Preventing rapid ripening of Pink Lady and Fuji apples

By Jenny Jobling

The Australian apple industry is one of Australia's major horticultural industries, valued around $360 million in 2000 and the Australian export of apples is currently worth $36.5 million (AHC, 2000). The industry does have potential to expand with the increased production of new varieties like Pink Lady and Fuji. The key for Australian producers is to produce quality fruit which maintains its crispness right through to the final consumer.

It is important that air stored or CA stored apples have a reasonable shelf life on reaching the wholesale market. Consumers who purchase floury apples are reluctant to purchase apples again in their next shop. Pink Lady and Fuji apples store well. However research has shown that Fuji and Lady Williams apples (a parent of Pink Lady) are induced to ripen rapidly if they are chilled for a month or more at 0^{o}C and then returned to ambient conditions (Jobling and McGlasson, 1995). Rapid ripening seriously reduces the consumer shelf life of these varieties. The fruit may be of excellent quality straight after removal from storage, but on arrival at the wholesale markets, or the supermarket the prized crispness and flavour, so important for quality has been lost.

A current AAPGA levy funded research project, being carried out by Sydney Postharvest Laboratory is looking at the issue of rapid ripening of Fuji and Pink Lady apples in more detail. The first season's data has confirmed that Fuji apples are susceptible to rapid ripening. Fuji apples stored for 35 days at 0^{o}C in air produced more ethylene than fruit left at 20^{o}C after harvest (Figure 1). Pink Lady apples however, were not susceptible to rapid ripening. The results for Pink Lady show that maturity at harvest and storage temperature are both important factors in determining post storage shelf life for this variety.

One hypothesis of this project was that storing the fruit at a warmer, non-damaging temperature might prevent rapid ripening. However, it is interesting to note that Fuji apples stored at 3^{o}C and 10^{o}C produced more ethylene than fruit after harvest. It is unlikely that this response is simply due to time in storage as Fuji is known to be a very low ethylene producer and the level of internal ethylene after 21 days at 20^{o}C was considerably lower than the level after 35 days in storage.

This was an unexpected result as it was thought that 3oC would be warm enough to prevent rapid ripening. There is some evidence from other researchers that one enzyme in the ethylene or ripening process may be sensitive to chilling temperatures below 12^{o}C. This may be an explanation for the induction of ripening at both 3 and 10^{o}C for Fuji apples. Further work next season will shed more light on this unusual response to air storage by Fuji apples.

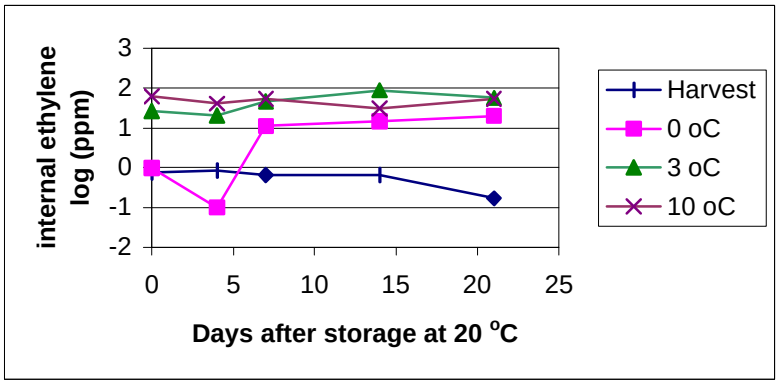

Figure 1. The effect of storage temperature on ripening of Fuji apples.

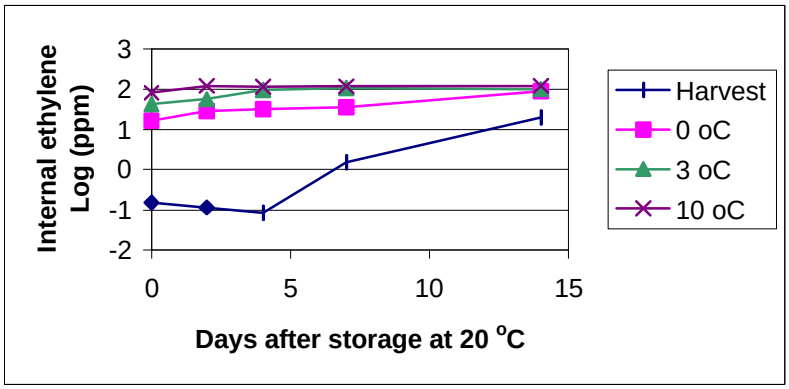

Figure 2. The effect of storage temperature on the ripening of Pink Lady apples.

