contents

## 1. Introduction

## 2. Storage before ripening

## 3. Ripening

## 4. Holding after ripening

## 5. Room operation

## 6. Problem solver

## Appendices

How to use the ripening manual .....	1
Steps in ripening mangoes .....	2
How long can I store mangoes before ripening? .....	3
Option 1: 7-10 days storage potential .....	4
Option 2: 5-7 days storage potential .....	5
Option 3: Ripen immediately .....	6
Ripening conditions .....	7
Time to ripen .....	8
Holding after ripening .....	9
Ethylene injection .....	10
Venting rooms .....	11
Monitoring fruit and handling conditions .....	12
Operating a forced-air ripening system .....	13
Operating a storage room .....	14
Common mango ripening problems .....	15
Frequently asked questions .....	21
1. Receiving assessment .....	23
2. Assessing skin colour and firmness .....	24
3. Harvesting periods .....	25
4. Contacts and references .....	26

# How to use the ripening manual

This manual provides instructions on ripening mangoes and will assist businesses at any point in supply chains, from producer to retailer, to operate a ripening facility.

The following page shows a flow diagram of the typical steps in ripening mangoes. To plan the ripening schedule, the fruit condition and prior handling practices must be checked on arrival at the facility. Depending on customer orders and the space available in the ripening rooms, the mangoes may be ripened immediately or stored prior to ripening.

Section 2 contains a decision tree and guidance on how long mangoes can be stored before ripening. The storage potential before ripening depends on the variety, ripeness and pulp temperature on arrival and the fruit age (days from packing). There are 3 recommended options:

- Option 1: 7-10 days storage potential
- Option 2: 5-7 days storage potential
- Option 3: Ripen immediately and do not store

Section 3 contains recommended ripening conditions (temperature, ethylene, humidity, room venting) and a guide to how long mangoes take to ripen with or without ethylene treatment.

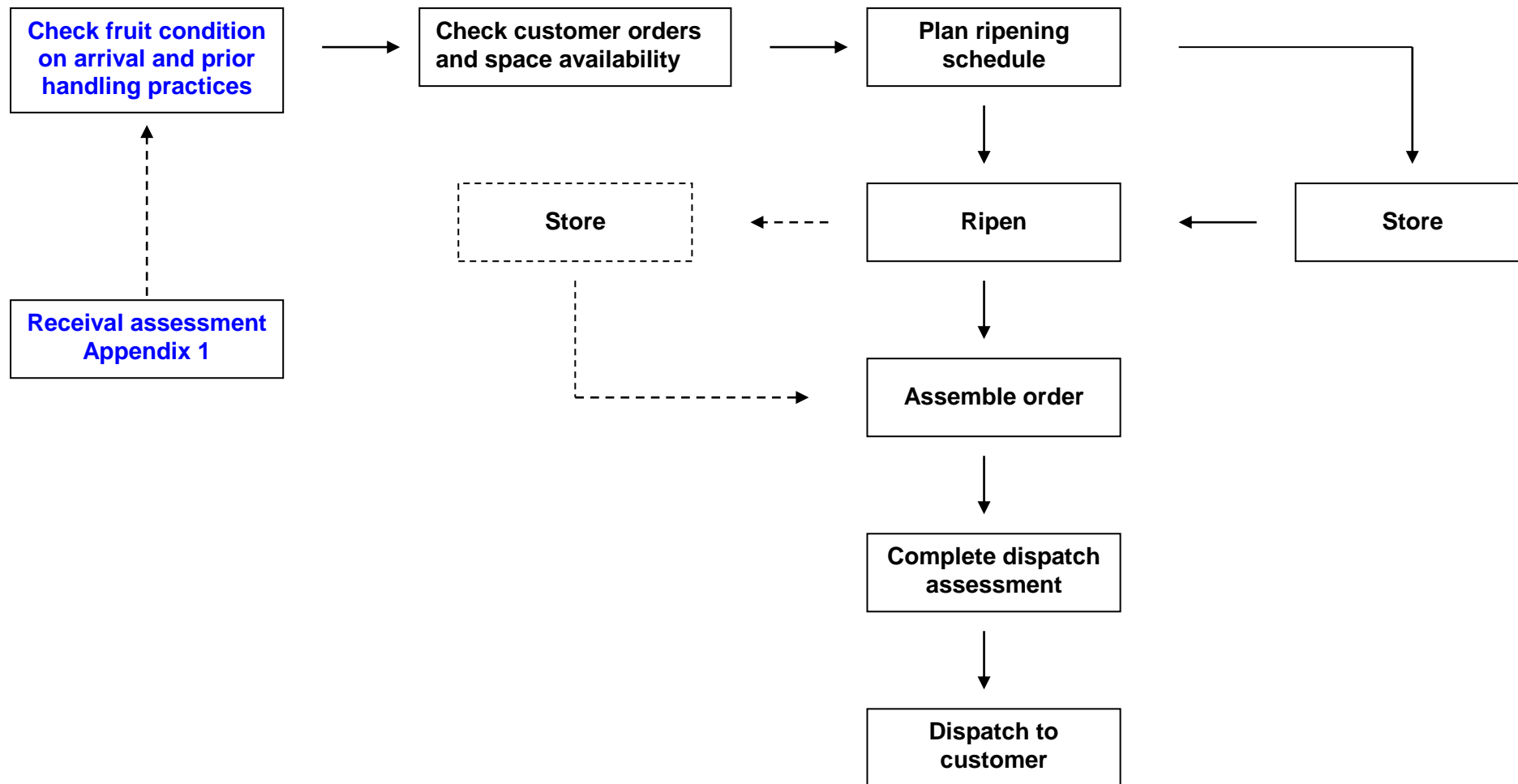
Section 4 provides recommended storage periods for 4 varieties following ripening – Kensington Pride, R2E2, Honey Gold, and Calypso™.

Section 5 provides guidance on operating ripening and storage rooms. It includes information on the various types of ethylene injection systems, venting of rooms to remove carbon dioxide, monitoring of fruit ripeness and room conditions, and effective temperature management for operating a forced-air ripening system and a storage room.

Section 6 will help identify common fruit quality problems that occur during ripening. Each quality problem has a photograph and description of the symptoms, information on what causes the problem and how it can be minimized or prevented. The section also contains answers to frequently asked questions about mango ripening.

