Summerfruit AUSTRALIA

Storage and quality guidelines

Decision aid tools for stonefruit growers

Contents

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Acknowledgements

The Serviced Supply Chains project is funded by the Hort Frontiers Asian Markets Fund, part of the Hort Frontiers strategic partnership initiative developed by Hort Innovation, with co-investment from the Department of Agriculture and Fisheries, Queensland, Department of Jobs, Precincts and Regions (Victoria), Manbulloo (mangoes), Montague Fresh (stone fruit), Glen Grove (citrus), the Australian Government plus in-kind support from The University of Queensland and the Chinese Academy of Sciences.

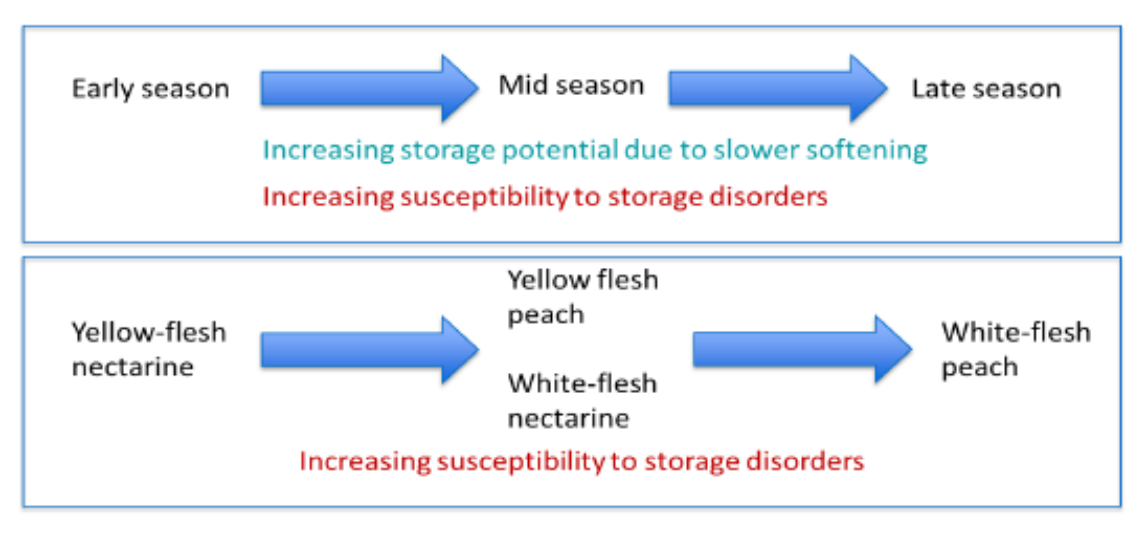
Disclaimer

Cultivar recommendations for cool storage

The Decision Aid Tools (DAT) program within the Serviced Supply Chains project aims to: develop models to predict remaining shelf life based on variable storage temperatures and export duration; determine export potential of stone fruit cultivars desired by Asian consumers; and understand the impact of harvest maturity and postharvest treatments on exported fruit quality.

Influence of seasonality and stone fruit type on storage potential

- Cultivar highly influences the rate of flesh softening, and susceptibility to disorders such as flesh browning and mealiness, during extended cool storage or sea freight export;
- Early season nectarine cultivars have a relatively low flesh firmness at commercial harvest and generally soften at a faster rate than mid-to-late season cultivars, but also tend to be less susceptible to storage disorders;
- Early-to-mid season white-fleshed nectarine and peach cultivars tend to be more susceptible to storage disorders, but among these stone fruit types, susceptibility will vary among cultivars;
- Regardless of seasonality or stone fruit type harvest maturity can have an important impact on cultivar cool storage performance, risk of storage disorders, and subsequent ripening behaviour and eating quality



Cultivar recommendations for cool storage

- Recommendations for cultivar storage potential should be considered general guidelines:
- Actual impact of cool storage will depend on other factors including growing conditions and climate, harvest maturity, postharvest treatments, and fruit packaging;
- Chilling injury refers to disorders including flesh browning (FB) symptoms, and flesh mealiness e.g., dry flesh and rubbery texture, particularly after ripening;
- Maximum cool storage durations are based on excessive softening of fruit or commercially-unacceptable disorders that may only be apparent after ripening;
- Fruit harvested at a low maturity ('unripe') above that recommended is likely to be more susceptible to disorders during cool storage.

