

Post-harvest Management of Fresh Cherries

**Post harvest fruit handling, cold chain management
and packaging of fresh cherries for domestic and
export sale**

A report for



By Tom Eastlake

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Executive Summary

The Australian cherry industry is one that, like many around the world, have realised that the quality of fruit produced and sold is the principle driver of an acceptable return to the grower. Large, hard, sweet, dark colour and dark flesh, smooth skin, long shelf life and a green stem is what the consumer in Australia and indeed around the world demands.

The Australian grower produces a high-quality cherry and the cold-chain management practice in Australia is very good compared to some parts of the world; however, it does lag behind the world's best.

Automated packing lines including carton fillers, punnetisers, bag fillers and palletisers provide significant labour savings to growers, but require a large-scale operation which is largely beyond the scale of the Australian cherry industry.

Innovative retailers around the world have migrated to new packaging as a way to increase fruit volumes sold. Australia has lagged behind this trend, with largely stagnant retail sale results.

Better presentation of fruit and fruit of a consistent standard gives consumers increased confidence in product which drives a willingness to purchase and consume more product.

Australia is a large country and freight distances can be very long. Thus, it proves difficult in to implement cost-effective ways to pack into new packaging types, such as punnets and bags, on farm.

The viewpoint that a grower's responsibility ends at the farm gate needs to change and growers need to be willing to adapt all the way to the retail level, to ensure they are partnering with businesses who are displaying the same care for the fruit that the farmer has shown in growing it in the first place.

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Foreword

My background is not in primary production; however, I have lived and worked in rural Australia all my life. Notwithstanding this, my parents were both from farming families and, as the son of a Stock and Station agent, my affinity with agriculture was very much a part of my being from a young age. Consequently, it was perhaps unsurprising that, in pursuing a career in finance after completing my education, I ended up specialising in agricultural finance.

My continued work in supporting the growth of individual farming businesses and companies led to my fervent desire to enter the agricultural industry myself. In 2008, I purchased what was my grandfather and grandmothers' horticultural property in Young, NSW. Primarily producing fresh cherries for the export and domestic market, this purchase seemed like a natural fit, especially since I had been working on the property during fruit harvest since 1996.

My drive to undertake a research project on behalf of the Australian cherry industry was principally driven by my own personal desire to give back to an industry which has given me so much over the years. I had a battle with cancer throughout 2013 that nearly took my life. During this time, I found immense support and strength from my friends within the Australian cherry industry. To undertake research to support the further growth of the industry which had already given me so much in my short time producing cherries in Australia was a privilege I have sought to undertake with the goal of advancing the production of Australian cherries.

Even in my short time running the orchard, the Australian cherry industry has changed. The closure of a number of export markets to the mainland cherry industry, due to changes in phytosanitary protocols, has seriously affected the industry. At the same time, we have seen domestic cherry production in Australia expanding rapidly, to the point where domestic consumption has reached the point of saturation. With limited opportunities to export internationally, due to a lack of commercially viable phytosanitary market access protocols, and a domestic market where consumption is not keeping pace with quantity of fruit being sold has led to multiple examples of oversupply.

In my deliberations on what I could research I could undertake to assist the Australian cherry industry, I sought to start with something that I thought was within reach of every Australian grower. While I couldn't definitively seek to advance market access to export markets, I could seek to ensure that when market access was achieved that the growers seeking to export would have the quality of fruit that an export market desired to consume.

If quality standards could be lifted, this would certainly assist with growers grow the domestic Australian cherry industry through a better consumer experience which would lead to increased consumption and better grower returns.

The primary goal of this report is to seek understanding of how other countries maintain consistent presentation of fresh cherries at a standard acceptable to consumer to both maintain and grow high levels of fresh cherry consumption.

Acknowledgments

Thank you principally to my family who supported me from the very beginning in seeking the opportunity to attempt this undertaking with Nuffield Australia on behalf of the cherry industry. Suffice to say this would not have happened without you, nor would I have had the desire to commence it without your support.

Thank you to Nuffield Australia, whose continued and tireless support of the Australian agriculture continues to have ramifications in the lives of all those who have been fortunate enough to undertake a Nuffield Scholarship, but also more broadly in the advancements that Nuffield have fostered in the Australian agriculture through their continued commitment to this industry.

Thank you to all of the businesses and individuals who contributed to this report across a vast breadth of distance. I have been continually humbled by your willingness to open your doors to be part of this project.

Thank you to Hort Innovation for your investment in this project and specifically your commitment to fostering not only the advancement of Australian horticulture, but the next generation of horticulturalists who will continue our industry in the future.

And finally thank you to the growers of the Australian cherry industry. I hope this project goes some way to not only repay your investment in this work, but also your investment in me as an individual and the vast support you continually provide. The support, fellowship and continued desire to improve the prospects of all industry are attributes not always present in a competitive commercial environment. It is certainly an integral part of the Australian cherry industry and it makes me proud to be an Australian cherry grower.

Abbreviations

CGA – Cherry Growers Australia

DAWR - Department of Agriculture and Water Resources

LRS – Levies Revenue Service

NZ – New Zealand

OSU – Oregon State University

PFA – Pest Free Area

SSA – Super Slender Axe

TSA – Tall Spindle Axe

UFO – Upright Fruiting Offshoots

USA – United States of America

WSU – Washington State University

Objectives

The Australian domestic market for fresh cherries is seeing an increasing trend towards being oversupplied during peak production (November-January), which is causing distinct pressure on growers who are producing quality cherries annually, but seeing an increasing risk of poor financial returns during oversupply periods.

As the Australian domestic market is the principal sale point for the majority of Australian cherries produced, and without new avenues for export trade, the growth of the domestic market represents the largest opportunity for growth in the demand for Australian cherries.

With an Australian consumer who purchases cherries primarily as an impulse buy based on consideration of the quality presented at retail, what are the opportunities for the cherry industry to improve practice to present a more consistent product for consumer consideration?

The objectives of this report are to answer this question, by asking:

- What is the best practice for fruit handling immediately after picking to prevent deterioration of fruit quality?
- How is technology in the packing shed developing and what opportunities are there for improvement in fruit handling at the packing shed?
- Improvement is consistently sought in cold chain management, from picking through to the retail level. What is the standard around the world and what should be growers aspiring to in maintaining cold chain in fresh cherry production?
- Have other countries been able to increase consumption of cherries and how have they done so?
- New forms of consumer packaging for fruit presentation are being sought by retailers at an increasing rate, both to improve presentation of product and as a point of difference from competitors. Does packaging make a difference to consumers and can it increase consumption?

Chapter 1: Introduction

The Allure of Export Markets

The Australian cherry industry is growing. Growth has expanded rapidly in the last seven years from approximately 9,000t in 2008-2009 to over 15,000t in the 2015-2016 season (Cherry Growers Australia (CGA), 2017), an increase of approximately 166%. This rapid growth has largely come from anticipation of new export markets being developed to facilitate new export trades, following extremely high export demand, particularly from South East Asian markets. While this has largely come to fruition for Tasmanian cherry producers, where the state maintains an internationally recognised Pest Free Area (PFA), being a state that is free fruit fly species. The mainland cherry industry – with the exception of the Riverland PFA – has not been able to open the same international markets for export cherry trade. Currently, the Tasmanian cherry industry has commercially viable phytosanitary market access to international markets, via air freight pathways to countries including China, Taiwan, South Korea and the United States of America (USA). Conversely, the mainland industry has not been able to achieve the same level of access.