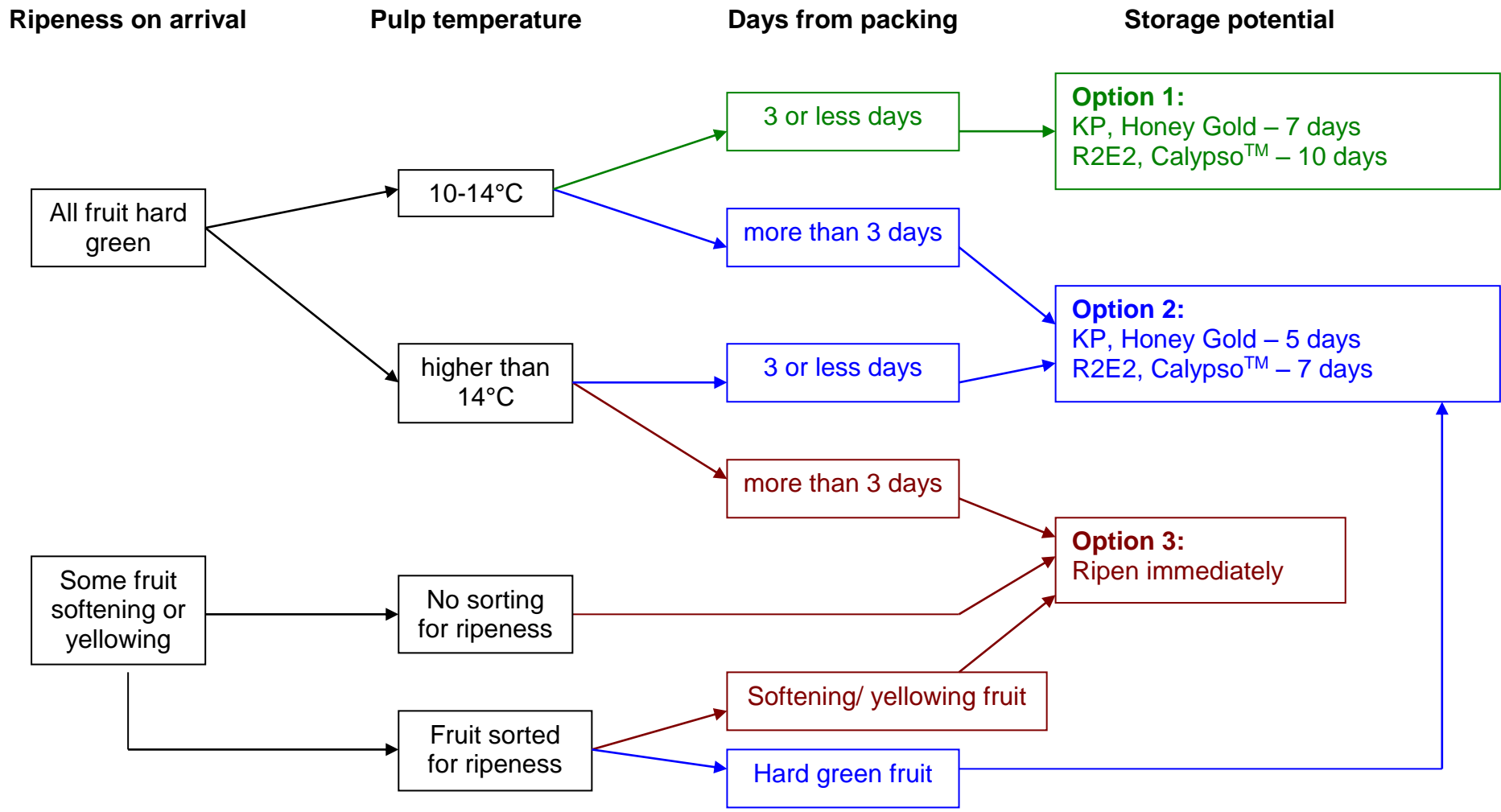
The appendices contain information on completing a receival assessment of the quality and ripeness of fruit on arrival at the ripening facility, assessing skin colour and firmness, harvesting periods for a range of varieties and production districts throughout Australia, and a list of contacts and references.

# Steps in ripening mangoes



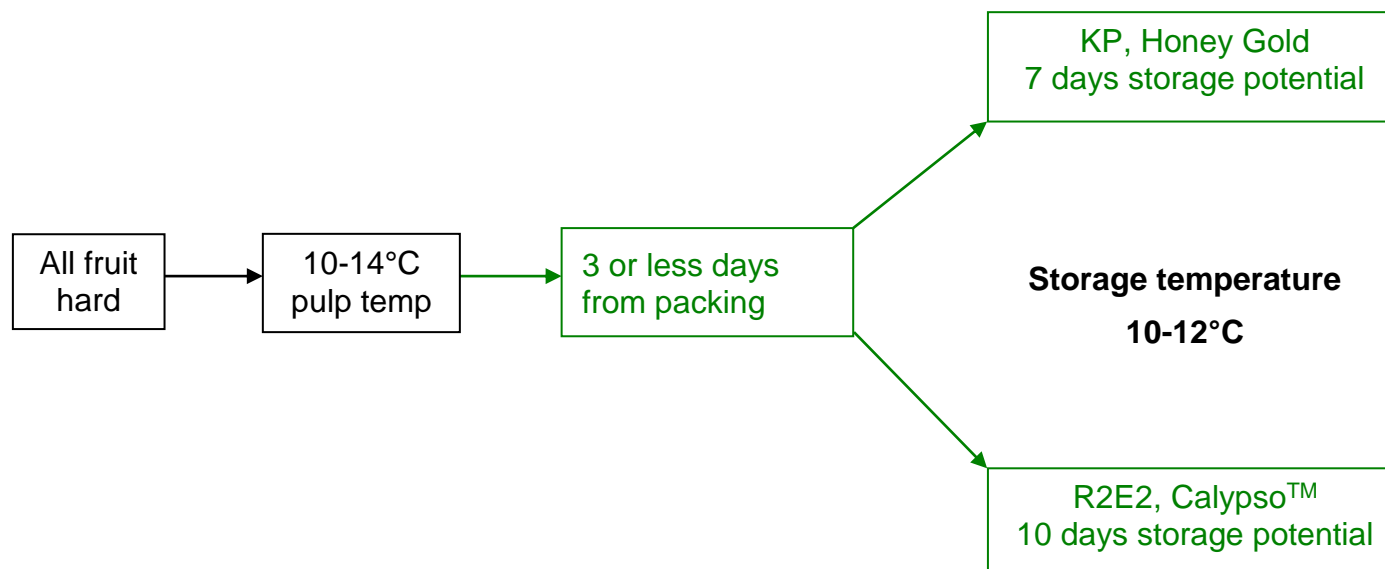
# How long can I store mangoes before ripening?

The storage potential of mangoes before ripening depends on the variety, pulp temperature on arrival and fruit age (days from packing).



## Option 1. Storage before ripening: 7-10 days storage potential

Check fruit ripeness, pulp temperature and days from packing.