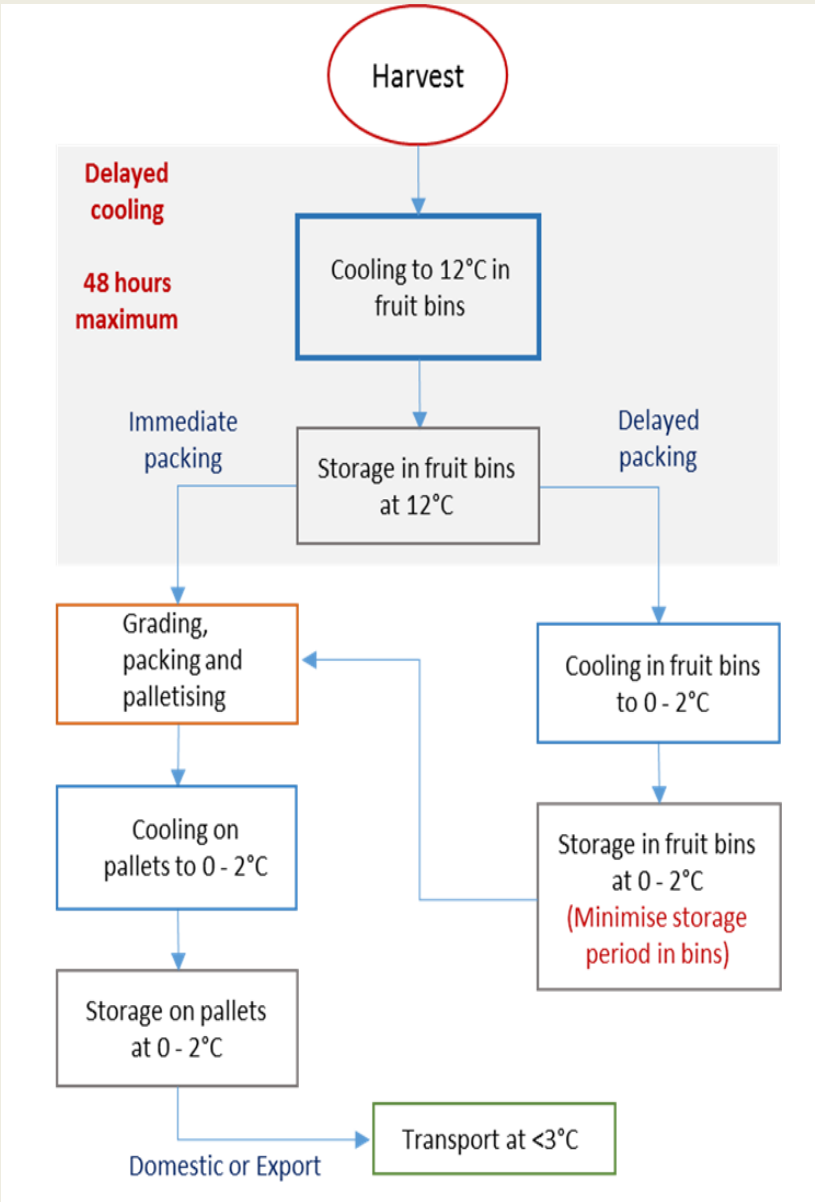
Stepwise cooling after harvest to maximise stone fruit storage potential

Stepwise cooling, also known as preconditioning, is the process of 'acclimatising' fruit to low temperature storage by removing its field heat after harvest in two steps:

1. An initial slow cooling and acclimatisation period where harvested fruit is placed at 10 to 12 ˚C for 36 to 48 hours.
2. Final rapid cooling of fruit down to 0 to 2˚C.