Tasmania is the only cherry producing state in Australia where more fruit is exported internationally (Levy Revenue Service, 2017) than sold domestically. However, significant new cherry trees have been planted and continue to be planted in traditional cherry growing regions and new regions around Australia, not just in Tasmania. New plantings coming into production in Tasmania have supported the growth in Tasmanian export trade. However, increased production on the mainland, notwithstanding some distinct export growth to non-phytosanitary markets, has diverted some supply from the domestic market.

In the 2015-2016 season, Tasmania exported 52% of their cherry crop compared to Victoria exporting 23%, New South Wales exporting 19% and South Australia exporting 6% (Fresh Consulting, 2016). This is largely unsurprising given the large disparity in prices received for the cherries, with Tasmanian cherries achieving anywhere up to 300% more than rival Australian cherry producing states. This disparity comes from increased demand for Tasmanian cherries from a broader international market base than mainland production states can access.

However, the allure of demand that many international markets have for Australian cherries has not slowed mainland growers' desire to plant additional area to cherries so they 'are ready' for new export markets when they open. This has led to a sharp rise in production, which, in the absence of new export markets, the domestic market has not been able to absorb.

The disparity in pricing between domestic and international markets is now well known and visible through the success that Tasmania has had in their export markets. This has caused the industry broadly to abandon any focus on seeking to grow the domestic market, as export markets provided more potential demand than the domestic market could ever possibly

provide. However, as export markets for mainland producers have not yet come to fruition, the domestic market has seen an increasing frequency of oversupply as producers have had nowhere else to market their fruit. In the absence of new export markets, this domestic market oversupply will be seen with increasing regularity.

Notwithstanding the clear focus of the Australian cherry industry on export markets, it is likely that most of the Australian cherry crop will continue to be sold on the domestic market. Even with the Tasmanian cherry industry as an example, these producers still sell just less than 50% of their crop domestically (LRS, 2017). With the Australian cherry crop expected to top 20,000 tonnes by 2020 (CGA, 2017). Even if 50% of cherries are exported, this will still leave 10,000t of cherries to be marketed domestically. This is more than the entire size of the domestic crop produced in 2009. Therefore, further opportunities for sale and increasing consumption domestically will need to be explored.

The importance of quality

The Australian consumer has a large range of imported and domestic fresh produce and quality is generally very high. The consumer is spoilt for choice and therefore quality, in any produce category, must be very high in order to entice the consumer away from a competing product. Internationally it is much the same, but with the added dynamic that Australian cherries specifically are a high-cost product. Australian produce, particularly in South East Asian markets, is recognised as high quality, safe, environmentally sound products and there is a premium that consumers are willing to pay for this. However, in order to extract the premium exporting producers demand, the produce must be of the highest quality. Any produce not exhibiting characteristics of being consistently extremely high quality will be relegated to receiving prices that are not acceptable to the grower.

Therefore, if the grower wishes to see a return (domestically or internationally) that is commensurate with expectations, there must be an unrelenting focus on maintaining quality. This focus does not end with fruit being picked from the tree, but follows through all steps that a piece of fruit takes on its way to retail sale.

Research around the world continues to highlight the plethora of ways fruit can be damaged after harvest. It has been said that the best a piece of fruit will ever look is when it is 'hanging on the tree' (Ken Eastman, 2015). Every time that piece of fruit is handled post-picking is an opportunity to lose quality. While best practice in varietal selection, tree management, crop load and nutrition can grow a superb piece of fruit, poor handling and presentation can result in an unsatisfactory piece of fruit being presented to consumer.

While the domestic market in Australia provides significant opportunity for cherry growers, the principles of improving the consumer experience are universal and will be required, regardless of whether a grower is seeking to sell fruit domestically or internationally.

Chapter 2: Post-harvest Handling

Understanding the impacts of post-harvest fruit handling, specifically in cherries, is a critical issue for growers. Cherries are a fruit that is extremely sensitive and therefore more susceptible to the negative impact of poor fruit handling practice than many other fruits. Additionally, the desired attributes for a cherry go far beyond the level of consideration a consumer would apply to many other fruit types. It is not enough for a cherry to be a consistent colour of the desired shade or red, mahogany or black, but the colour must be consistent (with the exception of white or 'blush cherries' which are largely not grown in Australia), the skin must be smooth, it must be firm and be free of indentation (or pitting). This is before the fruit is tasted and an acceptable sugar level and sugar/acid balance is considered. Also, cherries have the added requirement of having a long stem which, based on consumer feedback, must be a consistent green colour and be firmly attached. This comes off the back of a long history of education by both the cherry industry and indeed retailers themselves advising that the 'green stem' is an attribute that portrays the fruit's freshness.

Poor handling can affect all these attributes. Incorrect picking technique or rough handling to packing shed or in packing shed can remove or loosen stems, bruise fruit, cause indentation and crack or rupture skin. Time taken to deliver fruit to packing shed, time of day fruit is picked, time spent out of refrigeration and time between picking and cooling the pulp temperature of the fruit using water (hydrocooling), especially in times of high or extreme heat can cause shrinkage, wrinkling or 'alligator skin' as well as loosening stems. With the retailers' and indeed the consumers' quality standard so high, the importance of the upmost care in fruit handling is obvious.

In the field

While the cherry industry internationally is consistent in its approach to picking of cherries, after being physically plucked from the tree, a cherry's path to market becomes extremely diverse, depending on where in the world a particular orchard is located.

The USA and Canada are most like Australia in many respects: picking commences very early in the morning and concludes early in the afternoon, depending on heat. Fruit is picked into small totes or buckets and then aggregated in individual totes, lugs or fruit bins and transported to the packhouse. Larger orchard operations use large fruit bins for ease of transportation, compared to smaller receptacles which, although being gentler on fruit, take up vastly more space. Throughout Washington State, it seems most large-scale orchards have moved away from the wooden fruit bins of old, migrating to plastic bins such as those manufactured by Macroplastics. These bins are also seen in many orchards in Australia. The reasons for this change are many and the summation of their benefits does see them vastly superior to wooden bins in all aspects except initial purchase cost. Among these advantages are:

1. Rounded corners and smooth edges to prevent damage to fruit that is in contact with the bottom or sides of the bin.
2. Ventilation slots, which aid in cooling of fruit when refrigeration and facilitates fast drainage during hydrocooling.
3. They are quick and easy to sanitise, and they are made with FDA approved materials.
4. Lightweight.
5. Easy to stack and robust and sturdy when stacked.
6. Designed with a shallow depth and with cherries in mind to prevent undue compression and damage of fruit.
7. Long usable life.



Figure 1: Macroplastics 12FV bins in cold storage after hydrocooling awaiting packing, Washington State USA (Author, 2015)

Steve Cohen of Macroplastics in Washington State describes the development of their widely used 12FV fruit bin (Figure 1) as a response to damage inflicted on fruit that was traditionally packed in wooden bins. Feedback was sought from growers on what the attributes were in a new fruit bin that could be implemented in orchard systems, from picking through to packing. The 12FV was designed using much of the above 'advantage criteria' to provide sufficient reason to see growers change from the traditional wooden bins to plastic.

In large-scale operations, the use of fruit bins, such as the 12FV, has become standard practice as the need to ensure prompt aggregation of fruit in the orchard and delivery to packhouse is important, and smaller aggregates of fruit can prove costly to transport. However, while growers frequently adjust the quantity of cherries in a fruit bin if they are concerned about compression damage (Chris Monson, 2015) there is an alternative that has emerged that provides a distinct advantage in fruit handling, although at the expense of volume.