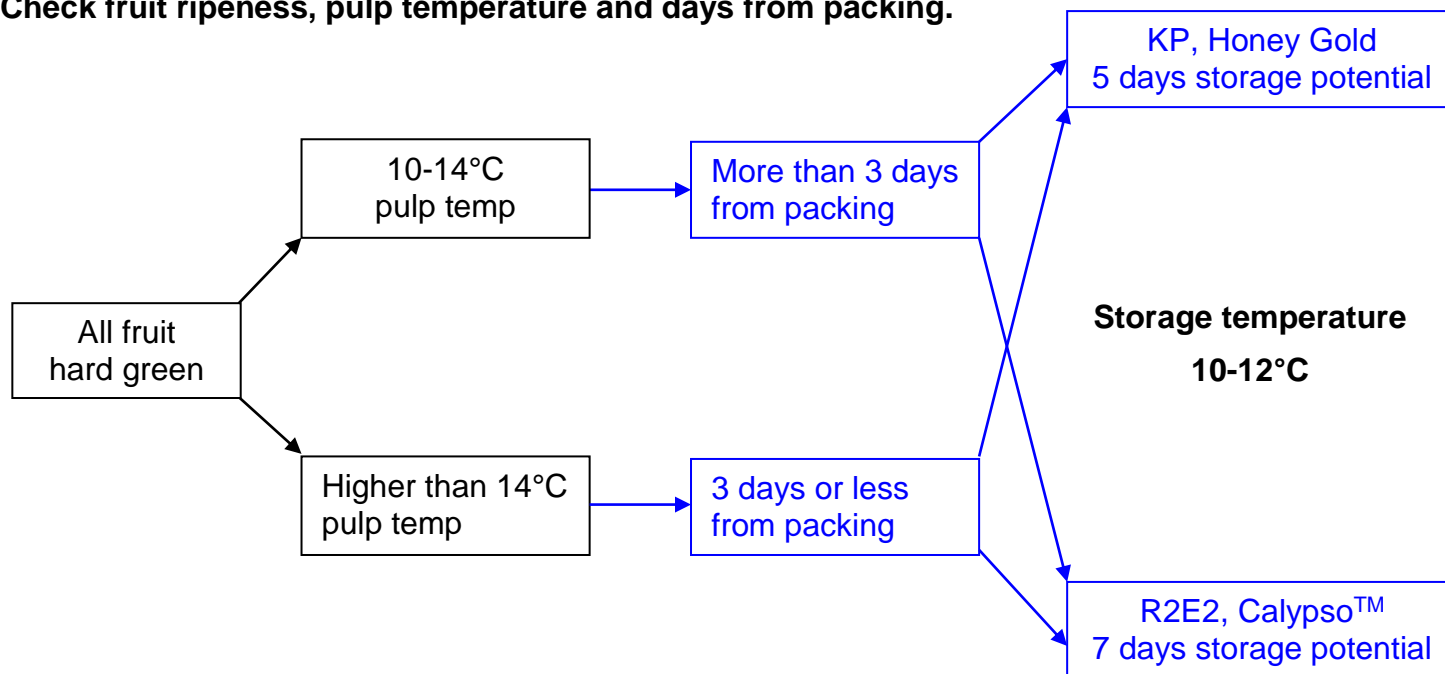


### Caution:

- If fruit ripens during storage, the skin will turn a pale yellow colour, flesh acidity will remain high, have reduced flavour, and rots may develop.
- Fruit must be pre-cooled effectively to 10-12°C within 36 hours of harvest and transported at 12°C.
- Place the fruit into the storage room within 4 hours of receipt at the ripening facility.
- Every day, check fruit condition and length of storage period. Remove fruit if there is a risk of fruit starting to ripen.
- Do not store late season fruit for more than 3-5 days.

## Option 2. Storage before ripening: 5-7 days storage potential

Check fruit ripeness, pulp temperature and days from packing.



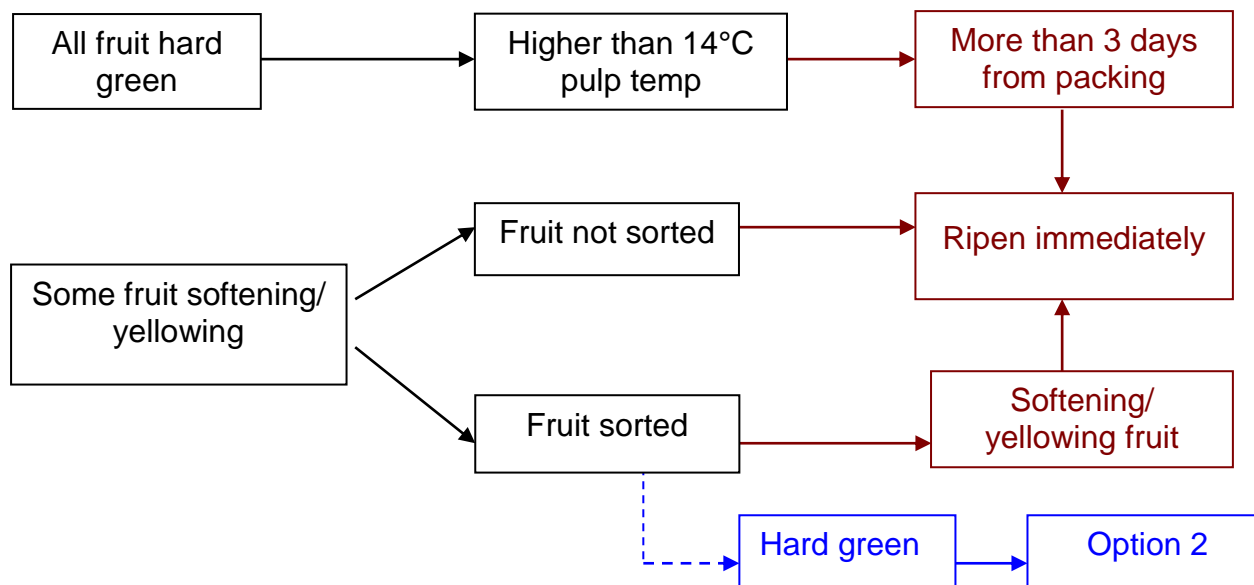
### Caution:

- The older the fruit are on arrival, the less the storage potential before ripening.
- High temperatures on arrival increase the risk of fruit starting to ripen in storage. Precool warm fruit to 12°C within 12 hours of arrival.
- Place cold fruit (less than 14°C) into the storage room within 4 hours of receipt at the ripening facility.
- Every day check fruit condition and length of storage period. Remove fruit if there is a risk of fruit starting to ripen.



### Option 3. Ripen immediately – do not store before ripening

Check fruit ripeness, pulp temperature and days from packing.



**Caution:**

- Loads that arrive with mixed ripeness can be sorted by pack dates and ripeness.
- Select the oldest pack dates and ripening fruit immediately.
- Store hard green fruit for a maximum of 5 days depending on variety.

## Ripening conditions

### Ripen mature fruit

- fruit must be mature to ripen properly
- immature fruit will soften slowly with poor skin colour and poor flavour
- the more mature the fruit (late season), the quicker the ripening time

### Room temperature – 18 to 20°C

- use a forced-air system to precool or warm fruit to ripening temperature
- maintain pulp temperatures between 18-22°C during ripening – pulp may be 1-2°C above room air
- hold fruit at the required temperature until it reaches a ripeness level ready for dispatch
- high temperatures above 22°C increase the risk of rots, reduce skin yellowing and fruit ripen too quickly
- low temperatures below 18°C will reduce skin yellowing and flavour development

### Ethylene duration and concentration

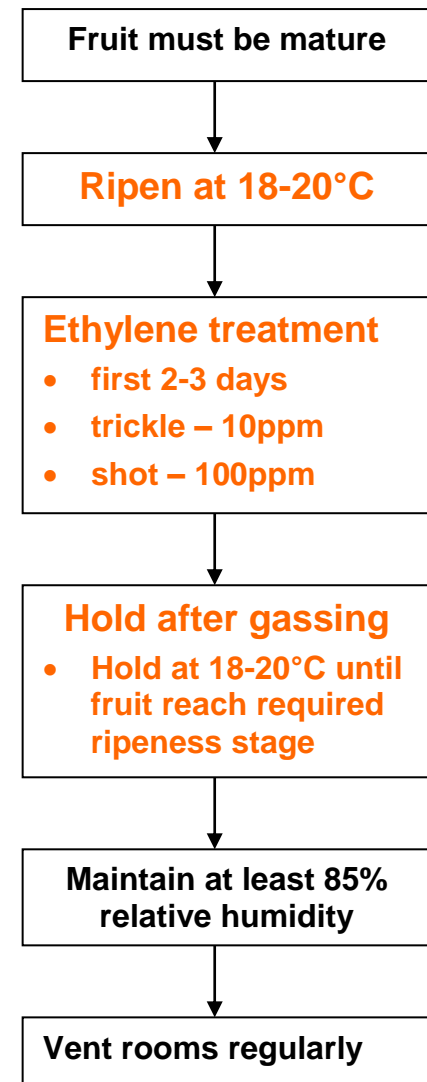
- precool or warm fruit to ripening temperature before injecting ethylene
- duration: first 2-3 days of ripening period
- concentration: trickle system: 10ppm continuous ethylene  
shot system: 100ppm ethylene every 6 to 8 hours