The advantages of stepwise cooling over traditional fast cooling after harvest include:

- Likely reduction in the susceptibility of fruit to storage disorders after long-term storage or sea freight export.
- Avoiding fruit temperature moving through the 'kill zone' of 3 to 8 ˚C due to multiple cooling and warming periods i.e., field heat removal, grading and packing etc.
- Potential reduction in refrigeration energy used due to lower peak refrigeration requirements during the stepwise cooling process.



Commercial considerations when using stepwise cooling after harvest

- Growers should aim to remove field heat from fruit directly after harvest via stepwise cooling and keep fruit temperature above 10 ˚C until packing is completed, with grading and packing ideally completed within 48 hours of harvest before final cooling of fruit down to 0 to 2 ˚C.
- A 'first in, first out' approach is best to ensure that preconditioning does not exceed 48 hours among any batch of fruit.
- If preconditioning including stepwise cooling, grading and packing, is completed within 48 hours then fruit are unlikely to soften appreciably faster during storage than fruit that undergo traditional fast cooling after harvest.

Harvest maturity and sea freight export recommendations for selected Australian stone fruit cultivars

Type and flesh colour	Seasonality	Cultivar	Maximum storage period at 2 °C (weeks)			Risk of storage disorders (no MA liner)	Limiting quality factors for storage	Maximum recommended harvest maturity (I_{ad} value)	Maximum recommnded harvest firmness (kg/cm^2)
			Modified atmosphere liner	Perorated high humidity liner	Sea freight simulations conducted				
White nectarine	Early	Diamond Pearl	6	3 to 4		Moderate	Chilling injury	0.8	5
	Early - Mid	Flavour Pearl	7	5		Low		0.7	7
	Mid	Majestic Pearl	6 to 7	4 to 5		Moderate	Chilling injury	1.3	8
	Early	Polar Light	4	3		Low	Softening	0.6	6
	Early	White Knight	4	2 to 3		Low	Softening	0.6	5
White peach	Mid - Late	Autumn Snow	4	3		Moderate	Chilling injury	0.8	8
	Mid	Pearl Princess	6 to 7	4 to 5		Low to Moderate	Chilling injury	no data	no data
	Mid	Polar Princess	4	3		High	Chilling injury	1.1	8
	Mid- late	Polar Queen	3 to 4	2 to 3		Very high	Chilling injury	0.7	8
	Mid - Late	Sierra Princess	4	3		Moderate to High	Chilling injury	1.0	8
	Late	Snow Fall	4	3		Moderate to High	Chilling injury	1.3	9
Plum	Late	Autumn Honey	7 to 8	4 to 5		na		na	na
	Mid	Red Phoenix	7 to 8	4 to 5		na	Shrivel	na	na
	Mid	Sunshine	6	4		na	Softening/ Shrivel	na	na
Yellow nectarine	Early	June Sweet	5	3 to 4		Low	Softening	0.6	6
	Early	September Bright	6 to 7	3 to 4		High	Chilling injury	1.2	7
	Late	Sol Candy	5	4		Low	Softening	1.1	7

na = not applicable

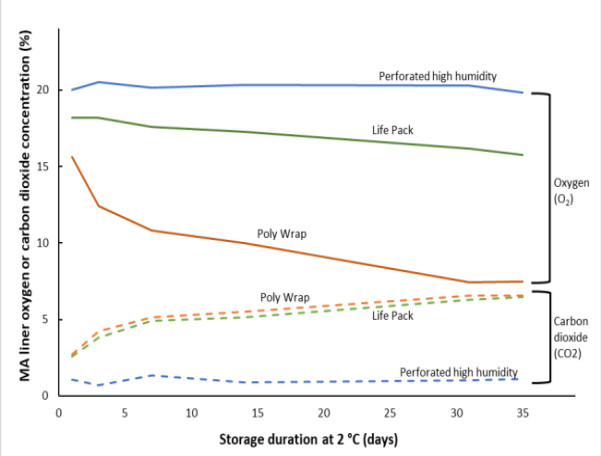
- Harvesting at above the recommended maximum maturity based on DA measurements is likely to result in incomplete ripening of fruit and higher risk of flesh disorders after storage or export.
- The rate of flesh softening, and susceptibility to storage disorders such as flesh browning symptomatic of chilling injury during export, is highly influenced by cultivar.
- Sea freight or storage duration is usually limited by appearance of moderate to severe chilling injury (i.e., flesh browning, mealiness) or excessive softening of fruit.
- Modified atmosphere (MA) liners are recommended for long term storage or sea freight export and generally extend cultivar storage potential by one to three weeks depending on fruit harvest maturity and inherent cultivar storage potential.
- Early season nectarine cultivars have a relatively low flesh firmness at commercial harvest and generally soften at a faster rate than mid-to-late season cultivars, but also tend to be less susceptible to storage disorders.
- Confidence in recommendations for each cultivar is represented by a greater number of sea freight simulations conducted to determine maximum storage potential.
- Information regarding harvest maturity to maximise storage, shelf life and eating quality is not available for many current export cultivars