Figure 2: Fruit being picked at Maggadalla Orchard, Young NSW (Author, 2015)

When fruit is picked, it is picked into a picking bucket or alternative receptacle before being aggregated into a larger unit for transport – such as the 12FV in Figure 1. This can involve either one or two separate steps. Using one step, pickers may fill their picking buckets and then tip directly into a larger 12FV for transport to the packing house (one tip from picking bucket to 12FV). Alternatively, pickers may pick into the picking bucket, then into a larger bucket or lug to achieve a larger volume before being tipped into a larger 12FV (one tip from picking bucket to lug, then second tip from lug to 12FV). This causes either one or two points of impact for each cherry, increasing the opportunity for impact damage, including bruising or pitting. As an alternate strategy, Macroplastics developed a new 9FV ‘macro tote’ that can be coupled and uncoupled to a picking harness. The picker fills the 9FV before uncoupling their harness from the 9FV and stacking the full 9FV on the ground. These are then collected and placed inside a larger Macrobin for transportation. This removes the need for the fruit to be tipped from one vessel to another and the first time the fruit is tipped is into the packing line.



Figure 3: Pickers aggregating 9FV totes full of cherries, Washington State (Author, 2015)



Figure 4: Pickers using the 9FV fruit picking tote, Washington State (Author, 2015)

This method is much preferred from a fruit protection standpoint (Cohen, 2016), however is not always feasible due to a loss of transport volume. For example, two 12 FVs stacked on top of each other hold approximately 360-400kgs of cherries. However, one single Macrobin occupies the same amount of space, however only holds approximately 220kgs of fruit when using 9FV totes. Therefore, almost double the amount of transport space is used when transporting totes and almost twice the space in the cool room to store them. On one hand, this does provide a cooling benefit due to the lower fruit density and heat load, however the additional space required to store will likely make this method prohibitively costly for large growers.



Figure 5: 9FV macrototes stacked inside a larger macrobin for transportation, (Source: www.macroplastics.com)

In the USA and Canada, it is industry standard practice to implement early morning picking, so fruit is picked out of the heat of the day. Similarly, consideration is given to the types of fruit picking receptacles used. However, these points are largely ignored in some other parts of the world.

In China and in parts of Germany and Belgium visited, it was commonplace to see cherry picking commencing mid-afternoon in the heat of the day with the mindset that fruit would be aggregated and transported to market in the cooler evening rather than the middle of the day after picking. Admittedly, many of these locations did not have any cold chain, e.g.

hydrocooling or cold rooms, on farm at all and this was described as the primary reason for this course of action (Martin Bulmer, 2015). Smaller scale operations in these regions have no standard picking container in many respects and use boxes, crates and buckets of all manner of construction to collect cherries and in many cases, undertake a rudimentary 'grading' after picking in the orchard prior to delivery to a centralise aggregator for sale. In many cases, no further grading takes place after delivery to the aggregator and the only size and quality grading done is whatever the picker can see in the field as they pick the fruit.

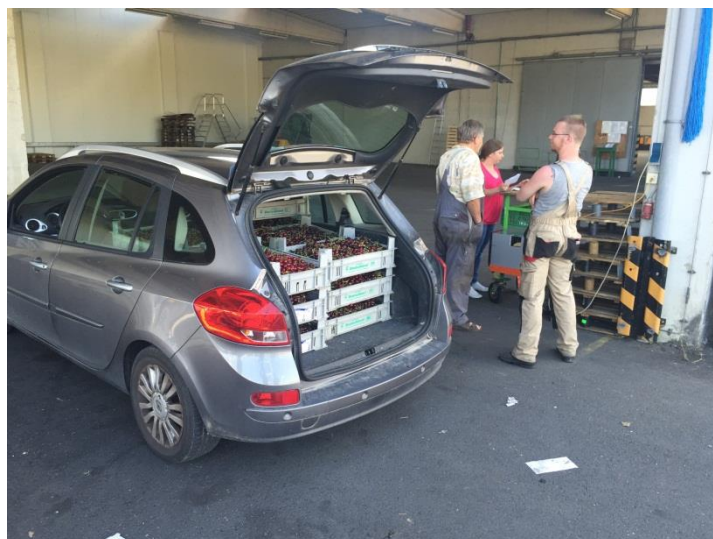


Figure 6: Fruit graded in orchard and unrefrigerated delivered for aggregation. Rheinland-Pfalz (Author, 2015)

As a matter of interest, this provides a basis of comparison to other parts of the world where picking practice is more standardised and the implementation of cold chain management is viewed as an absolute necessity rather than something that is optional at best. Martin Bulmer of the Rheinland-Pfalz describes these basic practices as *“something that requires greater focus.”*

Reducing Labour in the field

Regardless of geographic location, all cherry production areas around the world (Belgium, France, China, Germany, Italy, USA, Canada etc) have complaints about the increasing cost of labour. This concern has precipitated an ongoing research commitment from almost every cherry production area in the world to seek a mechanised method of harvesting cherries (Figure 7). Proposed methods have varied greatly and have used new methods of picking, including established methods used in other industries such as shaking olive trees and mechanically harvested wine grapes. None have yielded results that can be commercially implemented due to the results largely being considered to be destructive. Work continues in the Rheinland-Pfalz region where mechanical harvesters, similar to wine grape harvesters, are being trialled on two-dimensional pruning systems such as Slender Spindle Axe (SSA), Kim Green Bush (KGB) and Upright Fruiting Offshoots (UFO).

These trials are being continued and refined, however the damage inflicted to the cherries is too great currently to provide a commercial application, as losses would be too great and would certainly not offset the decrease in labour cost achieved by implementing mechanical pruning.



Figure 7: Cherries mechanically harvested in a fruit bin, Rheinland-Pfalz (Author, 2015)

Additionally, the results of the trial have yielded similar results to trials completed by Oregon State University (OSU) and Washington State University (WSU), which have seen mechanical pruning methods remove stems from the cherry in an overwhelming majority of fruit picked. This has led some researchers to encourage the industry (Long, Marin, Colona, Turner, Manning & Seavert, 2004) to consider the possibility of marketing stemless cherries. Indeed, WSU researchers (Eastman, 2015) continue work on systems for mechanical harvest, with growers being encouraged to consider cultivars that yield cherries with ‘loose stems’, specifically as they may lend themselves to lighter touch mechanical pruning methods.

Consensus opinions from growers seem to be that consumer acceptance for stemless cherries is not there (Monson, 2015), which has come after years of presentation by industry and retailers that a green stem is one of the principle attributes a consumer should seek in a fresh cherry purchase. Furthermore, that removing a ‘green stem’ as a desired attribute of a cherry through a desire to mechanically harvest, may actually serve to simply ‘commoditise cherries’ (Boulton, 2017).

Arrival at Packing Shed

After the picking and aggregation of cherries in the field, cherries are then transported to a central pack house for refrigeration, packing and then dispatch. This, like the picking method, is largely standardised, with the exception of some smaller orchards in Belgium, Germany and China, where in-field packing still occurs. The USA, Canada and Australia have moved to standard which require precise sizing, as well as high quality standards which generally do not allow for in-field packing in these markets. Most markets see all fruit graded on an optical

(computerised, using computer-controlled, camera defect detection) graders or by mechanical graders, designed to use a staff member to manually remove fruit exhibiting defects from cherries prior to packing.

Almost all sheds have hydrocooling on site (Figure 8) to commence or continue the refrigeration of cherries on receipt at the shed. Some fruit may have already seen hydrocooling in field prior to its arrival at packing shed. This is especially prevalent in large scale operations, which have a large number of orchards spread over a diverse geographic base, but only one or perhaps two centralised pack houses. If fruit is hydrocooled in the field, this is done using mobile hydrocoolers which are large, self-contained units that refrigerate water and then drench the fruit to bring their core temperature down as close to zero as possible. Once cold, this fruit is transported using refrigerated transport to the pack house. On arrival fruit is generally hydrocooled again prior to being placed into cold storage awaiting packing. For fruit not hydro-cooled in the field, it is important that fruit is delivered to pack house in the shortest possible time to ensure the longest shelf life. Research done at Oregon State University indicates that, for every hour a piece of fruit is out of refrigeration, up to a week of shelf life is lost (Long, 2015).



