Postharvest Handling

Once harvested, pear fruit quality tends to decline, and harvest maturity has a marked effect on ripening and storage performance <Link Harvest maturity>. Fruit that are too soft, for example, do not store for long periods. While many pear varieties can be stored successfully for several months, great care is needed to ensure pears are placed into correct storage conditions at the right maturity to ensure acceptable quality after storage. Late varieties often store better than early maturing varieties; for example Packhams store longer than Williams. Maximum storage life is usually determined by poor taste, soft and yellow fruit, or the incidence of storage disorders (<Link>.

Ripening

Pears behave very differently to other fruit, including apples, in that European pear varieties do not ripen properly on the tree and need to be cooled after harvest and/or treated with ethylene (sometimes for several weeks) to soften and develop full flavour. Some pear varieties require a period of cool storage up to 12 weeks to trigger ripening after harvest. Pears not fully ripened after harvest are less preferred by consumers and tend to achieve lower prices.
Ripening treatments are cool storage and ethylene application after storage. Ethylene is usually applied at 15 to 19^{o}C at 100 µl/L. Each variety requires a different treatment and it is important that sound local advice is taken before deciding on ripening and storage conditions.

As a general guide:
Williams: 2 to 3 weeks at -1 to 0^{o}C and/or 100 µl/L ethylene for 1 to 2 days at 18^{o}C.
Beurre Bosc: 1 to 2 weeks at -1 to 0^{o}C.
D'Anjou: 1 to 2 months at -1 to 0^{o}C and/or 100 µl/L ethylene for 1 to 2 days at 18^{o}C.
Packhams: at least 4 weeks at -1 to 0^{o}C.
Corella: up to 12 weeks at 0.5^{o}C (based on results from Forelle).

Storage

Pears are well suited to controlled atmosphere (CA) storage at -1^{o}C, 98% relative humidity. Storage at temperatures greater than 0 ^{o}C leads to accelerated softening, yellowing, internal browning and/or mealiness. Optimum commercial CA conditions for established varieties in Australia vary markedly between varieties. Pears that are stored too long fail to ripen, or become too yellow (e.g. Williams). Common pear varieties respond best to a storage temperature of -0.5^{o}C. Williams can only be stored for 4 months at -0.5^{o}C under 1 to 1.5% O_2 and 0 to 0.8% CO_2, as it is susceptible to scald and ultra-low O_2 atmospheres (ULO) of 1.5% inhibit this storage disorder. It benefits from rapid cooling. Packhams can be stored for up to 9 months at the same temperature under atmospheres of 3.5% O_2 and 3.5% CO_2 but may also need ULO (1.8% O_2 and 3.0% CO_2) to inhibit scald development. Storage information for blush pears is limited. Forelle has been stored successfully in South Africa for up to 7 months at 1.5% O_2 and 0% CO_2 .

Variety	Max Storage Time	Ideal Storage Temperature (^oC)	O_2 (%)	CO_2 (%)
Williams (Bartlett)	3 to 4 months	-1 to 0	1 to 1.5	0 to 0.8
Packhams	7 to 8 months	-1 to 0	3 to 3.5 ULO: 1.8	3.5 3.0
Corella	Up to 8 months	-1 to 0		
Beurre Bosc	5 to 7 months	-1 to 0		

Table 1: Storage temperatures (Little and Holmes 2000)

Modified Atmosphere Packaging (MAP) has also been demonstrated to successfully prolong quality in pears during storage, transport and marketing. For example, Williams pears were stored for 4 months under MAP (approx. 12.3% O_2; 5.6% CO_2) at 1^{o}C with no symptoms of scald or internal browning observed, while Doyenne du Comice was successfully stored in 'Lifespan' film for 6 months, 2 months longer than fruit stored in air.

Storage Disorders

Common storage problems that can develop during CA storage of pears include superficial scald, internal browning (senescent or core breakdown) and skin yellowing.

Scald is a brown skin discolouration which occurs if susceptible varieties are stored for >4 months below 4^{o}C. Packhams pears are moderately susceptible. Scald can be controlled by use of ULO, but harvest maturity does not seem to affect severity of symptoms in pears.

Internal browning (or core breakdown) results when pears are stored too long when tissue browns in the core, with browning spreading to the cortex in severe forms. Later picked fruit are more susceptible to core browning, which tends to become more obvious during marketing, i.e. after storage. Williams, Packhams and Beurre Bosc are all susceptible to core browning.

1-MCP (Smartfresh™) can be used to prolong CA storage of certain pear varieties, including Williams and Beurre Bosc, usually by inhibiting softening or scald and internal browning .

Storage pathogens

Pears are susceptible to many different types of fungal attack during storage particularly if fruit are damaged or cracked. In Victoria, common fungi causing postharvest diseases include Penicillium (Blue Mould), Mucor rot, anthracnose, Botrytis (Grey Mould) and Alternaria. Fungal infections can be difficult to contain and keeping pathogen levels low in the orchard is an important control step. Pre-storage fungicide treatments are often required to minimise attacks during storage and there are a number of these available. Growers must obtain specialist advice when planning and implementing a fungal rot control program (See Little and Holmes, 2000).