Pink Lady apples, in contrast to Fuji have a typical pattern of ethylene production (Figure 2). This variety is not induced to ripen at 0°C. The ethylene level of fruit after 21 days at 20°C was comparable to the level in fruit after 35 days in storage. This result shows that Pink Lady apples are not as susceptible to rapid ripening even though one parent of Pink Lady, Lady Williams has previously been shown to be susceptible.

The project also looked at fruit under CA conditions (2% O_2 and <1% CO_2) at either 0°C or 3°C. The results showed that Fuji apples stored under CA conditions did not produce ethylene (Figure 3).

This result suggests that storing Fuji apples under CA conditions prevents the development of rapid ripening and therefore significantly improves the shelf life of this variety after removal from storage compared to storage of fruit in air.

It is important to note that CA storage under these conditions (2% O_2 and <1% CO_2) was shown to be better at 0°C than at 3°C. This is an important result from a practical point of view as it shows just how critical cool room temperature management is for fruit quality.

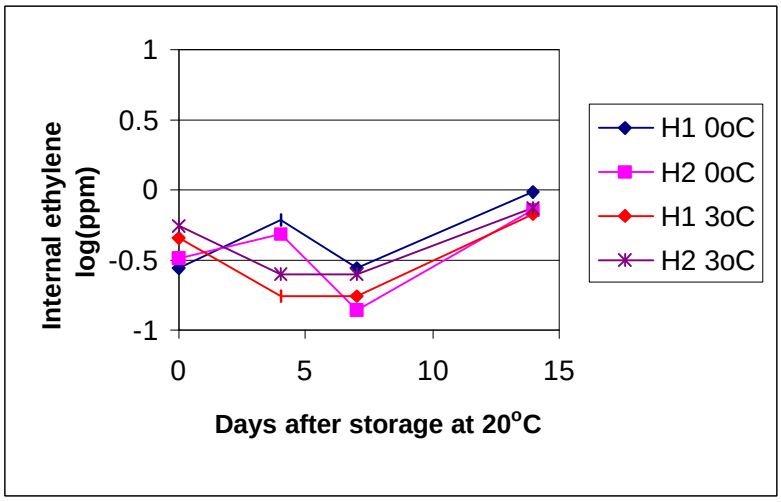

Figure 3. Changes in internal ethylene levels of Fuji apples after 3 months CA storage.

The effect on fruit quality can be illustrated by the relative rates of loss of firmness and the change in background colour.

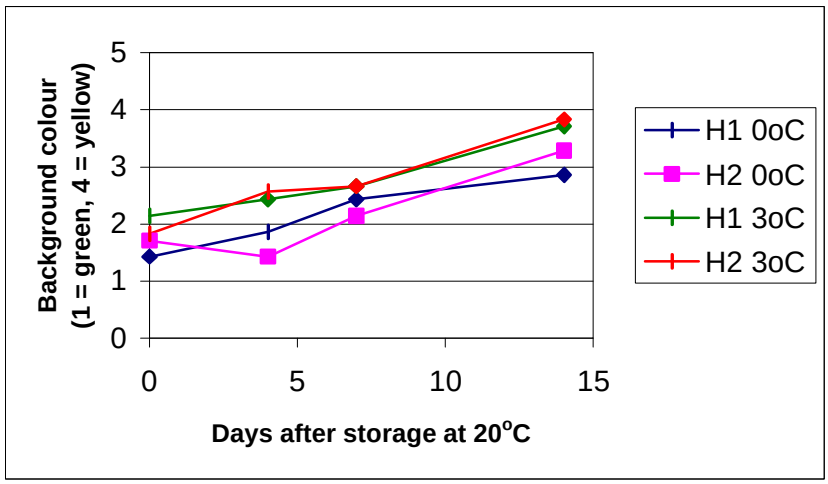

Figure 4. Change in background colour of Fuji apples after removal from 6 months CA storage.

