Building Strawberry Consumer Confidence: Lessons Learned from AM21000: Serviced Supply Chains II

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- For long supply chains, 1°C is optimal for strawberries
- Holding berries above 4°C for more than 1–2 days reduces shelf life
- Reducing relative humidity (RH) from 90% to 65% significantly impacted weight loss and shelf life
- Fruit shelf life and quality varied with regions, cultivars and seasons
- Delays of 1-2 hours from harvest to cooling reduced berry quality

Strawberries are among the most popular fruits purchased by consumers, valued for their health benefits and convenience as a snack. However, consumer confidence can quickly decline when strawberries deteriorate soon after purchase.

Over the past three years, the AM21000 Serviced Supply Chains II (SSCII) project team has worked closely with industry to improve the consistency of strawberry quality delivered to market. The project has developed practical decision-support tools, informed by supply-chain monitoring and storage simulation trials.

Tracking and analysing strawberry supply chains

Between 2023 to 2025, 38 strawberry supply chains were monitored using real-time data loggers from:

- Central Queensland (CQ) and the Sunshine Coast (SC) to Melbourne (2.5 days duration)
- Tasmania to Brisbane (3 days duration, transhipped in Melbourne and Sydney)
- Southern Queensland (SQ) to Brisbane and Sydney (Less than 1 day duration)

Most consignments from Queensland were cultivar '*Red Rhapsody*' while SQ shipments included '*Cabrillo*' and '*Albion*'.

Quality assessment procedures were developed to measure quality impacts (bruising, rots, dehydration and other defects) from supply chain conditions. Trained quality assessors collected sample trays on arrival in market. The assessments were conducted upon arrival and again at 7 and 10-14 days to measure shelf-life performance.

A quality assessment app was developed to collect the shipment data, accessible in real time. Individual business reports were generated from the data in the app and provided to the grower and marketer to identify and track areas of improvement.

Figure 1. Strawberry tray with logger inserted to monitor supply chain conditions
Photo credit: Queensland DPI

Figure 2. Assessing strawberry quality with the quality assessment app
Photo credit: Rudge Produce Systems

Data driving improvements

In the first year of monitoring, average supply chain temperatures were 7.5°C compared to 3.7°C in the final year. The main reason for the decrease was improved pre-cooling practices, with average dispatch temperature reduced from 8.7°C to 4.1°C over three seasons. Consignments with higher average temperatures had more bruising and decreased shelf life. Monitoring and reporting activities increased participating businesses' awareness of the need to improve pre-cooling practices and, in some cases, to invest in appropriate equipment.

> **We identified that we weren't achieving best practice, so we invested in a new cold room with much higher cooling capacity and a lot more air flow inside.** Brendon Hoyle, Ashbern Farms.

Practice changes improved temperature and humidity control with:

- Dispatch achieving < 5°C, a shift from 15% to 70% of consignments
- Average supply chain achieving < 5°C, a shift from 0% to 90% of consignments
- On arrival < 5°C (within spec for most retailers), achieving a shift from 15% to 70% of consignments
- On arrival < 8°C (within spec by all retailers), achieving a shift from 30% to 90% of consignments
- Improved humidity management, with average supply chain humidity increasing from 64% to 83% of consignments

Figure 3. Improvement in average strawberry supply chain temperature from 2023 to 2025

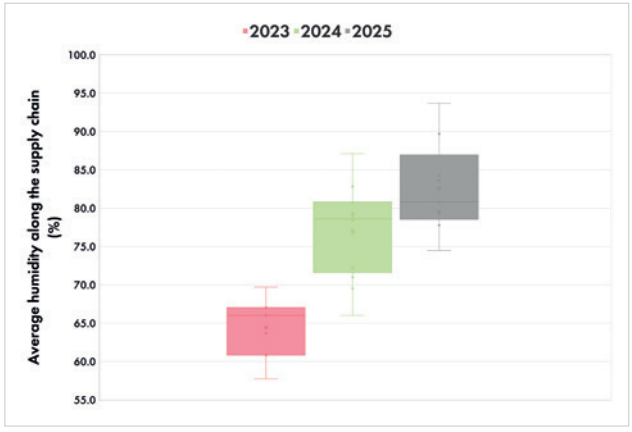


Figure 4. Improvement in average supply chain RH from 2023 to 2025

Quantifying impacts of temperature and relative humidity (RH)

Thirteen laboratory simulation trials, from 2024 to 2026, were conducted to quantify the impacts of temperature and RH on strawberry quality.

The same quality measures were used as for the monitoring. When preparing the treatments, it was identified that around 30% of the fruit had some level of bruising caused during harvesting and packing.

This emphasised the need for growers to ensure fruit is cooled to around 10°C before packing.

'*Red Rhapsody*' and '*Cabrillo*' cultivars were tested. A range of scenarios were tested using 1, 4, 10, 15 and 20°C over a range of storage durations (days).