### Room humidity

- maintain at least 85% relative humidity

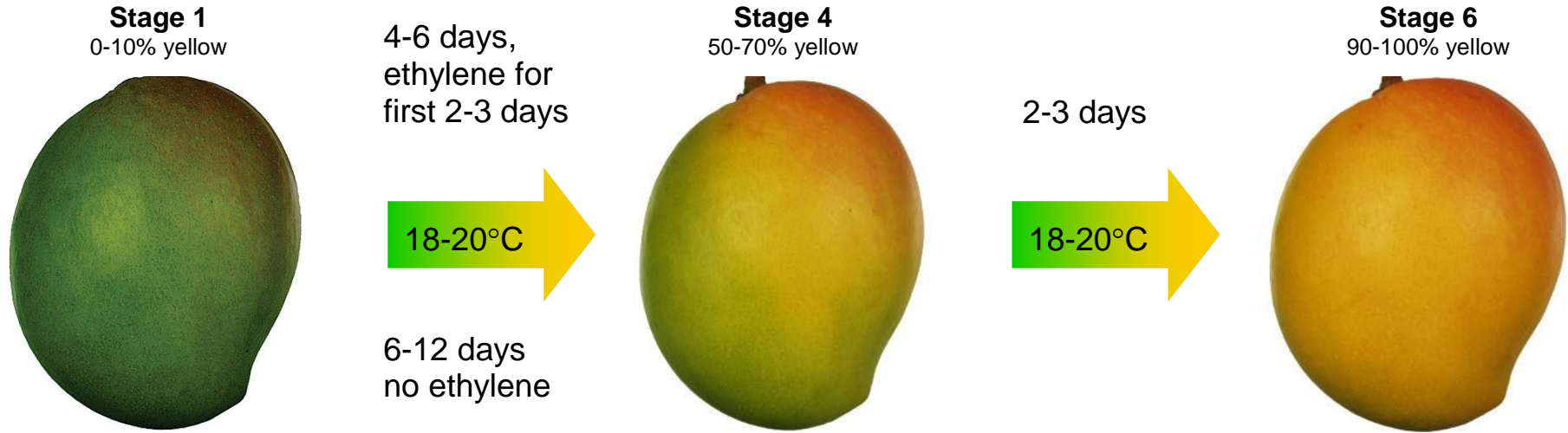
### Room venting

- vent rooms to maintain carbon dioxide level below 1%
- trickle system: vent rooms continuously to allow at least one room volume change every hour
- shot system: vent rooms by opening doors for at least 10-15 minutes every 6 to 8 hours



## Time to ripen

### Kensington Pride



#### Factors affecting time to ripen:

- Variety – the time to ripen with ethylene is similar for all varieties but the firmness and skin colour at eating ripe varies
- Fruit maturity – will ripen quicker with increasing maturity
- Fruit temperature – will ripen quicker as temperature increases
- Ethylene – will ripen quicker with increasing treatment time up to 3 days





#### Firmness and skin colour of mango varieties when eating ripe

Variety	Firmness when ripe	Skin colour when ripe
Kensington Pride	Soft	Stage 5-6 (70-100% yellow)
Honey Gold	Soft	Stage 6 (90-10% yellow)
R2E2	Firm soft	Stage 4-6 (50-100% yellow)
Calypso™ (“B74”)	Firm soft	Stage 6 (90-100% yellow)

## Holding after ripening

To slow further ripening, hold fruit after ripening at 10-12°C for a maximum of 5 days depending on variety and ripeness.

### Maximum holding period after ripening at 10-12°C

	Sprung	Firm soft		Sprung	Firm soft
<b>Kensington Pride</b>			<b>R2E2</b>		
	3 days	1 day		5 days	3 days
<b>Honey Gold</b>			<b>Calypso™</b>		
	3 days	1 day		5 days	3 days

## Ethylene injection

### Systems

- Shot injection – one volume of ethylene injected every 6-8 hours to achieve 100ppm in ripening room
- Trickle injection – continuous measured flow of ethylene to achieve 10ppm in ripening room
- Catalytic generation – one volume of gas generated every 6-8 hours to achieve 100ppm in ripening room
- Controlled monitoring – ethylene level in ripening room is monitored and ethylene is injected when concentration drops below set point of 10ppm – carbon dioxide level is also monitored and vents are opened when concentration reaches set point of 1%

**Shot system**



**Trickle system**



**Controlled monitoring**



**Catalytic generation**



Ethylene is available in cylinders as pure ethylene or RIPEGAS™, which contains 6% by volume of ethylene.

In a typical shot system, the required volume of gas is first flushed into a secondary cylinder before injecting this volume into the room.

With catalytic generators, ethanol is poured into the generator and catalysed into ethylene. The amount of ethanol required is calculated to match the room volume.

## Venting rooms

A system for positively venting the ripening room is required to remove carbon dioxide (CO<sub>2</sub>). Carbon dioxide is produced by the ripening fruit and will build up if the room is not regularly flushed. Carbon dioxide levels above 1% can inhibit fruit ripening and are a health hazard to operators. Concentrations of 3-5% cause increased respiration and headaches and 8-15% cause headache, nausea and vomiting and may lead to unconsciousness. Concentrations as high as 12% have been measured in fruit ripening rooms.

### Venting systems

- Shot systems and catalytic generators – room is manually vented by opening the doors for 10-15 minutes every 6-8 hours. Run the room fans to flush the room.
- Trickle system – room is continuously vented with inlet and outlet vents. The inlet vent is typically behind the cooling coils to suck in fresh air. Carbon dioxide is heavier than air so the outlet vent is best placed on a wall near the floor. The vents need to be large enough to allow at least one room volume change every hour.
- Controlled monitoring – A sensor is placed inside the room and monitors the level of carbon dioxide. Inlet and outlet vents are placed in the same positions as for the trickle system. When the carbon dioxide level reaches 1%, the outlet vent is opened, a fan is started and the room is flushed. Once the room is flushed the outlet vent is closed.