Figure 8: Fruit arriving for hydrocooling at pack house, Washington USA (Author, 2015)

In the packing shed

While packing was once done exclusively by hand, the large packers of the world today use large, commercial grading equipment to pack fruit. The design and breadth of inclusions to a cherry grader today are as varied as the different varieties of cherries that they pack. However, there is a distinct push to reduce labour as much as possible, regardless of the size of the operation. Traditional mechanical cherry graders that used a large staff of employees to hand-sort fruit for quality after the fruit had been sized have been replaced by large scale graders using high definition (HD) cameras. These systems use sophisticated computer software that seeks to remove as much damaged fruit as possible, with only a small complement of staff as a 'final check.' These new computerised graders have revolutionised packing sheds and have made way for quantum leaps in flexibility in packing techniques, which can now accommodate the requirements of fruit firmness, defect and colour as well as traditional measures such as

size. While reducing staff, they have also allowed for higher volumes to be processed. The development of this technology has been extremely rapid with reports of the 'world's largest optical grader' eclipsed each year. In 2012, NZ manufacturer Compac reported building the world's largest optical grader in a new 36-lane machine installed in California. This was eclipsed in 2014, 2015 and then 2016 again with a 72-lane machine installed in California. The growth of the cherry industry globally is rapid and processing power has had to grow with it.

About as far from the hand sorting in field in China is Monson Fruit's installation in Washington State, which includes a 44 lane Compac machine installed in 2015 (Figure 9). This machine uses Compac's own proprietary grading software using HD cameras, which is their own variation of similar software utilised by global competitors such as GP Graders and Unitec. While catering for computerised defect, colour, softness and size grading, it also features automated packing of punnets, cartons and random-weight bags. This is an extremely automated shed and is highly productive as it is required to be to ensure prompt packing of the fruit that Monsons handle each year.

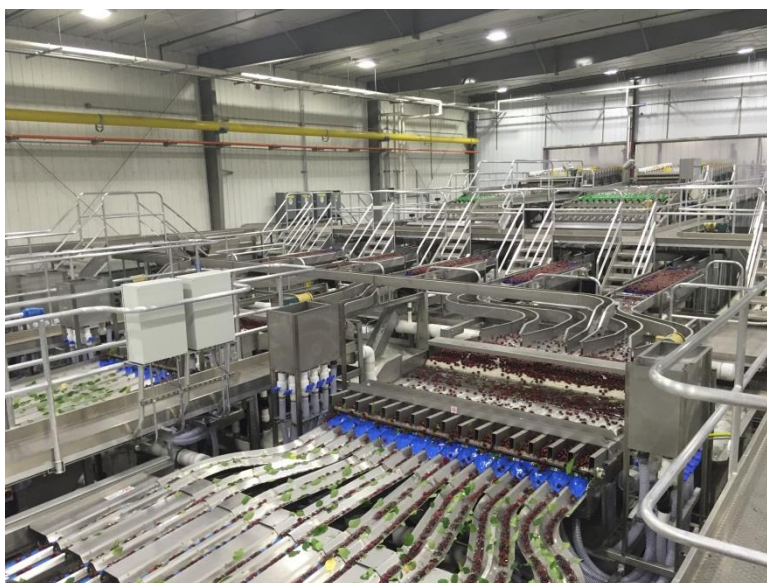


Figure 9: Compac grader at Monson Fruits, Washington State USA (Author, 2015)

This machine incorporates a rotary bin tipper as the method of dumping fruit into water. Compared to the original bin tippers, where the fruit bins were inverted with fruit 'falling' onto a canvas) mat which was then retracted, dropping the fruit into water, these new rotary tippers submerge the bins in water prior to tipping, removing any impact on the fruit. This method of tipping is becoming a universal standard with global grader manufacturers GP Graders (Aus), Compac (NZ) and Unitec (Italy) all implementing rotary bin tippers. A variation on the rotary bin tipper is also the rotary 'tote tipper.' This system operates on the same principle as the rotary bin tipper, but instead of full fruit bins being loaded, the system loads the smaller tote units for a submerge-then-tip operation. This continues the advantages of using totes as this effectively brings fruit from the field to the shed and into the grader without a single point of impact, but again would be limiting for large scale producers.

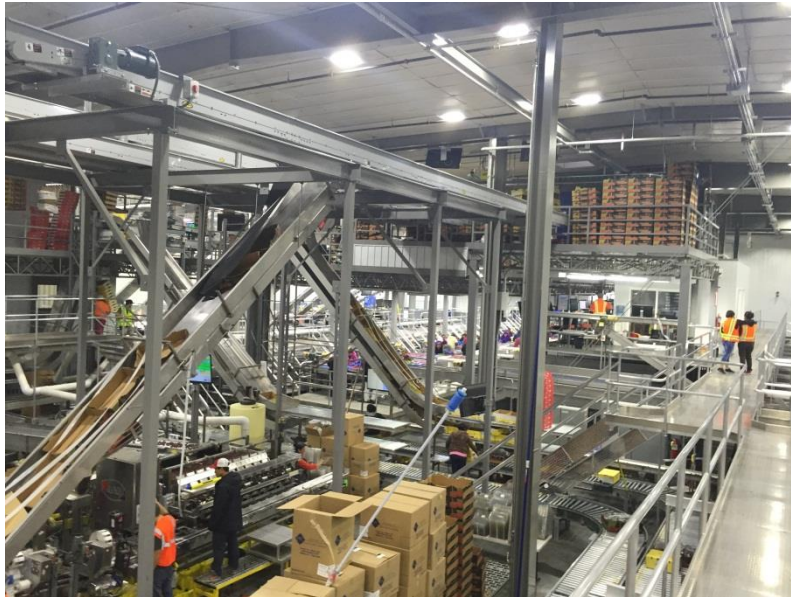


Figure 10: Automation at its finest. Monson Fruits, Washington State (Author, 2015)

Further evidencing their focus on premier fruit handling, the Compac processing line at Monson Fruits has incorporated separate lines which can ‘branch off’ from the main processing line to pack specialised fruits such as Rainier and Skeena. Skeena is a high-quality variety that can exhibit some cracking if given prolonged exposure to water during packing. As most modern graders, including the Monson fruit machine, use water to deliver fruit, the Monson machine can be altered to reduce the water exposure to the cherries while being packed. Rainier are a white or ‘blush’ cherry which is an extremely high quality and premium tasting piece of fruit. It is highly desired in both the USA and Asian markets. However, being a white cherry, it is extremely sensitive to impact. The packing line at Monson Fruits, has a separate ‘low impact’ line specifically to pack Rainiers to ensure the white, blush skin of the rainier is not damaged during packing. Rainier lines have been developed using impact sensors to determine where fruit experiences the most impact; using this data, the grading line has been altered to remove these impact points.