Trials in the Pear Field Laboratory DEPI Tatura

Preliminary observations of the storage performance of new Australian National Pear Breeding Program (ANPBP) blush varieties indicates they may perform very differently from each other, and differently to current commercial blushed, European cultivars, such as Corella (Forelle). Detailed postharvest performance trials will commence in the 2014/15 season.

Further information

These Australian and international sites may be useful for growers. However they are intended as an information source only. Any specific recommendations may be outdated or irrelevant for Australian conditions and growers should seek local advice.

Australian Resources

Little, C. and Holmes, R. (2000) Storage technology for apples and pears. DNRE Victoria. 528pp.

International Resources

US: UC Davis **Recommendations for Maintaining Postharvest Quality:** http://postharvest.ucdavis.edu/producefacts/#fruitsmelons

US: Washington State University: http://postharvest.tfrec.wsu.edu/pages/J6I2A

USA Pears: http://www.usapears.com/Industry%20Research/Completed%20Research/Post-harvest%20and%20Packing.aspx

Storage Disorders:
US: UC Davis http://postharvest.ucdavis.edu/produce_information/Fruit_Physiological_Disorders/

Postharvest Diseases
US: Washington State University: http://decay.tfrec.wsu.edu/
http://postharvest.tfrec.wsu.edu/topical.php?variety=diseases&keywrds=pear&token=Pear+Diseases+and+D...

References (Note full access may incur a fee)

Kupferman, E. (2001) CA Storage of Apples and Pears December 2001. Washington State University Tree Fruit Research Extension Center. http://postharvest.tfrec.wsu.edu/EMK2001D.pdf

Crouch, I. andBergman, H. (2012) Forelle Pears: Postharvest Manipulations to Enable Versatile Marketing of Good Quality Fruit. http://www.experico.co.za/wp-content/uploads/2012/10/Forelle-early-market-and-storage-article-corrected.pdf

Ekman, J.H., Clayton, M., Biasi, W.V. and Mitcham, E.J. (2004) Interactions between 1-MCP concentration, treatment interval and storage time for 'Bartlett' pears. Postharvest Biol. & Technol., 31: 127-136.

Villalobos-Acuna, M.G., Biasi, W.V., Flores, S., Jiang, C-Z, Reid, M.S., Willits, N.H. and Mitcham, E. J. (2011) Effect of maturity and cold storage on ethylene biosynthesis and ripening in 'Bartlett' pears treated after harvest with 1-MCP. Postharvest Biol. & Technol., 59: 1-9.

Wang, Y. and Sugar, D. (2013a) Internal browning disorder and fruit quality in modified atmosphere packaged 'Bartlett' pears during storage and transit. Postharvest Biol. & Technol., 83: 72-82.

Wang, Y. and Sugar, D. (2013b) Ripening behaviour and quality of modified atmosphere packed 'Doyenne du Comice' pears during cold storage and simulated transit. Postharvest Biol. & Technol., 81: 51-59.

1-MCP (or 1-methylcyclopropene)

1-MCP, known commercially as Smartfresh™, is registered for use with pears in Australia. It is applied to fruit after harvest to slow down ripening. It does this by blocking ethylene receptors on the fruit, thereby inhibiting the ripening effects of ethylene gas. Specific recommendations for use are only available for cultivars Packhams and Williams.

Care should be taken when using MCP with Packhams as this cultivar tends not to ripen after application. 1-MCP does not protect against high CO_2 injury, low temperature damage or fungal pathogen development. Scald symptoms and yellowing were inhibited in Williams pears with 1-MCP but care is needed to ensure optimal application rate is applied, as 1-MCP can significantly inhibit post-storage ripening. The effects of MCP are not readily reversed by application of ethylene, and it is not clear what the best combination of MCP application conditions and storage conditions are to ensure optimum storage and ripening of pear fruit. Delay of softening during storage and associated incomplete ripening after storage can be a problem.

Further information

These Australian and international sites may be useful for growers. However they are intended as an information source only. Any specific recommendations may be outdated or irrelevant for Australian conditions and growers should seek local advice.

Australian Resources

Smartfresh Recommendations for CA stored Packhams in Australia (pdf)

Smartfresh Recommendations for CA stored WBC pears in Australia (pdf)

Smartfresh Recommendations for RA stored WBC pears in Australia (pdf)

Beth Mitcham, Jim Mattheis, Jenny Bower, Bill Biasi and Murray Clayton (2001)
Responses of European Pears to 1-MCP. Perishables Handling Quarterly 108: 16-19.

Ekman, J.H., Clayton, M., Biasi, W.V., Mitcham, E.J. (2004). Interaction between 1-MCP concentration, treatment interval and storage time for 'Bartlett' pears. Postharvest Biol. Technol. 31, 127–136.

Villalobos-Acuna, M., Biasi, W., Flores, S., Mitcham, E. (2010). Pre-harvest application of 1-MCP influences fruit drop and storage potential of 'Bartlett' pears. HortScience 45(4): 610-616.