Outlet vent is placed near the floor and can be closed when not flushing the room



A fan connected to the outlet vent helps to flush the room



For the controlled monitoring system, a carbon dioxide sensor opens the vent when the level reaches 1%

## Monitoring fruit and handling conditions

### Temperature

- Check set temperatures daily for ripening and storage rooms. Calibrate the room temperature gauges with a temperature logger at least monthly to ensure the gauges are accurate
- Spot check pulp temperatures at least monthly to ensure that fruit temperatures are uniform within pallets and between pallets. Probe fruit through the stem end and check packages in different layers and on opposite sides of the pallet. Do not check fruit in the top 3 layers as the temperature may not be representative of other fruit in the pallet

### Ethylene

- Ethylene is monitored using a gas aspirating pump (eg Kitagawa) and detector tubes
- Spot check ripening rooms weekly to ensure correct concentration is being injected during ripening
- Spot check storage rooms weekly to ensure that ethylene is not present in room

### Carbon dioxide

- Carbon dioxide is monitored using a gas aspirating pump (eg Kitagawa) and detector tubes
- Spot check ripening rooms weekly to ensure that levels don't exceed 1%

### Ripeness

- Check fruit daily in ripening rooms to monitor the ripening rate
- Check fruit daily in storage rooms and storage period and remove fruit at first sign of ripening
- Check packages in different layers and on opposite sides of the pallet
- Do not check fruit in the top 3 layers as ripeness may not be representative of other fruit

### Shelf life (library samples)

- Sample fruit at dispatch and hold in an air conditioned room (20-23°C) to assess ripe fruit quality
- Select fruit weekly for each variety from each grower/ packer to monitor for seasonal effects
- Assess the fruit when ripe for skin colour, external appearance and flesh quality

### Monitoring records

- Monitoring records help to identify problems and areas for improvement, and provide feedback to growers/ packers
- A handling log records room conditions (temperature, ethylene, carbon dioxide) and tracks fruit movement from receipt to dispatch
- A shelf life assessment record together with photographs provides feedback to grower/ packers on fruit quality



Temperature data logger



Gas pump and detector tube

## Operating a forced-air ripening system

Forced-air coolers enable effective control of fruit temperature during ripening, provided the containers are suitable and the pallets and room are stacked to optimise air movement across the fruit. If uneven amounts of air flow through different layers or pallets, ripening will be uneven within and between pallets. Air will always take the path of least resistance and flow through gaps around containers and pallets rather than through the containers.

### Checklist for forced-air ripening systems:

- Are the cartons, crates or containers stacked so that the side with the most ventilation area is aligned in the forced air line to allow maximum air flow through the pallet?
- Are the containers stacked in columns to ensure even air flow through all layers on the pallet?
- Are the pallets placed tightly against the plenum and along the row to minimize gaps between the pallets?
- Are large gaps between pallets covered to prevent air bypassing between the containers on the pallets?
- When ripening pallets with different types of containers, are the pallets with containers having the least amount of ventilation placed at the front of each row (near the plenum) and pallets with containers having the most ventilation placed at the back of the row?
- Are the heights of the pallet stacks even between the two rows so that the tarp fits tightly without any gaps underneath?
- For open top containers, does the tarp cover the full width of the 2 rows of pallets or the tops of pallets are covered to prevent air leaking under the tarp?

Stack pallets to same height along the 2 rows to ensure tarp fits tightly without gaps underneath



Cover the top row of open top trays.



Place pallets with least ventilation at front of row near fan



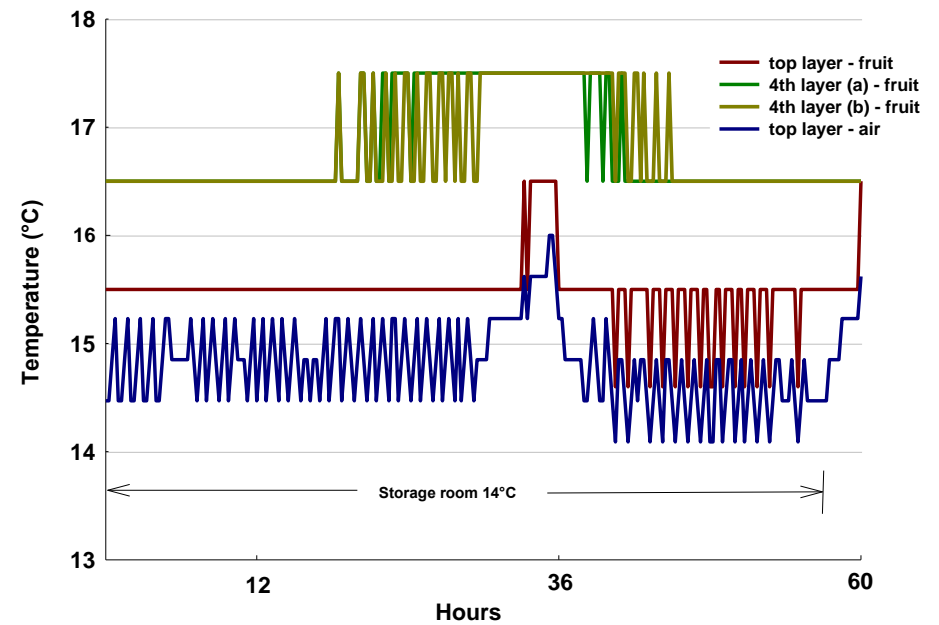
## Operating a storage room

Ensure a space of at least 10cm is left around all sides of pallets during storage to allow effective air circulation to maintain fruit temperatures



Allow a space of at least 10cm around pallets to ensure effective air movement

Pulp temperature variation between layers on the pallet due to insufficient air circulation around pallets during storage at 14°C. Fruit on opposite sides of pallet in the 4<sup>th</sup> layer were 2°C higher than fruit in the top layer.



## Fruit ripens too slowly

### What is it?

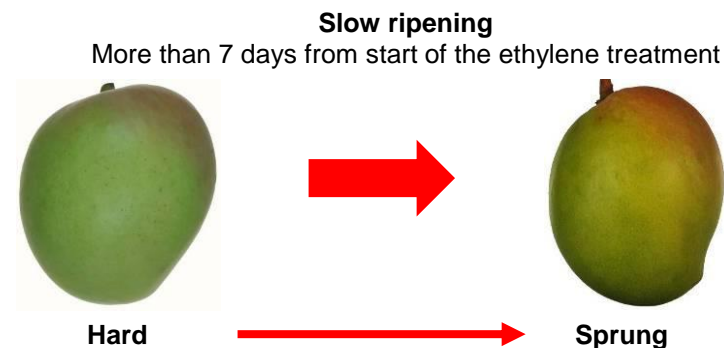
- Fruit takes more than 7 days to reach sprung stage

### What causes it?

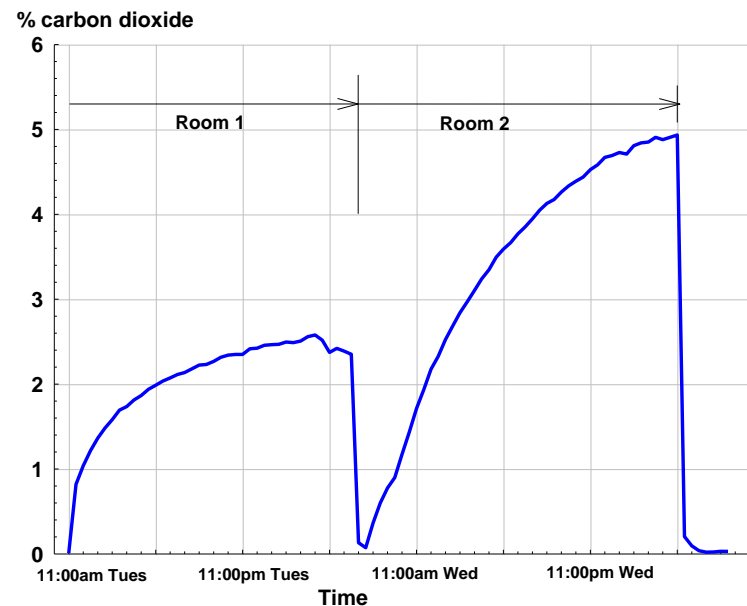
- Immature fruit ripen slowly even if ethylene is used.
- Low fruit temperature – the lower the temperature, the slower will be the ripening.
- High carbon dioxide – levels above 1% inhibit ripening.
- Faulty ethylene injection – empty gas bottle or leakage/blockage in injection system