A clear example of the findings was that berries held at 10°C for just one day lost a third of their shelf life

Figure 5. Preparing treatments for the time by temperature storage trials. Around 30% of fruit had to be discarded due to some level of bruising
Photo credit: Queensland DPI

Storage conditions		Storage duration (days)			
Temp (°C)	RH (%)	1	3	5	7
1	92	10.7	9.3	9.3	6.4
4	93	-37%	-46%	6.7	
10	93	6.8	5.0	2.6	0.5
15	96	6.6	3.6	0.8	
20	92	5.4	1.6		

Figure 6. Impacts of temperature and time on strawberry shelf life (days). After one day at 10°C, there was a 37% loss of shelf life, and after three days at 10°C, the shelf life was nearly halved. The impacts of low relative humidity (RH < 70%) were assessed against the recommended high-RH conditions (> 90%).

Low RH significantly increased fruit weight loss and reduced shelf life by 3–4 days, even when stored at 4 °C

The trials showed that a 25–30% reduction in RH had a similar negative effect on strawberry quality and shelf life as increasing storage temperature by 5–6 °C.

Storage conditions		Storage duration (days) prior to transfer to 4°C plus 63% RH					
Temp (°C)	RH (%)	Constant	1	2	3	5	7
1	92	13.0	7.8	7.3	7.1	5.1	5.2
4	93	10.8	7.7	6.8	6.4	5.4	4.5
10	93	7.2	7.9	6.1	5.5	3.7	2.0
15	96		6.2	4.3	2.2	1.4	
20	92		5.0	2.6	1.2		
4	63	7.0					

Figure 7. Impacts of RH on strawberry shelf life (days). Low RH at 4°C is shown to reduce shelf life by nearly four days (circled in red).

Trials on delayed cooling after harvest examined responses in both '*Red Rhapsody*' and '*Cabrillo*' cultivars. Four trials with '*Red Rhapsody*' from the Sunshine Coast (September–October 2025) and five trials with '*Cabrillo*' from Stanthorpe, Queensland (October 2025–February 2026) assessed cooling delays of one to eight hours under ambient conditions (25–30°C).

Delayed cooling accelerated weight loss, dehydration, and softening. A two-hour delay reduced shelf life by 19%, while an eight-hour delay almost halved shelf life

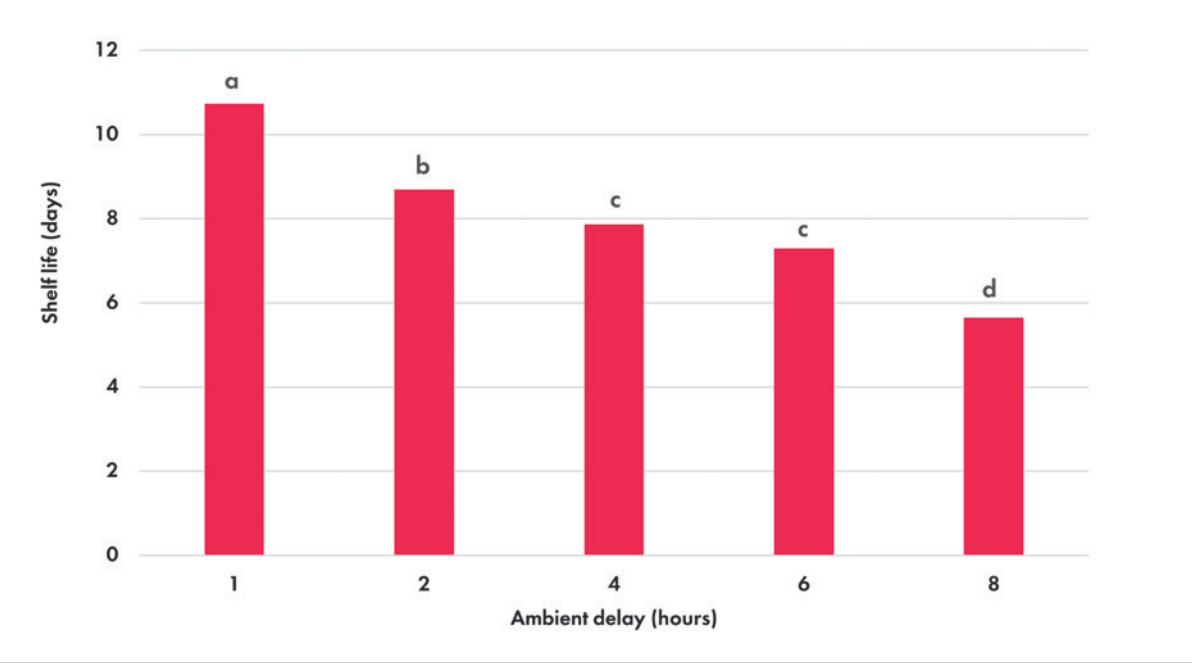


Figure 8. Ambient delays in cooling at harvest reduced shelf life. Note that the longer the cooling is delayed, the shorter the shelf life becomes.

Can we predict strawberry shelf life?

