

Assessment of the Postharvest Handling System for Broccoli Grown in the Lockyer Valley, Queensland, Australia

Lung Sing Wong* and John Bagshaw†

Abstract

In winter 1999, we assessed the handling system for broccoli grown on a farm in Gatton, Australia and marketed in the Brisbane wholesale market. The assessment covered the chain from harvesting, packing, storage, and transport, through to marketing. Process flow charts were developed, highlighting every step in the handling and marketing system. We gathered information at each process by questioning and observing, and also identified the loss points and hazards to quality. Where possible, we measured loss at each critical point and identified solutions or areas for further research.

The main loss points identified were during harvesting, loading bins for the coolroom, cool storage, broccoli tipped onto carousel sorting tables, and sorting. Potential solutions and areas for further research are discussed.

THE objective of this work was to identify limitations to product quality and security, and make recommendations for system improvement or further targeted research and development. The scope of the assessment was from harvesting to packing, storage, transport, and marketing. We conducted an assessment of fresh broccoli in winter 1999 on a medium-size family farm that markets its broccoli through the Brisbane wholesale market.

- select case study systems;
- map process flows (Figure 1);
- describe and document activities at each process;
- measure losses;
- identify problems in the handling system; and
- present ideas to overcome problems, or for further research and development if required.

The results were tabulated (see Appendix Tables A1–A3).

Methodology

The methodology was adapted from that developed by La Gra (1990), and entailed the following steps:

* Horticulture Postharvest, Queensland Department of Primary Industries, Gatton Research Station, LMB 7, MS 437, Gatton, Queensland 4343, Australia. Email: <wongl@dpi.qld.gov.au>.

† Quality Management Group, Horticulture Institute, Queensland Department of Primary Industries, 80 Meiers Road, Indooroopilly, Queensland 4068, Australia. <BagshaJ@prose.dpi.qld.gov.au>.

Observations

The following observations were made:

- 14% of potential heads were rejected in the field, because of poor shape or colour, small size, damage, or dirt on heads.
- 18% were rejected at packing, because of mechanical damage, dirt on heads (from tractor wheels), over or under-size heads, or misshapen heads.
- Heads were cool-stored for 2–3 weeks at the time of the study (waiting for prices to improve). Most

stems were trimmed at packing to remove cut surfaces that had browned during storage.

- The cool chain was generally well maintained to retail stores.
- Some produce waits at the wholesale market for 4–8 hours overnight at ambient temperatures.

Suggestions for Improvement or Future Research and Development

The following suggestions are made as a result of the assessment:

- At harvest, growers could change from the use of bins on the back of a tractor to a harvest aid with lateral conveyors. Picking staff need to be trained to handle product carefully.
- Damage from tractor wheels might be reduced by wider row spacing of plants or by the use of tractors with narrower wheels.

- Do not over-fill field bins. This will avoid crushing of heads when bins are stacked three-high for coolroom storage.
- Do not store for longer than two weeks (at three weeks, cut stems had turned brown), or identify improved storage conditions to extend storage life.
- Redesign bin-tipping equipment to reduce head damage.
- Train packers to quality standards to reduce the numbers of packable heads being rejected.
- At the wholesale market, store all consignments in coolrooms.

Reference

La Gra, J. 1990. A commodity systems assessment methodology for problem and project identification. Moscow, Idaho, USA, University of Idaho, College of Agriculture, Postharvest Institute for Perishables.