### How can it be minimised or prevented?

- Check fruit maturity – dry matter should be above 14%
- Check the room temperature setting and calibrate the room temperature gauge to ensure it is accurate.
- Check carbon dioxide levels and venting.
- Shot system. Manual flushing of room may not be frequent enough. Open the doors to vent the room every 6-8 hours.
- Trickle system. The size of inlet and outlet vents may not be large enough or the length of the outlet pipe may be too long or the outlet vent may not be located correctly (near floor). At least one room air change per hour is required.
- Check ethylene level and treatment duration. Inject ethylene into ripening room for first 2-3 days.



Carbon dioxide level in shot ripening rooms. In room 1 the level rose to 2.5% in 18 hours until door was opened to vent room and 5% in room 2 after 20 hours with doors shut



## Uneven ripening

### What is it?

- Fruit ripening is uneven within trays, between trays in pallets or between trays on different pallets in the ripening room.

### What causes it?

- Variable fruit maturity within trays.
- Ripening rate will vary if fruit are ripened without ethylene.
- Variable fruit age. If the pallets are stacked with packages from different growers/ packers or different pack dates, ripening rate will vary.
- Variable fruit temperature. Mangoes generate heat during ripening and if not removed, temperature will rise and fruit will ripen quicker. This can occur if package ventilation is insufficient or if pallets are cross stacked or if pallets with different packages are placed in the ripening room.

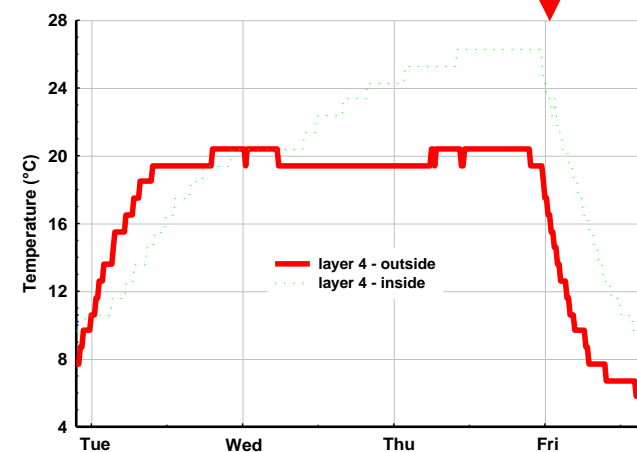
### How can it be minimised or prevented?

- Check ethylene level and treatment duration.
- Check the grower/ packer details and pack dates. Restack pallets with the same grower or similar pack dates.
- Check the package design. Is the ventilation suitable to allow enough air to flow across the pallet? At least 4% of the package side must be vented.
- Check the stacking of pallets. Stack pallets with packages that have similar ventilation area on all sides or column stack the packages.
- Check pallet and tarp placement. Look for gaps between the pallets and under the tarp. Air will always take the path of least resistance.
- If there is a mixture of pallets on the forced air cooler, place pallets having the least amount of ventilation at the front near the fan. For example, stack pallets with cartons at the front and pallets with plastic returnable crates at the back.

Ripening rate will vary if ethylene level or duration is insufficient



Fruit inside (green line) the pallet rose 6°C more than outside (red line) due to insufficient air flow through the pallet. Cooling after ripening was also slower. Inside fruit were one ripeness stage ahead of outside fruit



## Poor skin yellowing

### What is it?

- The fruit softens but the skin fails to yellow evenly as the fruit ripens.
- Skin appears mottled with areas of green and yellow.
- In severe cases, skin can be green and eating ripe (green ripe)

### What causes it?

- Fruit maturity – early season fruit with low dry matter content will not yellow evenly during ripening.
- Excessive nitrogen fertilizing
- Canopy shading – inside fruit do not yellow fully
- High ripening temperatures above 24°C
- High carbon dioxide levels above 1% in ripening room

### How can it be minimised or prevented?

- Check grower details. Fruit maturity, nitrogen fertilizing and canopy management varies between growers.
- Check the room temperature setting and calibrate the room temperature gauge to ensure it is accurate (18-20°C).
- Check fruit temperature is uniform between positions within pallets and between pallets. Air flow through packages must be sufficient to remove the heat generated by ripening fruit (Section 4 Room operation, page 13).
- Vent the ripening room regularly to prevent carbon dioxide buildup (Section 4 Room operation, page 11).

High ripening temperatures or high carbon dioxide in the ripening room cause the skin to yellow unevenly



Green ripe fruit can be caused by excessive nitrogen fertilizing, canopy shading, picking immature fruit or high ripening temperatures



## Fruit rots

### What is it?

#### *Body rot*

- A dark grey to black rot, usually round and slightly sunken. Pink spots may be present when the rot is advanced. The rot does not penetrate deep into flesh.

#### *Soft stem end rot*

- Fast growing, grey to light brown, watery soft rot starting around the stem and penetrating deep into the flesh.

#### *Firm stem end rot*

- Black, firm rot, usually semi-circular and slightly sunken, starting around stem.

#### *Dendritic spot*

- Small black spots with irregular edges in a branched pattern. Rot is slow growing and does not penetrate deep into the flesh.

### What causes it?

- Poor field hygiene. Infection of fruit occurs on the tree and the organisms remain dormant until the fruit starts to ripen.
- Incorrect or poor application of fungicide treatments in the pack shed.
- Fruit ripening at high temperatures above 22°C.
- Fruit overripe – holding ripe fruit for too long.

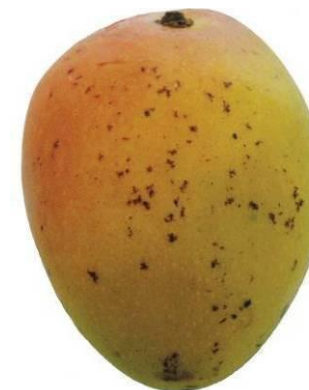
### How can it be minimised or prevented?

- Check the grower/ packer details. Infection levels vary between growers and the effectiveness of the postharvest fungicide.
- Check the room temperature setting. Ripen fruit at 18-20°C.
- Check fruit temperature is uniform between positions within pallets and between pallets.
- Do not store ripe fruit for longer than 3 days.