The global cherry industry is not just competitive for growers, but also for grader manufacturers and in Italy, one of the market leaders in grading technology, Unitec, continually seeks to advance cherry packing technology. Headquartered in Bologna, Italy, Unitec (Figure 11) have advanced the limits of cherry grading and optical grading technology over a number of years. Benedetta Ricci Lamino of Unitec describes Unitec’s focus to remain as the ‘leader’ in fruit handling equipment and that it comes from taking nothing as ‘acceptable’ and from a belief that everything can be improved. Benedetta describes their review of a basic element of a cherry grader, a saw blade within a cluster cutter (stem separator). Saw blades that will serve to separate two or more stems that are joined together exist on the market and are used by their competitors. However, in their review of the effect of standard saw blades on stem retention, Unitec found that the standard saw blades used created undue pull force on the stem, resulting in too many stems being pulled from cherries being processed. They therefore invested in developing their own cluster cutter saw blades to

reduce stem pull force and now are the only grader manufacturer in the world with their own patent on cluster cutter blades. Similarly, Unitec's internal work detected a distinct efficiency gain in graders than ran in a straight line. As a function of the pack houses they are installed in, graders usually wrap around themselves to make most efficient use of the space they are housed in. However, for new installations being completed, Unitec now recommends all packhouses allow the graders to run in a straight line rather than incorporating continual bends for both a processing efficiency standpoint as well to assist in maintaining low impact and high fruit quality.

In the development of their new Cherryvision 2 cameras and software, Unitec have also installed their cameras on an angle, rather than directly above the fruit to detect 'nose crack.' Nose crack is a crack or split on the very tip of a cherry, especially prevalent in 'heart shaped' cherries. As optical graders take photos of a cherry from overhead as they rotate underneath the camera and the stem prevents the cherry from rotating a full 360 degrees, nose cracking has been a difficult defect for optical graders to detect. However, the new Cherryvision 2 cameras have some of the best detection rates of nose crack on the market today, due to this change of installation angle of their HD cameras (Lamino Ricci, 2015).

While these changes only apply to two very small parts of a cherry grader, they show the continual development undertaken by manufacturers to seek improvement in cherry packing and processing features that are important to growers; stem retention, impact reduction and defect detection. It also sets a new standard for cherry producers around the world. The previous leaps forward in cherry packing, such as the development of the first roller sizing mechanical graders, developed platforms that could last a decade or more, the technology behind new cherry and indeed fruit grading equipment continues to advance at a rapid rate. It is likely that cherry packers will likely be on a path of continual improvement into the future as new packing developments are constantly launched. Since 2015, packing houses in North America and now in Australia have seen the replacement or upgrading of some of the initial optical graders, with new HD camera graders that incorporate some of the new developments in grading technology developed in the last six years.



Figure 11: Unitec's headquarters including their manufacturing and R&D divisions. Bologna, Italy (Author, 2015).

Chapter 3: Cold Chain Management

Cold chain management is an essential part of any fresh produce commodity's requirement to reach the consumer in peak condition. There is no doubt that in the fresh fruit market, that the longevity of a piece of fruit is directly linked the speed at which it commences its time in the cold chain and how well that cold chain is maintained, right through to consumer consumption. There are clearly distinct differences in approaches to cold chain management, as already highlighted. The focus on cold chain management ranges from being a 'high focus' to 'not at all.' In large scale, commercial pack houses, regardless of location in the world, much attention is given to maintaining the cold chain; from strict attention to water temperature in hydrocoolers, to temperature-controlled cold rooms and transport refrigeration.

Too much at stake

With the perils of a lack of cold chain maintenance already well established, such as the proven reduction in shelf life of cherries, it is surprising that there can be any apathy towards it. In Australia, where horticultural producers have few (if any) regional produce aggregation points, long transport lengths to deliver to market and a distinct focus on future exports, cold chain management needs to be on the forefront of every growers' mind. In the USA, almost all cherry production regions do not see more than 80km to deliver produce to a distribution hub for fresh produce for supermarket chains. Exporters must deliver to port, but even freight forwarders have hubs near the point of production to ensure that the cold chain is maintained. In Australia, USA fruit is often transported long distances before and after being packed and the need to maintain the cold chain is extremely important.

After viewing cold chain management in Australia, with all the data about the perils of ignoring cold chain and then the extremes to which it can be taken in the large-scale operations in the USA and Canada, it is not surprising to see that all growers in Australia have some sort of refrigeration practice. However, a different position can be seen in multiple countries across Europe and in China. Fruit is picked and packed in fields in the heat of the day and then transported by tractor on trailer, at very slow speeds, to warehouse for distribution. The fruit shown in Figure 12 is indicative of many other tractors and lorries seen delivering fruit to warehouse in Germany and Belgium for distribution. This fruit sat in broad daylight while the cars, lorries and tractors in the queue were unloaded and this grower's turn rolled around.

Speaking to the grower, estimates were that the time the fruit had been off the tree prior to arriving at the warehouse was to be measured in 'hours,' rather than in minutes. This fruit had been packed in field in many cases and was to be unloaded before being placed into cold storage. Due to the lack of hydrocooling, the fruit would have a very slow cool-down to the ambient temperature of the cool room. Indeed, inside the coolroom, the heat radiating from stacks of packed cherries could be felt and would make it difficult for pallets of cherries stacked next to hot fruit to remain cool. The fruit was to be dispatched early in the morning the following day and considering it was mid 30 °C ambient during the day and the fruit had been in the sun for a good portion of the day, it is entirely possible that the fruit did not reach three

degrees prior to dispatch, drastically reducing shelf life. David Minnis of 888 Exports describes the perils of fruit being dispatched prior to reaching this temperature. There is generally not enough cooling power, without ‘fast coolers’ or hydrocooling, to get fruit down to temperature and hold it there after the logistics of fresh produce begins (Minnis, 2016).



Figure 12: Cherries arriving packed on trailer to warehouse in Rheinland-Pfalz (Author, 2015)

In Chile, the domestic crop is forecast to top 250,000t with continual growth forecast in the future. Most of this crop is destined for export and, due to the volume exported, is exported using sea freight. Shipping times from Chile to Asia can be (and have been in the past) well over 30 days. This extended duration in storage can have a devastating effect on fruit quality, especially if the fruit has not maintained in cold storage. Juan Pablo Zoffoli, a professor at Pontificia Universidad Catolica de Chile in Santiago, describes the Chilean’s focus on growing and packing quality fruit and maintaining their cold chain as vital to their success. Without the focus on cold chain, they simply would not be able to maintain the logistics that they do. Longer periods of cold storage are not just the norm, they are required to get the volume of fruit they ship each year to market. Necessity is said to be the mother of invention and Chile is certainly keeping its focus on ensuring their cold chain is maintained.

James Christie, co-founder of Bryant Christie Inc, specialists in market access and horticultural exporters, tells a similar story to that of Juan Pablo. He advises that the USA cherry industry is similarly focused on maintaining the cold chain, due to its reliance on premium quality and shelf life, which underpins the USA’s ability to export. It has been the USA industry’s willingness to seek best practice in fruit growing technique and its investment in cold chain that has underpinned its success in exports. The USA is a mature market in the sphere of sea freight, incorporating some long shipping time-frames before arrival in the chosen export market. The ability to maintain the cold chain to maximise shelf life post-harvest including pre- and post-packing, in James’ view, is certainly one of the reasons the industry has confidence in their product prior to loading into a sea container.

Where does responsibility end?

While confidence in the product at dispatch from pack house is a good first step, James also believes that the responsibility does not end at the farm gate. Farmers should only be entering into selling arrangements after they see a genuine willingness and ability to maintain proper management of fruit through the supply chain, to consumer point of sale, by the fruit buyer. The responsibility of the grower is no longer just to deliver to market or to a wholesaler or retailer but to ensure fruit reaches consumers in the same condition it has been delivered to the retailer. This is not only to protect the potential return received from sale, but for brand and market protection. Growers need to prevent a poor consumer experience. The USA is operating within a similar target market to Australia: a premium product market at a premium price. They understand that the competition for shelf space around the world is increasing and if you want to command a premium you have to provide a premium product.