One of the key outcomes of the SSCII project has been the development of predictive shelf-life models to help growers and marketers better manage quality risk for strawberries, avocado, mango, and summerfruit. Shelf-life trials for avocado, mango, and summerfruit commenced earlier in the project, with validated models for selected cultivars already released to industry. Preliminary strawberry shelf-life models have been developed, though further validation using a larger number of commercial shipments will improve prediction accuracy. Even at this stage, the models provide growers and supply-chain partners with a useful tool to assess shelf-life risk, support dispatch and market decisions, and help deliver more consistent fruit quality to customers.

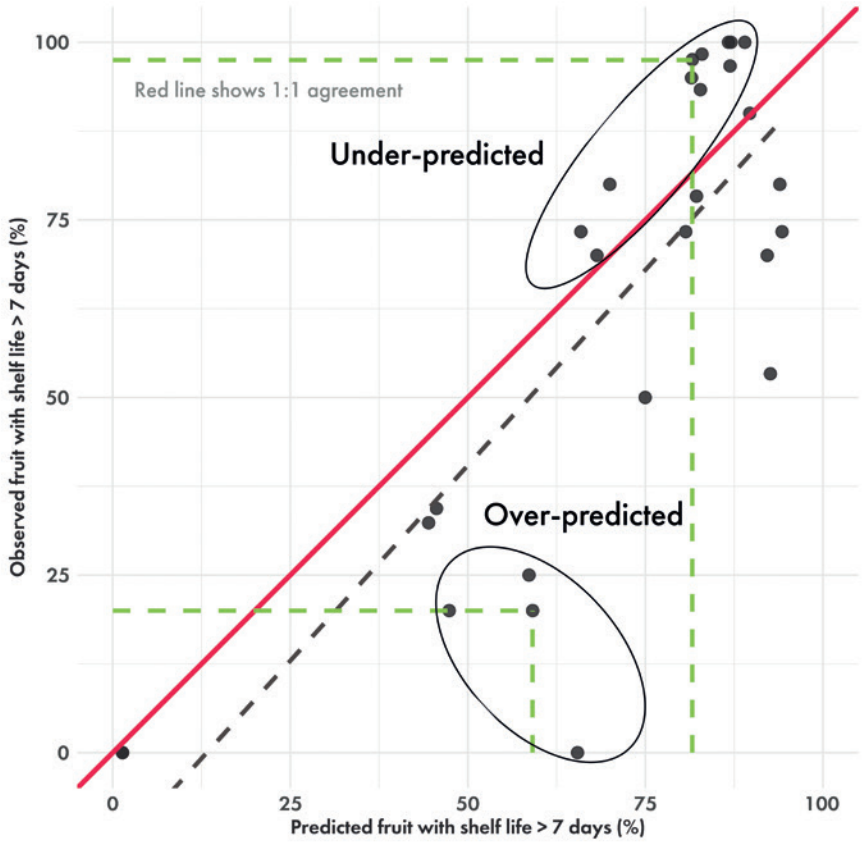
Cabrillo

- 460 Punnets from 3 trials from one farm
- Spring, summer, autumn (2025/26)
- Model explains 68% of the variation in shelf life observed in the trials
- Typical prediction error was around 1.5 days
- Includes temperature, duration (days), RH and harvest timing

Red Rhapsody

- 763 Punnets from 10 trials in 2024, 2025
- Substantial year to year effects
- Model explains 73% of shelf life differences when year is known
- Typical prediction error for a new or unknown year is around 2-3 days
- Includes temperature, duration (days), weight, harvest timing and year effects

Figure 9. Strawberry shelf life prediction model development



Each point represents one shipment (two export shipments with 0% predicted and observed values overlap at the origin). The red line shows perfect agreement between predicted and observed performance (1:1 line). The grey dashed line shows the overall fitted relationship across all shipments.

Figure 10. *'Red Rhapsody'* shelf life model validation. Predicted versus observed data for 27 shipments

Return on investment impacts

An economic analysis was completed with Ashbern Farms and SSS Strawberries, two of the key collaborating strawberry-growing and marketing businesses in Queensland.

The potential costs and benefits associated with adopting the following two project learnings were quantified.

- Build confidence in delivering consistent, high-quality fruit, using real-time loggers to monitor supply chain conditions and build accountability with supply chain partners to achieve a price premium.
- Improve pre-cooling practices and investment in infrastructure (cold rooms and cold room upgrades) to reduce rejection rates on arrival in the market.

The analysis was based on 6.5 million punnets per year, between the two businesses, to Australian domestic markets. Implementing the recommendations was forecast to achieve a return on investment of 3.3 : 1.

Key Takeaways

- Pre-cool strawberries to around 10°C for packing, within 2 hours of picking
- Pre-cool to less than 5°C before transport to market
- Ensure adequate fast cooling capability and cold rooms for storage for the business's volume of strawberries
- Don't overcrowd cold rooms
- Ensure RH in all cold rooms and transport is > 90%
- Regularly monitor consignment handling conditions, fruit quality and shelf life
- Fruit quality and shelf life will vary between cultivars, regions and seasons (years)

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