Body rot



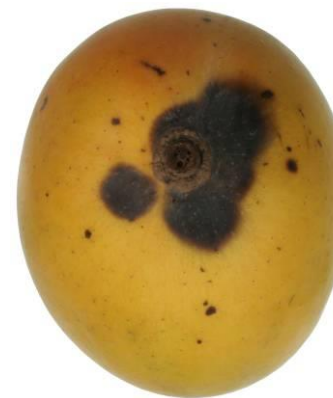
Dendritic spot



Soft stem end rot



Firm stem end rot



## Skin spotting

### What is it?

- Light brown spots on skin up to 5mm in diameter and typically associated with the lenticels

### What causes it?

- Sap build-up in water during harvesting and packing.
- Ethylene injected into the ripening room while the fruit are hot (above 24°C).

### How can it be minimised or prevented?

- Check the grower/ packer details. The effectiveness of the de-sapping operation varies between growers and packers.
- Precool fruit to the ripening temperature (18-20°C) before injecting ethylene into the ripening room.



Ethylene injected **before** precooling fruit



Ethylene injected **after** precooling fruit



## Skin blotching

### What is it?

- Blotches on the skin varying from grey to dark brown in colour, Skin maybe sunken in severe cases.
- Flesh is usually not damaged.

### What causes it?

- Storage or transport of fruit below 10°C. Severity increases as the temperature decreases and the storage/ transport period increases. Symptoms increase when fruit is removed to air temperature.
- Ethylene present in the room during long term storage of mangoes. Severity increases as the ethylene concentration and storage period increases.

### How can it be minimised or prevented?

- Do not store or transport fruit below 10°C.
- Check the temperature setting of storage rooms and calibrate the room temperature gauge to ensure it is accurate.
- Do not store mangoes for long periods with other produce that release ethylene (e.g. banana, avocado, tomato).
- Locate storage rooms away from ripening rooms and ethylene cylinders.
- Only use electric fork lifts in storage rooms.

Dark brown blotches on skin caused by storing or transporting mangoes below 10°C



Low level of ethylene (1ppm) present in room during storage of mangoes for 2 weeks



## Frequently asked questions

### *What do I do if the fruit arrives hot?*

- \* Check the fruit history – stage of season and pack dates. See Section 2. Storage before ripening for more information.
- \* Ripen fruit immediately if the temperature is above 14°C and fruit age is more than 3 days from packing.
- \* If the fruit age is 3 or less days from packing, the mangoes may be stored before ripening for up to 5 days depending on the variety. Precool fruit to 10-12°C within 12 hours of arrival.
- \* Check fruit condition and length of time in storage every day. Remove fruit if there is a risk of fruit starting to ripen.

### *What do I do if fruit arrives already softening or yellowing?*

- \* Ripen the fruit immediately. Do not store the fruit.

### *What temperature do I use for ripening mangoes?*

- \* Ripen fruit at 18-20°C. Fruit temperature is typically 1-2°C above the air temperature. See Section 1. Ripening for more information.

### *How much ethylene do I add to the ripening room and for how long?*

- \* There are 4 methods for injecting ethylene into the ripening room – shot, catalytic generator, trickle, and controlled monitoring. Use 100ppm ethylene for the shot and catalytic generator methods and 10ppm for the trickle and controlled monitoring methods. The duration of the ethylene treatment is 2-3 days. Refer to Section 4. Room operation for more information.

### *What temperature and for how long can I store mangoes before and after ripening?*

- \* Store mangoes at 10-12°C before and after ripening.
- \* Before ripening, fruit may be stored for up to 10 days depending on the variety, arrival temperature, and the fruit maturity and age. See Section 2. Storage before ripening for more information.
- \* After ripening, fruit may be stored for up to 7 days depending on the variety and stage of ripeness. Refer to Section 3. Storage after ripening for more information.



### *What causes uneven ripening of mangoes within and between pallets?*

- \* Uneven ripening may be caused by ripening multiple growers or pack dates in the same room, insufficient ethylene concentration or duration or uneven fruit temperatures
- \* If there is fruit from different growers/ packers or different pack dates in the room, the ripening rate will vary. Check the package labels at receipt for details of the grower and packer and the pack dates, and segregate batches that may ripen differently.
- \* The ripening rate of fruit within packages varies due to maturity differences. Gassing mangoes with ethylene increases the uniformity of ripening. Check the ethylene level and treatment duration. Gas fruit for the first 2-3 days and hold at the ripening temperature until the fruit reaches the required ripeness stage.
- \* Fruit temperature variations within ripening rooms may be caused by placing different packages in the room, variable stacking of the pallets and the location of the pallets. In a forced-air system, air will always take the path of least resistance. If the container ventilation space is too small or there are gaps between pallets or under the tarp, there may not be enough air flowing through the pallets. The temperature on the inside of the pallet will be higher and the fruit will be riper than the outside of the pallet.
- \* Ideally it is best to have the same package type on all pallets in the ripening room. Where this is not possible, position the pallets so that the less ventilated packages are placed at the front nearest to the forced-air fan and the packages with the most ventilation placed further away. Air flow should be as even as possible across all pallets.
- \* Refer to the description of "Uneven ripening" on page 16 for more information.

### *Why do I lose my breath when I walk into a ripening room?*

- \* This is a sure indication that the level of carbon dioxide has reached a high concentration (3-5%) and is affecting your breathing. As well as being a health hazard, carbon dioxide levels above 1% will inhibit ripening. Mangoes generate carbon dioxide during ripening and the level will build up if the room is not vented effectively.
- \* Vent the room immediately by opening the door(s) for 10-15 minutes. Refer to section 4. Room operation for instructions on venting for the various types of ripening systems.

# Appendix 1.

## Receival assessment

### Purpose

- To check if the product complies with the specifications and to plan the ripening schedule.

### Sampling

- Select 3 packages or at least 50 fruit across the size range for each grower and pack date.
- Select the packages from different pallets and avoid the top 3 layers.
- Record delivery details on a record form – brand, variety, date, type and no. of packages
- Record label details – packer, grower, pack date, pallet no., product ID, count/fruit size

### Check prior handling practices

- Check the pulp temperature of a fruit from the middle of each package.
- Calculate the number of days from packing to delivery.
- Note the stage in season for the variety and district – early, mid or late.

### Check packing, fruit quality and ripeness

- Weigh the package and record the net fruit weight.
- Observe the presentation and record if improvement is needed (eg loose pack, mixed sizing, missing stickers).
- Photograph the pack before removing any fruit for assessment.
- Assess each fruit for firmness and skin colour and record if any fruit are softening or colouring.
- Assess each fruit for external appearance and record the number of fruit out of grade according to defect type.
- Calculate the percentage of out-of-grade fruit according to major and minor defects and determine whether the product meets specification.

### Provide feedback to grower/ packer

- Send electronic copy of receival assessment record and photographs to grower/ packer after completion of assessment.
- Request extra information about prior handling if fruit ripening is detected or uncertain about storage potential.