There are many examples in grocers and supermarkets around the world of poor quality fruit reaching the market, which will provide a poor customer experience and prevent repeat business. Cherries are especially susceptible to deterioration in the absence of cold chain. A 'green stem' is one of the primary attributes that consumers look for in cherries at place of purchase and unfortunately, it is the first thing to deteriorate outside of the cold chain. Brown stems, shrivelled skin and soft flesh all occur rapidly outside of cold chain. At a supermarket visit in Rheinland-Pfalz, researcher Martin Bulmer was dismayed at the poor quality of cherries presented for retail sale, in a region where a commercial cherry orchard could literally be seen from the front door of the supermarket (Figure 13). However, this is not an incident isolated to this region and can be seen all over the world. Multiple growers in multiple countries extol the virtues of the outlets that show best practice in presenting cherries and lament those who do not (Monson, 2015, Mathison, 2015, Byrne, 2016, Minnis 2016).

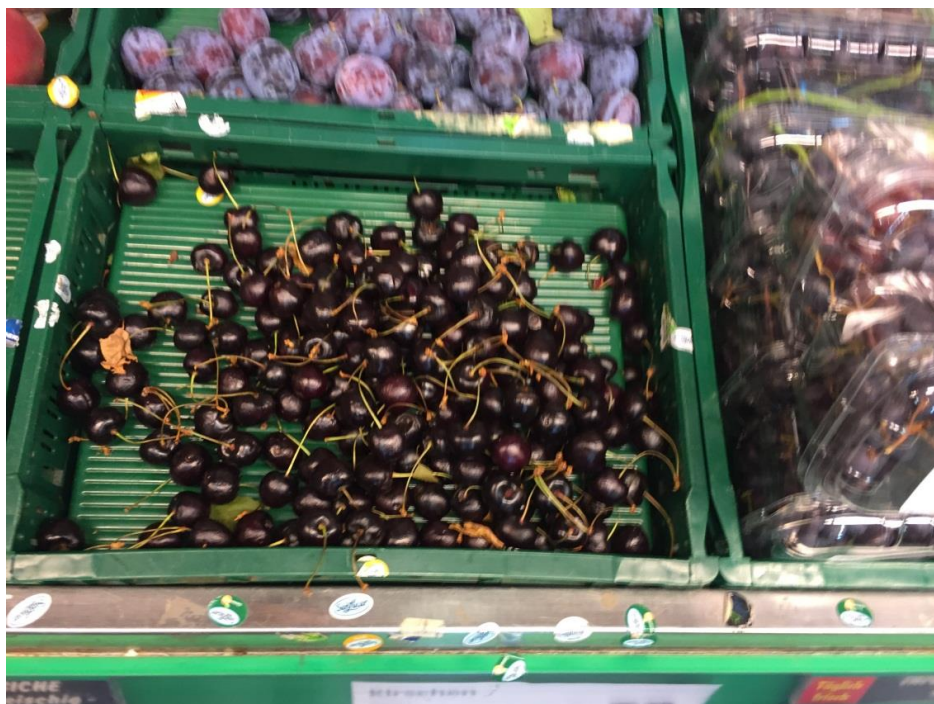


Figure 13: Poor quality cherries for sale in Rheinland-Pfalz, Germany (Author, 2015)

Follow the fruit

Stemilt Growers are one of the world's largest packers of apples and cherries. A brand known worldwide for their unique 'Stemilt' logo and ladybug; their cherries can be found all around the world, including in Australia. West Mathison is the President of Stemilt Growers and recounted a story of what led his grandfather and third generation farmer Tom Mathison to found 'Stemilt Growers.' This story portrays a key message for all fruit producers, even today.

In 1958, Tom Mathison had a disastrous cherry crop. Harvesting 100 tonnes of cherries for only \$88. Tom had traditionally used the local co-operative to market his fruit for him, as did much of the growing community around him. The co-operative used to pack grower's fruit and ready it for shipment packed in ice before loading it onto a train and shipping it to markets across the USA. The disaster in 1958 almost saw the end of Tom Mathison's business and in his desperation to find out the answer to why the returns were so poor, made the decision to follow his cherries to market to see what condition they were arriving in and how they were marketed.

Following the fruit to market on the rail car, Tom reached the east coast and saw the quality of this cherries being unloaded. The poor quality of the cherries on arrival were a disappointment and an awakening for Tom, as he had seen what the fruit looked like at dispatch compared to arrival and suddenly knew that this discrepancy must be rectified.

In 1960, Tom travelled to California to see how cherry producers packed and transported their fruit. He returned home with a new outlook, a new packing standard and built a small packing facility to meet his new requirements. After packing his cherries in his first year as a grower and packer, Tom followed his fruit to market once again and saw it sold for \$40 for a 20-pound box. Almost half of the return for the entire season only two years before. After his success in 1960, several neighbours sought out Tom to pack their fruit also and in 1964, Stemilt Growers began.

The message for growers here is very clear. If you are unsure of how your fruit looks when it gets to market, then "follow it." Quality when dispatched at pack house is not necessarily an accurate indication of quality at destination or even more importantly at point of sale.

Chapter 4 – Packaging

The packaging of fresh produce becomes increasingly diverse and unique each year. This presents more options for the consumer and the grower/packer alike; however, the cost to keep 'current' with packaging requirements can be a significant burden on the grower. There are examples of market growth around the world that are attributed to new and innovative packaging types and this seems to warrant moving to meet the market on its requirements for new packaging.

What does the retailer want?

Cherries have traditionally provided retailers with challenges. A commodity that was presented to consumer in large boxes presented consumers the ability to rummage through every cherry in the box to pick out the ones they wanted, squeezing and bruising the ones they rejected for some poor subsequent consumer to pick up. It has been an ongoing problem and in some years, has presented retailers with shrinkage problems to the extent where they have walked away from a cherry marketing program because of eroding returns. David Harris, of Harris Farm Markets, describes the challenges of cherries as a commodity and highlights that, as a retailer, if the consumer is seeking cherries as a commodity and they pose a problem, innovation is required in dealing with the problem.

In recent years, Australian supermarkets have moved more and more to pre-packaged fruit and vegetables across a range of products. Designed to present the product to the consumer in the best possible condition with a reduced chance for shrinkage, the success of this program has only led to more and more product lines going down the pre-packaged route rather than a loose 'serve yourself' approach.

A move to smaller box sizes such as 2kg and 1kg was a simple change, implemented by many Australian pack houses and this continues to this day, with only minor changes required to packing infrastructure. The only change required is an increased staffing component to deal with the additional packaging of smaller pack sizes. This move was relatively easy as it still allows boxes to be stacked on pallets and delivered to markets in full pallets. Smaller cartons also present no loss in shipped volume and therefore the price per kilogram freighted stays largely the same. However, while these smaller quantities initially provided some alternatives for consumers, there are still a large portion of consumers for whom 1kg or 2kg of cherries is simply too high a quantity to purchase at one time.

As an alternative, punnets have become widely spread in supermarkets now for smaller quantities such as 250g or 500g. These are inexpensive packaging types and, as they are clear, they present the fruit clearly for the consumer to see and provide an additional enticement for purchase. They can easily be branded uniquely to the retail outlet and due to the vast range of sizes, can quickly be changed for the demographic that the outlet services. Punnets are also a widely accepted receptacle for the consumer, as they have been present in supermarkets

for decades for commodities such as strawberries. While punnets have changed, largely to the clamshell type punnet on the shelves today, they still remain a popular choice by retailers.

However, the downside of punnets for a packer is two-fold. Initially, the infrastructure required to pack punnets is costly. Packing punnets on a commercial packing line is quite difficult, due to the speed at which cherries are packed and the need to fill punnets at the same speed as cartons, to keep the overall packing speed of the grader consistent. This requires automation such as punnet fillers, which are costly. Many growers have become frustrated with punnets over time due to their difficulty in integrating into a commercial packing line (Monson, 2015). However, due to the increasing demand by packers the technology options in packing punnets have expanded rapidly and despite the infrastructure cost remaining high, the increased options for packing punnets now present more opportunities for packers to pack on site.