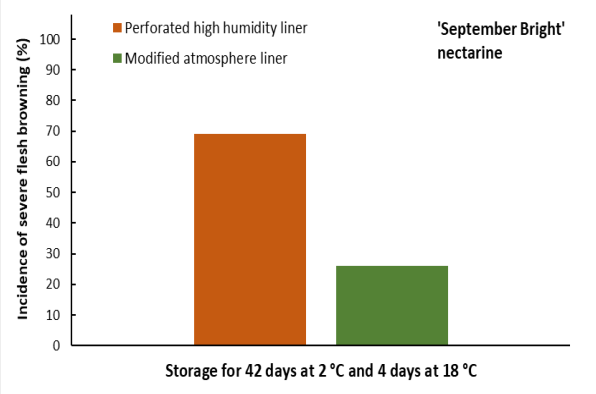
Effective use of modified atmosphere (MA) packaging for sea freight export of stone fruit

Modified atmosphere (MA) liners are now commonly used by growers and exporters for sea freight consignments to reduce fruit weight loss and are required by many importers who prefer consignments to be packed in liners. MA liners are likely to have commercial benefits during sea freight export by increasing storage potential of most peach and nectarine cultivars.

MA liners reduce the oxygen concentration and increase the carbon dioxide concentration around fruit, and with low temperature storage, they reduce fruit quality loss, decrease fruit susceptibility to storage disorders, and reduce water loss.

Recent trials conducted by Agriculture Research Victoria have demonstrated that current commercial MA liners can reduce the incidence of severe flesh browning, an indicator of chilling injury, by up to 25 % in moderately susceptible cultivars such as 'Majestic Pearl', and by up to 50 % in highly susceptible cultivars such as 'September Bright, when compared to fruit stored in perforated high humidity liners.





Commercial considerations when using modified atmosphere liners for stone fruit:

MA liners are likely to extend storage life of most peach and nectarine cultivars by up to two weeks without impacting on fruit quality after ripening but this will depend on a cultivar's susceptibility to storage disorders, with a maximum storage life in MA liners for moderately susceptible cultivars of 6 to 7 weeks, and 4 to 5 weeks for highly susceptible cultivars.

Good postharvest temperature management is important to maximise the benefits of MA liners, and to ensure that carbon dioxide concentrations around fruit are maintained at beneficial levels, whilst reducing the risk of condensation on fruit within sealed liners.

MA liners need to be sealed to effectively extend cultivar storage potential and so cannot be used where methyl bromide fumigation is utilised for fruit disinfestation, but they are suitable for disinfestation treatment using irradiation.

Export supply chain tracking and monitoring

Temperature and time play an important role in preserving fruit quality after harvest and during the export supply chain. Growers and exporters can track and monitor land, sea and air freight consignments in real-time using new generation wireless SIM-based (4/5G) data loggers so that informed decisions can be made during or before the fresh produce arrives at its final destination.

Real-time data loggers

There are several brands (Copeland formerly Emerson, Escavox, Frigga, Sensitech and Tive) currently available with different features and functions including temperature, humidity, light, shock or vibration, carbon dioxide sensors, external probes, and location.