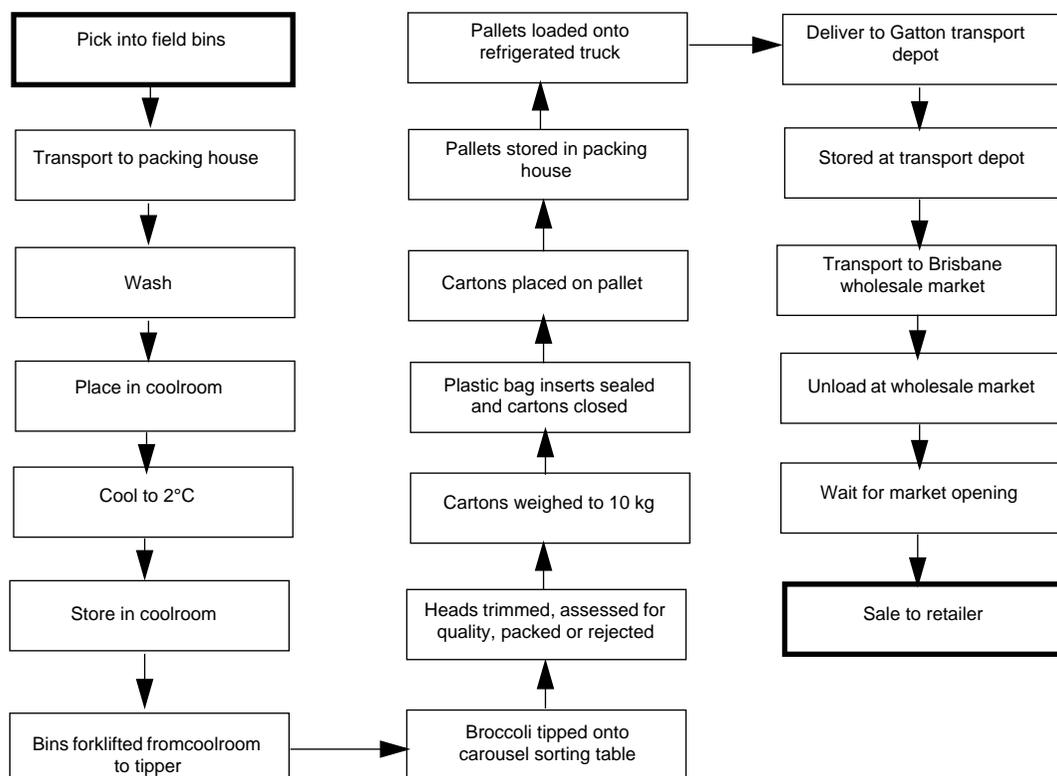


Figure 1. Process flow chart for the postharvest handling system for broccoli grown in the Lockyer Valley, Queensland, Australia

Appendix. Tabulated results of case study assessment.

Table A1. Summary of activities.

Steps	Action type ^a	Temperature	Distance	Time taken	Observations
Pick into field bins	O	Ambient 20–25°C		Time to fill 3 bins 1.25 hrs	Heads cut, leaves near head removed, heads thrown into bin (thrown up to 2 m). Tractor wheels hit heads when soil builds up on wheels
Transport to packing house	T	Ambient	On-farm 1 km Other farms to 10 km	10 to 45 minutes	
Wash	O	Water		5–10 minutes	Water hosed over bins. Aim to cool produce. Inefficient due to water channelling
Place in coolroom	T		Short	Couple of minutes	Use forklift to carry bins
Cool to 2°C	O	Room at 2°C		At least 24 hours	Bins stacked on top of each other in refrigerated coolroom. Room cooled + hose washing to maintain humidity
Stored in coolroom	S	2°C		Up to 3 weeks	
Bins forklifted from coolroom to tipper	T	Product 2°C	Short	0.5–1 minute	Coolroom faces directly into refrigerated 10°C packing area
Broccoli tipped onto carousel table	O	10°C	Short	5 minutes	Small number of heads damaged in tipping. Bin tipped mechanically.
Heads trimmed, assessed for quality, packed or rejected	O/I	10°C		5 minutes per bin	9 packers. Rejects into bulk bin & dumped. Packable head stems trimmed with knife due to browning of cuts after 3 weeks storage. Not pattern packed. Possible damage to heads from adjacent stems
Cartons weighed to 10 kg net	O	10°C			Scales on conveyor line. Regularly calibrated
Bags sealed and cartons closed	O	10°C		30 seconds	Tops of bags twisted and folded then ties with plastic tie. Carton top closed by hand
Cartons placed onto pallet	O	10°C		30 seconds	8 cartons per layer, 5 high, then pallet on top 2 layers high

^a O = operation. T = transport. I = inspection. D = delay. S = storage.

Table A1. Summary of activities (cont'd).