Chris Monson invested in new specialised punnet filling, labelling, stacking and containerising equipment as part of his pack house expansion in 2015. The new machine, filling multiple punnets at a time, has increased his opportunities to pack punnets on site and has opened new opportunities for his supermarket supply that previously he did not hold. This machine is largely unstaffed and completes the work for punnetising automatically.



Figure 14: Automatic Punnet Fillers, Monson Fruits Washington State, USA (Author, 2015)

However, Chris does have an advantage in packing punnets on site, due to his close proximity to the required destination for punnets post-packing; there is a distribution hub very close to the pack house. In Australia, many regional pack houses have been thwarted by attempts to pack punnets on site due to their inability to efficiently stack them (Hall, 2016). This has led to packers shipping large quantities of 'air' (in the air space between the punnets) on pallets which has increased the price of freight per kilogram shipped. This has increased the freight cost to the point where packing punnets on site in a regional location is no longer viable.

Conversely, it is quite acceptable for a pack house located close to a metropolitan centre to pack punnets due to the low cost of shipping to their wholesaler or retailer.

To get around this issue, there are a number of 'pre-packing' firms that have commenced at supermarket distribution hubs or wholesale markets who offer a 'fee for service' arrangement for pack houses and growers to ship bulk fruit to them in cartons, prior to packing fruit for retail sale. This provides an alternative to the expensive freight options that prove prohibitive for some regional growers. The downside is the double handling and wasted packaging that packers have in containerising fruit to send to a pre-packer, only to have that fruit container discarded after pre-packing. Also, there is double handling involved as the fruit has been packed twice and has another opportunity to be damaged, mishandled or lose the maintenance of the cold chain.

Shipping a pre-pack, such as a punnet internationally, only magnifies the problem of shipping cost per kg due to the cost of international freight. Freshpick in Malaysia is a fresh fruit import and wholesale business, but also offers a pre-packing service to both its growers and buyers. Born of a desire from growers to reduce freight costs, the growers supplying Freshpick also benefit from the lower cost of labour and packaging in Malaysia, while still being able to provide the pre-packaged product that the market demands. This approach has been widely used by exporters in other countries as a cost reduction measure.



Figure 15: Fruit being repackaged into punnets from 10kg boxes At Freshpick, Malaysia (Author, 2016)

As an alternative to punnets for retail sale has come the emergence of the 'random weight bag.' A clear plastic bag, providing an even lower unit cost than the punnet, the random weight bag provides consumers with a clear receptacle that presents the fruit extremely clearly while still keeping consumers' 'fingers off' the produce. Random weight bags are weighed at checkout at a set price per kilogram, or can be filled at a consistent, specified using specialised, and highly expensive, automated bag fillers.



Figure 16: Random weight bags, prepared in Malaysia by Freshpick (Author, 2016)

Much specialised equipment, similar to punnet filling machines, had to be installed the pack houses to commence filling random weight bags. The introduction of random weight bags in Australia had already been preceded by many successful years of trade in the USA.

Random weight bags are continuing to grow in acceptance and it is positive to note increasing interest from major supermarkets in Australia in marketing fruit using this method. Like punnets, it does require a similar investment in additional infrastructure to cater for filling random weight bags, it doesn't have the same freight disadvantage. Random weight bags can be filled in a master carton using a bag filling frame that serves to almost fill the master carton to capacity. This means that the master carton, compared to a traditional 5kg carton, does not suffer from the same imbalance in kilograms per dollar of freight cost that a punnet does.

Regardless of type of pre-packaging, based on the plethora of different packs offered at supermarket level today and indeed the continued interest in lowering wastage and pre-packs, it is likely that this will remain a part of the supermarket landscape into the future. The key attribute of displaying fruit in a clear package which prevents the consumer from handling individual pieces of fruit will likely be a common distinctive of future packaging for fresh cherries.

What does the consumer want?

While there is a distinct advantage to the retailer in prepacks as highlighted above, Australian cherry industry research highlights that consumers primarily purchase cherries as an impulse buy and based on the quality presented. For those consumers seeking to purchase cherries at retail level, the demand for a quality product is very high. Shrinkage and spoilage due to poor consumer handling of product presents a bad experience to both consumer and retailer.

As the consumer in Australia overwhelmingly purchases cherries as an 'impulse buy,' the presentation of the cherries on offer clearly becomes the most important part of the cherry retail experience. Figure 17 shows how premium cherries are presented for retail sale in Asian markets and how this leads the way in terms of enticing consumer to purchase.



Figure 17: Premium cherries presented for sale in a Malaysian supermarket (Author, 2016)

'Gift packs' of cherries, particularly in South East Asia, is a very big driver of cherry consumption. There is an underlying desire to purchase quality cherries, both as a gift to another as well as for ones' own household. Cherries are seen as a luxury item and are expensive, so the quality and presentation must reflect the price being asked. When imported cherries are presented for sale, they are almost without exception presented for sale as pre-packaged. Due to their high cost, compared to other domestic fruits, their appearance and presentation drives acceptance of their higher price. Cherry research conducted for the Cherry Industry Advisory Group 2014 by Hort Innovation highlighted that price was one of the principle barriers to purchase. For consumers who seek to purchase cherries in Australia, there is clearly a mismatch between the perceived value for cherries and their actual cost.

Haini Xie, fresh produce manager for 7-11 in Thailand, lamented a similar problem when seeking to add imported USA cherries to their fresh produce division. Providing cherries for retail sale on a price per kilogram basis proved to be difficult due to the segment of customer they were servicing. The price per kilogram was seen as too high. Changing their approach, they moved to selling a smaller pack size with cherries prepacked in cups of less than 200g and a fixed price per unit. This reduced the unit price significantly and suddenly consumption took off, as they were seen as a cost-effective and healthy alternative 'snack.' The perceived value for cherries was suddenly in line with consumers expectations. This has seen the growth in cherry retail expand considerably and they are currently reviewing what can do next to drive further growth in cherries.

Growing the market

Packaging sizes and types are not just limited to growing the market in Asia. Chris Monson in Washington State spoke to the success that random weight bags have had in expanding consumer consumption in the USA. The introduction of these bags has improved consumption enough for growers to notice the increased demand they are seeing for their produce domestically.

Similarly, one of the largest successes in market growth, especially in imported cherries, has been seen in Thailand. Cherry consumption has seen rapid growth for a number of years.

THAILAND								
List of supplying markets for a product imported by Thailand								
Product: 080929 Fresh cherries (excl. sour cherries)								
Sources: ITC calculations based on The customs department of the kingdom of Thailand statistics since January, 2015.								
ITC calculations based on UN COMTRADE statistics until January, 2015.								
Unit : Australian Dollar thousand								
Exporters	Imported value in 2012	Imported value in 2013	Imported value in 2014	Imported value in 2015	Market share in 2012	Market share in 2013	Market share in 2014	Market share in 2015
World	5813	6437	8258	11730	100.00%	100.00%	100.00%	100.00%
United States of America	2754	2236	3280	4141	47.38%	34.74%	39.72%	35.30%
New Zealand	1545	2785	2718	3847	26.58%	43.27%	32.91%	32.80%
Canada	399	477	802	1425	6.86%	7.41%	9.71%	12.15%
Chile	1059	932	1340	1326	18.22%	14.48%	16.23%	11.30%
Australia	21	6	105	950	0.36%	0.09%	1.27%	8.10%
Japan	14	0	0	23	0.24%	0.00%	0.00%	0.20%
Côte d'Ivoire	0	0	0	20	0.00%	0.00%	0.00%	0.17%
China	19	1	0	0	0.33%	0.02%	0.00%	0.00%
Cook Islands	2	0	11	0	0.03%	0.00%	0.13%	0.00%

Figure 18: Source ITC provided by AusTrade based on UN Comtrade statistics since 2015

Thailand has seen a 200% growth in domestic consumption of cherries in only three years. This has largely come from a concerted effort by retailers to support the expansion of the segment in Thailand, such as the example by 7-11 detailed above in Figure 18.