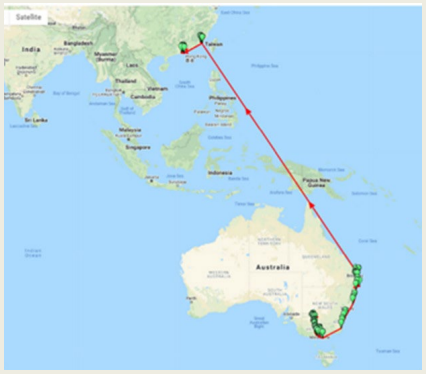
Key features and benefits

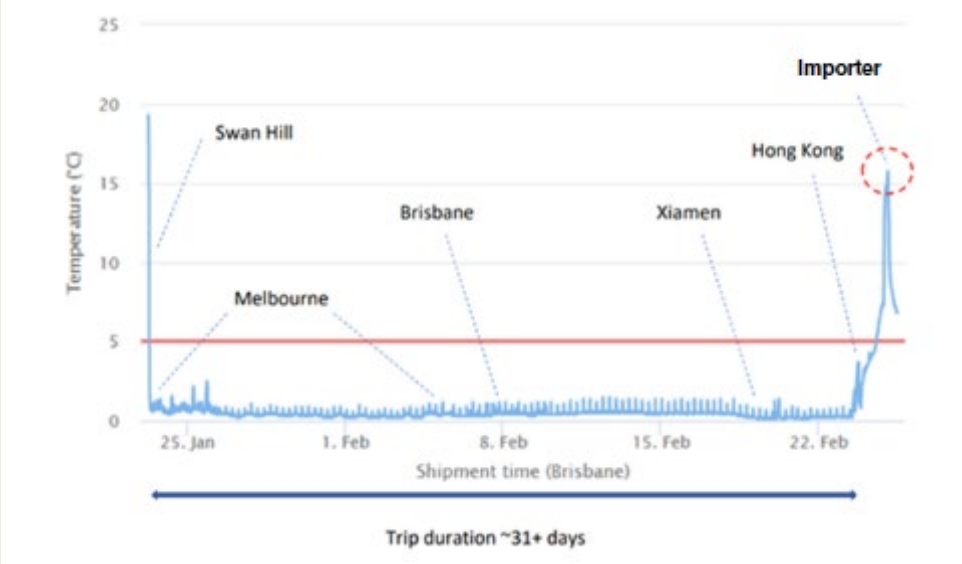
- Real-time data accessible on mobile/PC devices soon after activation so no need to retrieve loggers
- Real-time alerts via email or SMS or apps (Android & IOS) can be programmed to track arrival times at specific points in the supply chain, and to track if consignment parameters fluctuate outside pre-set limits
- GPS and light functions are added security in terms of food fraud and traceability as it indicates when and where package or doors have been opened
- Geofencing around airports and accelerometers in some loggers help switch devices to flight mode prior to take off
- Temperature monitoring range from -30 ˚C to +70 ˚C
- Relative humidity range from 5 % to 95 %
- Single use of up to 120 days or multiple use (provided loggers can be returned)
- Data logging interval 10 mins. and uploading interval 10 mins. to 10 hrs. (configurable via app. or dashboard)
- Reports in PDF, CSV or Excel; backup via micro-USB cable
- Units have a shelf life of up to 12 months

Tips:

- Start loggers early in an area with good mobile phone reception at least 1 to 2 hours prior to deployment to ensure logger connects to mobile network or data may not be visible until unloading in export markets

- Place loggers on top of cartons or near doors of reefer containers for best reception
- Set up temperature and location alerts to maximize capability of real time loggers
- Decreasing frequency of logging and uploading intervals will increase battery life and extend recording time
- Review cool chain data to streamline export process and reduce temperature fluctuations





Research findings

- Agriculture Victoria has monitored over 150 sea and air freight consignments of table grapes, apples and stone fruit to Asian and European markets.
- Excessive transit times are usually the main issue with sea freight of many perishable crops such as fresh nectarines hence cultivar selection, preconditioning fruit, modified atmosphere packaging and an efficient cool chain are critical.
- Unforeseen delays during trans-shipping or at customs inspection points may inadvertently extend supply chain durations.
- Border closures and travel restrictions due to COVID-19 reduced air freight services and interrupted freight forwarder schedules; however, even under normal supply chain conditions, temperature fluctuations of up to 15 ˚C are not uncommon.
- Monitoring transit conditions can help exporters redirect produce to other markets or inform importers to prioritise the consignment for rapid sale.
- Collected data may be used as evidence to determine the validity of claims or disputes.