Figure 4 illustrates the change in background colour for Fuji apples and the results are similar for Pink Lady apples. For consumers this is an important quality parameter, as shoppers "buy with their eyes". Fruit with a greener background colour, are regarded by most consumers as fresher than those that have gone yellow.

Another important quality parameter is the loss of flesh firmness. Figure 5 shows that Pink Lady apples from the later harvest stored at both 0 and 3°C were softer and lost firmness more quickly than fruit harvested earlier (Harvest 1 which was 10 days earlier). This result is well known but it is sometimes overlooked as growers try and leave the fruit on the tree as long as possible in an effort to gain maximum pink blush for this variety. This result shows that fruit aimed for sea freight in air must be

harvested at the correct maturity if fruit quality is to be maintained during transport. Consumers prefer crisp apples and so fruit harvested at the correct time, before ethylene production has begun, are more likely to have an acceptable shelf life on arrival compared to fruit harvested later. Storage temperature is also important with fruit stored at 0°C being firmer than those stored at 3°C for both harvest dates.

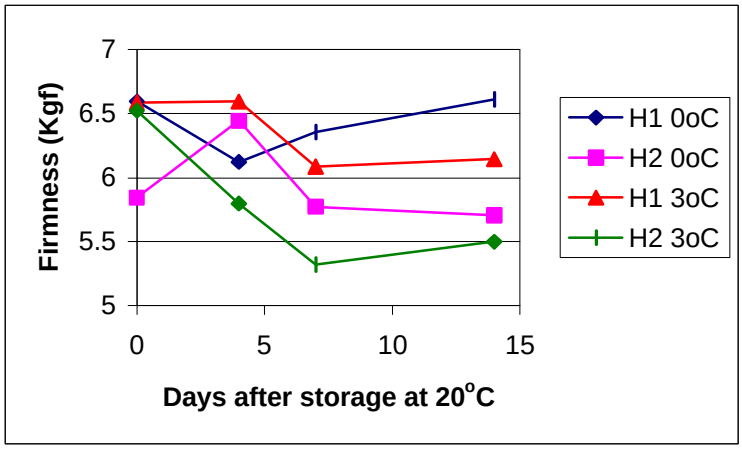

Figure 5. Change in firmness of Pink Lady apples after removal from 6 months CA storage.

This research will continue next season with fruit from both the Batlow and Orange districts. Australia has a reputation for producing excellent quality Pink Lady and Fuji apples. There is a risk however, that this reputation may be damaged if the se varieties of apples are stored at a warmer temperature as the outturn shelf life and quality will be reduced. A few degrees can make a significant difference in outturn fruit quality and shelf life.

The apple industry will benefit from this research as a result of the development of handling and storage guidelines for Pink Lady and Fuji apples that will prevent the rapid loss of quality on removal from storage, particularly for export fruit. These guidelines will ensure the consumer shelf life of these premium varieties is assured and the good reputation of the industry is maintained.

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Practical Implications for Growers

- Fuji apples are susceptible to rapid ripening if stored in air at low temperatures. The best way to prevent rapid ripening is to store fruit under CA conditions.

- Pink Lady apples are not prone to rapid ripening but storage life is compromised if harvest maturity is late and cool room temperatures are higher than 0^oC for both air storage and CA (2% O_2 and <1% CO_2).

- The important message for apple growers is that control of cool room temperatures is essential. This is true for both varieties of apples. The storage life of both Pink Lady and Fuji apples is compromised if the cool room temperature is 3^oC rather than 0^oC.

- A 3^oC difference in temperature may seem small but it has a significant effect on the out turn quality of the fruit. This preliminary results highlights the importance of cool room management for ensuring postharvest fruit quality.

Literature cited.

Australian Horticultural Corporation (2000). The Australian Horticultural Statistics Handbook. AHC 1999.

Jobling, J.J. and McGlasson, W.B. (1995). Chilling at 0^oC in air induces ethylene production in Fuji and Lady Williams apples. Australian Journal of Experimental Agriculture 35: 651 – 655.

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