However, a similarly impressive example of best practice marketing can also be seen in the Tops Supermarket Chain. Tops operates medium and high-end supermarkets in the Thailand market and adjusts its retail concept to suit the demographic it is pursuing. They have fought an extremely robust cherry marketing campaign, especially over the last three years and have seen extremely high growth through a continued focus on cherries. At their high-end stores especially, the saturation of the store with cherries is extremely prevalent and their turnover in fresh cherries is extremely high. It is worth noting that Figures 19-24 all come from the same store. There are cherries presented for sale literally throughout the store. No other single supermarket item has as much exposure as cherries in this store.



Figure 19: Pre-packaging and weighing of cherries done in store (Author, 2016)



Figure 190: Cherries for sale at checkout at exit to store (Author, 2016)



Figure 21: Cherries at standalone presentation point in centre of store (Author, 2016)



Figure 22: Cherries presented in prepacks in refrigerated fruit section (Author, 2016)

The proliferation of cherries in the Tops Market is absolutely profound and no other commodity bears any similarity to the exposure that the imported USA cherries hold. General manager of Tops Market explains that this is a targeted decision, based on the desire of the Thai consumer to impulse buy good quality cherries. They are all visible in their clear prepacks and are a high-quality product. Turnover is so high each day that there is little concern about

the vast quantity of cherries that sit on the floor out of refrigeration, as they are all sold quickly and no degradation in fruit quality is observed.

Staff from both Tops Market and 7-11 approached the growth of the cherry segment in Thailand differently, but both contributed in the growth that Thailand continues to see for imported cherries. Both entities attribute a significant proportion of the growth to the success of implementing new sale strategies, using new and unique measures of presenting fruit to consumer. This came down to packaging type, packing size and availability for consumer to view and consider the purchase.

Overall, this level of innovation in approach highlights the need for growers to partner with the right people and companies that will respect the produce being provided and work to provide the best possible product to the consumer. The diligence and commitment of the Thai retailers to the marketing of imported cherries, particularly from the USA, is profound and serves as a standard of what can be done in market, even when off a low base.

Conclusions

The Australian cherry industry is modern by the standard of many international countries. It has learned from the world's best over time and has reaped the benefits of adopting new approaches in growing, packing and marketing.

A difference in scale and resultant ability to adopt new technologies is certainly present in many countries around the world, such as the USA, Canada and Chile. However, Australian growers can continually look to these production areas for ways to improve their own production as most things can be implemented in some way on their own property.

Cold chain management in Australia is good compared to some parts of the world, however still lags the world's best.

Implementing fully automated packing lines in Australia, as seen in the USA, will come in time, but the smaller industry and pack house size will limit adoption in some operations for now. Packaging has improved significantly, and it is unfortunate Australia continues to lag behind the world's best operators.

Consumption statistics speak for themselves – better packaging leads to higher consumption for a product that is still an 'impulse buy.'

Much needs to be done at the shop front to give the consumer the best product. This will drive the growth of consumption more than any other factor.

Growers need to partner with distributors who will ensure that their fruit handled with the respect and care it requires.

Recommendations

In making recommendations to industry on the completion of this research, it is clear that the world of cherry production is an incredibly diverse place. With the exception of the industry neglect of a clearly defined domestic marketing strategy to improve cherry consumption within Australia, Australian cherry production broadly ranks among the better cherry producing nations in the world.

However, there is room for improvement. The scale of the world's larger producers dwarfs the large producers in Australia. Even acknowledging Australia's aspiration of growth to a national crop of 20,000t by 2020, the domestic industry is still small by comparison with the large cherry producing nations such as USA (363,000t) and Chile (150,000t). The economies of scale available to large growers in these countries provide opportunities for technological advancement that will remain off limits for many producers in Australia, simply because they do not stand to make the same return on capital invested, compared to their larger international contemporaries.

However, even with a disparity in production tonnage and capacity there are improvements that the industry can seek to undertake over time which will see the industry and individual growers better served through their adoption. These include:

- No matter how good a piece of fruit may be in orchard, all can be undone by poor fruit handling from picking to packing. A process of diligent review and continuous improvement needs to be implemented to ensure quality standards are not diminished.
- The development of optical graders and new computerised grading is the beginning of a continual evolution in packing equipment and packers may need to be ready for a new era of constant improvement in technology adoption.
- Fruit must be introduced to the cold chain immediately after picking. The benefits to quality alone is worth the investment in improved cold chain, but cold chain also comes with the benefit of longer shelf life that will provide growers more marketing options.
- The rest of the world has migrated to accepting cold storage for cherries. For both phytosanitary reasons and marketing flexibility. It would be worthwhile for Australian cherry producers to explore the possibilities these options may present their businesses.
- Grower's responsibility for fruit extends far beyond dispatch from the farm gate. This same level of care needs to be taken along the supply chain to ensure the consumer is getting the good product the producer expects them to have. Anything less than this has the potential to lower prices received and reduce future sales opportunities. It is worthwhile for any grower who hasn't done it; to follow their fruit through to the retail level - just to see what the consumer is getting and ensure it is what the producer is happy with them receiving.

- Know what retail channels need and what consumers want in order to provide both with a good experience.
- Consumer packaging will continue to change and evolve. Packers need to respond to consumer demand and be ready to move with them. The benefits are there in growing market size and profitability.
- Consideration needs to be given by industry to domestic marketing and to developing a structured approach to expanding cherry consumption in Australia.

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Plain English Compendium Summary

Project Title: Post-Harvest Management of Fresh Cherries	
Nuffield Australia Project No	1514
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Objectives	To determine opportunities for the Australian cherry industry to improve post-harvest management of fruit across key areas of physical fruit handling, grading technology, cold chain management and new marketing opportunities through innovative use of new packaging.
Background	The Australian cherry industry continues a focus on continuous improvement to processing. This report asks where Australia sits on the global stage with regard to post harvest handling of fruit, and what gains have been made in recent years to cold chain management and fruit packaging options which would serve to benefit the Australian cherry industry.
Research	Research was conducted by visiting a number of key cherry research institutes in the USA, Canada, Italy, Germany and China. A review of published data across post-harvest fruit handling was undertaken and is included. Multiple interviews with producers, packers, wholesalers, exporters and importers contributed practical insights into potential improvements into post-harvest handling of fruit.
Outcomes	The Australian cherry industry is well advanced in post-harvest fruit handling in many respects but still lags the world's best. The smaller size of the Australian cherry industry will slow the adoption of some new technology. Innovation in packaging has been slowly adopted in Australia and in other countries around the world, new packaging and innovative sales strategies have led to increased consumption. Australia would be well served to adopt some of these innovations to boost its domestic market, which becomes saturated at times.
Implications	Adoption of the latest and most extensive automated packing lines will be difficult in Australia, due to a lack of size in the industry. Incremental gains in cold chain management practice and fruit handling in packing shed can be, and always should be, sought. Packaging has driven increased production in many countries around the world, as it has sought to meet the consumers' demands in presentation of fruit and fruit quality. The Australian market would be well served to consider adoption of similar techniques.
Publications	Presented at 2016 Nuffield Australia National Conference, Adelaide, SA