Summerfruit AUSTRALIA

AUSTRALIAN PEACH & NECTARINE SPECIFICATIONS

The following specifications have been developed by the Australian Summerfruit industry as a communication tool between suppliers and buyers.

SAMPLE SIZE

Test and record a minimum 10 pieces of fruit for each assessment, then calculate and record the average.

STORAGE & HANDLING

- Transport in a refrigerated vehicle at 0° to 2° Celcius
- Store at 0° to 2° Celsius
- Avoid storing Summerfruit between 2° and 8° Celsius - as fruit will not ripen naturally or may exhibit internal disorders upon ripening such as flesh browning, bleeding, rubberiness or mealiness (loss of juice)
- Fruit stored at higher temperatures (e.g. 20°C+) will ripen faster so need to be consumed within 48h
- Stonefruit bruises easily - minimise handling by displaying in the original trays
- Avoid stacking fruit more than 2 deep when loose

SUGAR SPOTTING

The sweetest nectarines have small sugar spots (speckle) on the top half

BACKGROUND COLOUR

Avoid stonefruit with a bright green background colour, as it is immature and will NOT ripen

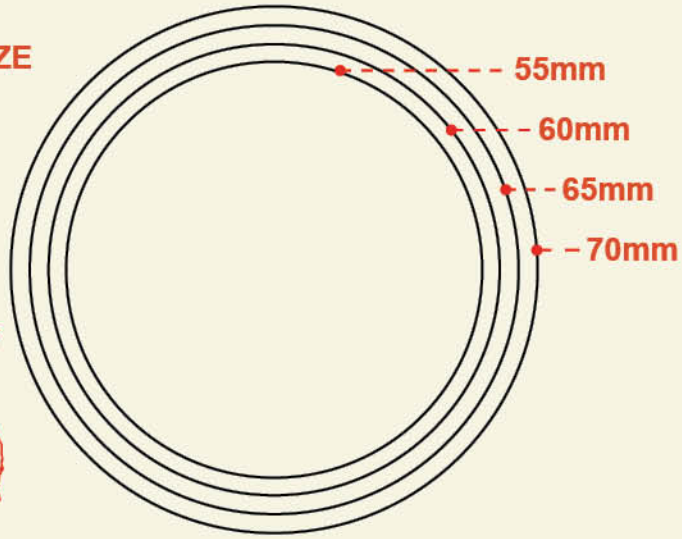
BLUSH

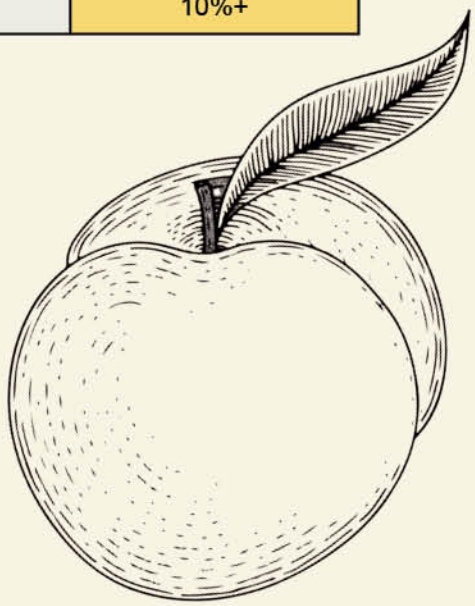
	Premium Export	Minimum Export	Minimum Domestic
Blush (%)	70%+	40%+	20%+

SWEETNESS

	Premium Export	Minimum Export	Minimum Domestic
Brix (%)	14%+	11%+	10%+

SIZE





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