Steps	Action type ^a	Temperature	Distance	Time taken	Observations
Pallet stored in packhouse before transport	S	10°C		1–5 hours	
Pallets loaded onto truck	O	2°C			Forklift. Product probed for temperature and cartons checked for damage by transporter
Deliver to Gatton depot	T	10°C	15 km	Half-hour maximum	Refrigerated truck owned by transporter. Pallets unloaded by forklift. Grower arranges pick up time with transporter
Stored at transport depot	D	2°C		1–4 hours	Stored in coolrooms
Transport to Brisbane wholesale market	T	2°C	100 km	1.5 hours	Refrigerated truck. Arrives between 10 pm and 2 am
Unload at wholesale market	O	10°C		45 minutes	Arrive at wholesale market between 10 pm and 2 am
Wait for market opening	D	10–15°C		4–8 hours	Wait until opening at 6 am. Most produce kept in coolrooms, some at ambient on market floor
Sale to retailer	O	15–20°C			Deliver to retailers coolroom on wholesale market site

^a O = operation. T = transport. I = inspection. D = delay. S = storage.

Table A2. Impact of losses.

Steps	Impact of losses ^a		Comments
	Quantity	Quality	
Pick into field bins	M	M	12–14% rejected at harvest due to poor shape or colour, damaged heads, dirt on heads. Heads thrown into bins sometimes cause damage. Tractor wheels can hit heads, especially if mud builds up on wheels — damage and mud on heads
Stored	L	L	
Transport to packhouse	L	L	Small distance to packhouse from own farm site. On other supplier farms, heads sometimes stored at ambient temperature before transport to packing house
Wash	L	L	Washing process using hose to cool and raise humidity is questionable. Sprinkler set up would be better. Hosing time too short (5 minutes)
Place in coolroom	L	L	Bins placed three high to be forklifted into coolroom. Top bins can crush heads in lower bin. Into coolrooms within half-hour of arrival at packhouse
Cool to 2°C	L	L	Room cooling over at least 24 hours. Heads sprinkled with water regularly to reduce moisture loss once cooled
Stored in coolroom	M	M	If long storage (2–3 weeks), stem cuts may turn brown. Stems need to be trimmed at packing if this happens
Bins forklifted from coolroom to tipper	L	L	Packing area held at 10°C
Broccoli tipped onto carousel table	L–M	L–M	Some loss due to mechanical damage as heads tipped out of bins
Heads trimmed, assessed for quality, packed or rejected	L–M	L–M	Trimmed if stored for a long time. Rejects average 18% (at a time when prices are low). Less rejected when prices are high
Cartons weighed to 10 kg net	L	L	
Bags sealed and cartons closed	L	L	Bags maintain modified atmosphere during marketing

^a H = high. M = moderate. L = low.

Table A2. Impact of losses (continued).

Steps	Impact of losses		Comments
	Quantity	Quality	
Cartons placed onto pallet	L	L	Pallets stacked maximum 5 layers high to meet supermarket requirements (1 pallet × 5 high + 1 pallet × 2 high on top)
Pallet stored in packhouse before transport	L	L	Stored at 10°C for 4–7 hours
Pallets loaded onto truck	L	L	Forklift
Deliver to Gatton depot	L	L	Refrigerated truck at 2°C. Some damage if pallets shift when trucks on rough farm tracks
Stored at transport depot	L	L	Stored in coolrooms
Transport to Brisbane wholesale market	L	L	Refrigerated transport
Unload at wholesale market	L	L	Cool night temperatures
Wait for market opening	L	L	May heat up if held at ambient. Mainly stored in coolroom
Sale to retailer	L	L	Transferred from wholesaler's coolroom to retailer's coolroom

^a H = high. M = moderate. L = low.

Table A3. Problem identification and suggestions for improvement.

Step (loss point)	Cause of losses	Suggested solution/further research/ comments
Pick into field bins	Rejects due to poor shape, colour, damaged or dirty heads. Heads thrown into bins. Tractor wheels hit heads — damage and mud on heads	Variety selection, agronomic improvements. Staff trained to handle product carefully. Use harvest aid (with side conveyor) instead of bins on back of tractor Consider wider spacing for tractor rows, or narrower tractor wheels.
Place bins in coolroom (after washing)	Bins loaded three-high to transfer into coolroom. Top bins can crush heads in lower bins	Do not overfill bins
Store in coolroom	Cut stems turn brown during long storage (three weeks). Need trimming at packing	Avoid long storage
Broccoli tipped onto carousel table	Mechanical damage from contact with equipment	Redesign equipment to reduce damage
Heads trimmed, assessed for quality, packed or rejected	Damaged, undersized, poorly bearded, discoloured, dirty heads rejected by packers	Train packers to quality standards, so packable heads not rejected
Waiting at wholesale market (for market opening)	Some consignments left on market floor. Heat up during waiting	All consignments to be stored in coolroom