### Plan ripening schedule

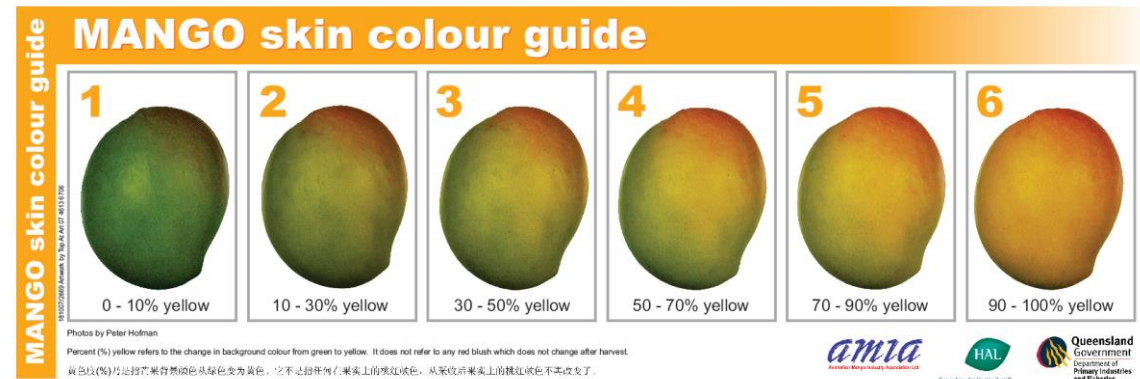
- Check customer orders, ripening space available and storage potential using the decision tree on page 5.



## Assessing skin colour and firmness

### Skin colour rating scale

Rating	Skin colour
1	0-10% yellow
2	10-30% yellow
3	30-50% yellow
4	50-70% yellow
5	70-90% yellow
6	90-100% yellow



### Fruit firmness rating scale

Firmness stage	Description
Hard	No give with strong thumb pressure
Rubbery	Slight give with strong thumb pressure
Sprung	Fruit deforms by 2-3 mm under moderate thumb pressure
Firm soft	Fruit deforms by 2-3 mm under slight thumb pressure
Soft	Whole fruit deforms with slight hand pressure



Grasp with the whole hand to check firmness

# Harvesting calendar

Mango varieties and seasonality

Variety	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Kensington Pride	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	
R2E2		Harvest	Harvest	Harvest	Harvest	Harvest	
B74 (Calypso™)		Harvest	Harvest	Harvest	Harvest	Harvest	
Honey Gold			Harvest	Harvest	Harvest	Harvest	Harvest
Keitt					Harvest	Harvest	Harvest
Kent					Harvest	Harvest	Harvest
Palmer					Harvest	Harvest	Harvest
Pearl					Harvest	Harvest	
Brooks						Harvest	Harvest

**Harvest seasons for production regions:**

Darwin, Northern Territory	Late September – November
Katherine, Northern Territory	October – November
Kununurra, Western Australia	October – November
North Qld (Bowen, Burdekin) Qld	November – December
Far North Qld (Atherton Tablelands)	December – February
Central Qld (Rockhampton, Yepoon)	January – March
South East Qld (Gin Gin to Gatton)	January – March
Northern New South Wales	February – March
Carnarvon, Western Australia	February – March
Gin Gin, Western Australia	February – March

## Contacts

### Ethylene gas

- \* BOC ([www.boc.com.au](http://www.boc.com.au)) – pure ethylene, Ripegas™
- \* Air Liquide ([www.airliquide.com.au](http://www.airliquide.com.au)) – pure ethylene

### Catalytic ethylene generators

- \* QA Supplies ([www.gasupplies.com](http://www.gasupplies.com))
- \* American Ripener ([www.ripening.com](http://www.ripening.com))
- \* Ventech ([www.ventech.co.uk](http://www.ventech.co.uk))

### Temperature/ humidity monitoring equipment

- \* OneTemp ([www.onetemp.com.au](http://www.onetemp.com.au)) – data loggers
- \* Hastings Data Loggers ([www.hdl.com.au](http://www.hdl.com.au))
- \* ECEFast ([www.ecefast.com.au](http://www.ecefast.com.au)) – data loggers, meters
- \* RS Australia ([australia.rs-online.com](http://australia.rs-online.com)) – thermometers

### Gas monitoring equipment (ethylene, carbon dioxide)

- \* EE Muir ([www.eem.com.au](http://www.eem.com.au)) – Kitagawa gas aspiration pump
- \* Air-Met Scientific ([www.airmet.com.au](http://www.airmet.com.au)) – detector tubes/ aspiration pump
- \* Vaisala ([www.vaisala.com](http://www.vaisala.com)) – carbon dioxide, humidity, temperature data logger

### Controlled monitoring equipment

- \* Controlled Ripening Systems Australia ([www.crsa.net.au](http://www.crsa.net.au)) – GT Automatic Fruit Ripener™

### Technical advice

- \* DAFF website ([www.daff.qld.gov.au](http://www.daff.qld.gov.au)) – handling guides
- \* Australian Mango Industry Association website (<http://industry.mangoes.net.au>) – handling guides, Mango quality assessment manual, training information

# References

- \* Mango handling guides
  - o Mango skin colour guide
  - o Mango handling guide
  - o Mango defect guide
  - o Mango ripening guide
  - o When will mangoes be ripe
  - o Important points for mango ripening and storing
- \* Mango training module
  - o Handling mangoes in export destinations
- \* Mango quality assessment manual

### MANGO ripening guide

- Ripen mature fruit  
Fruit must be mature to ripen properly. Immature fruit will soften slowly with poor skin colour and flavour.
- Keep fruit temperature between 18° and 22°C  
Use forced air cooling or air-stark trays to pre-cool fruit and maintain pulp temperature between 18° to 22°C. Hold fruit at this temperature until it reaches a ripeness level ready for sale. Make sure that fruit is below 22°C before introducing ethylene.
  - Temperatures above 24°C during ripening increase the risk of rots, skin blemishes and green skin colour at ripe.
  - Temperatures below 18°C during ripening increase acidity, rots and green skin colour at ripe.
- Set room temperature at 18° – 20°C  
Set room temperature between 18° and 20°C, as fruit pulp temperatures may be 1° to 2°C above room temperature during ripening.
- Expose fruit to ethylene for two to three days
- Set ethylene concentration  
Trickle systems - 10ppm continuous ethylene  
Shut systems - 100ppm ethylene every 6 to 8 hours
- Maintain room humidity  
Design rooms to operate above 85% relative humidity
- Vent rooms regularly  
Vent rooms to prevent carbon dioxide buildup. High concentrations affect skin colour and fruit flavour.  
Trickle systems - Vent rooms continuously to allow at least one room volume change every hour.  
Shut systems - Vent rooms to opening doors for at least 10 minutes every 8 to 18 hours.

When will the fruit be ripe?

Stage 1: with ethylene 4 - 6 days  
Stage 4: 6 - 12 days without ethylene  
Stage 6: 2 - 3 days to full yellow

### When will mangoes be ripe ?

1: 0 - 10% yellow  
4: 50 - 70% yellow  
6: 90 - 100% yellow

4-6 days with ethylene for first 2-3 days  
18° - 20°C  
or  
6-12 days without ethylene  
Store 3 days at 12°C, + 2-3 days at 18-20°C to full yellow

Time to ripe: 6 to 18 days

### Kensington Pride

### MANGO skin colour guide

1: 0 - 10% yellow  
2: 10 - 30% yellow  
3: 30 - 50% yellow  
4: 50 - 70% yellow  
5: 70 - 90% yellow  
6: 90 - 100% yellow

### MANGO defect guide

- Stem end rots
- Dendritic spot
- Anthracnose
- Sapburn
- Skin browning
- Lenticel spot

### MANGO handling guide

Right temperatures Better Mangos

10°C: Too Cold  
10°-12°C: Store  
12°-16°C: Transport  
18°-22°C: Ripen  
24°C: Too Warm