Preventing rapid ripening of Fuji and Pink Lady apples

By Jenny Jobling

It is often assumed that apples will have a longer storage life if they are stored as close to 0°C as possible. This generalisation is dangerous as some apple varieties are in fact chilling sensitive. The fact that some varieties of apples are chilling sensitive has been known for many years. Storage at 0°C damages these varieties and so a temperature of 2°C is often recommended.

Storage at low temperature actually damages susceptible varieties and shortens their shelf life. Chilling sensitive apples can develop core flush (a browning of the core area), low temperature breakdown and soft scald. It is therefore important to understand what varieties are chilling sensitive and which ones aren't.

Some apple varieties are susceptible to chilling injury.

Chilling injury occurs in many fruit, mainly those of a tropical origin such as tomatoes, bananas and cucumbers. The symptoms of chilling injury are usually not obvious until the fruit are brought out of storage and warmed up. Many symptoms of chilling injury involve alterations to the normal ripening process. Unripe fruit are more susceptible than ripe fruit to this type of injury. This is because all the major changes that occur during ripening have occurred or have at least started in ripe fruit and so chilling injury cannot reverse what has already happened. Chilling injury does however make both ripe and unripe products more susceptible to diseases.

For apples the problem with chilling sensitive varieties is that storage at 0°C can actually stimulate rapid ripening. This is because chilling can stimulate the production of ethylene and this promotes rapid ripening and a subsequent shortening of the shelf life. Research has shown that Granny Smith, Fuji and Lady Williams are all chilling sensitive varieties (Jobling *et al*., 1991; 1995).

Research has shown that Fuji and Lady Williams apples are induced to ripen rapidly if they are chilled for a month or more at 0oC and then returned to ambient conditions. The figures show that both Fuji and Lady Williams apples stored at 0°C in air have higher internal ethylne levels than those stored in air at 20°C. Higher internal ethylene levels indicate that fruit have been induced to ripen as a result of being stored at 0°C in air for 32 days. Those fruit induced to ripen appeared to be in excellent condition on removal from storage but their shelf life was severely reduced.

This characteristic is especially important for Fuji apples. Fuji naturally has a very low level of ethylene production and a correspondingly longer shelf life. This is in comparison to Gala apples for example, that have very high levels of ethylene production and a

subsequently shorter shelf life (Jobling *et al.*, 1995). It is shame if this beneficial natural characteristic is abused by storing the fruit at a damaging storage temperature.

A new research project.

Sydney Postharvest Laboratory has begun a research project funded by HRDC that aims to develop an understanding of Pink Lady and Fuji apples that will prevent rapid ripening occurring in these varieties. Pink Lady is included in the study because one of its parents is Lady Williams and the chilling sensitive trait may have been passed on.

Pink Lady is an important new variety. There has been considerable success exporting Pink Lady to Europe although, there has been a problem with inconsistent out turn. This inconsistent quality might be the result of chill induced ripening. Rapid ripening seriously reduces the consumer shelf life of susceptible varieties. The fruit may be of excellent quality straight after removal from storage, but on arrival at the wholesale markets, or supermarket that prized crispness and flavour, so important for quality has been lost.

Storage temperature is especially critical during export to more distant markets. Here the shelf life after transport is critical, as the fruit may still have to travel reasonable distances to reach consumer markets. If consumers receive poor quality, floury fruit, then the demand for repeat sales will be stifled. The storage temperature prior to and during export can make the difference between good and poor quality fruit.

The quality of Pink Lady and other susceptible varieties could be retained longer by storing them at a low but non-ripening inducing temperature. Storage temperature is also important for controlled atmosphere storage (CA). Storage at 2 ^{o}C is recommended when ultra low oxygen is used (<2%), but still few operators use this. There is a belief that the lower the storage temperature the better the result, no matter what. Fruit that have suffered chilling injury soften and yellow much faster after warming than if they had not suffered chilling injury during storage.

The new research project aims to determine if storing susceptible varieties in ultra low oxygen CA at 2 – 4 ^{o}C will prevent rapid ripening. If apples are stored at a slightly higher temperature then they won't be stressed and they will not be induced to produce ethylene. This will mean that the background ethylene level will also be lower and consequently the storage life of the fruit will be improved. The fruit will not be induced to ripen as quickly on return to room temperature and therefore the consumer shelf life will be extended.

The new research will be carried out over 2 seasons (2001 and 2002). Fruit will be harvested from the Orange district in 2001 and from Batlow in 2002. Three maturities of fruit will be tested. The fruit will be stored at 0 or 3^{o}C either under CA (<1.0 % CO_2 and 1.8 % O_2) or in air. The fruit will be assessed after 3 and 6 months storage. The firmness, presence of flesh disorders, extent of skin greasiness and internal ethylene concentrations will be measured.

This research will help to develop storage guidelines for Pink Lady and Fuji apples stored in air and ultra low oxygen CA that prevents the induction of rapid ripening, particularly in export fruit. These guidelines will ensure the consumer shelf life of these premium varieties.

Figure 1: Storage at 0^{o}C in air induces rapid ripening in Lady Williams apples.

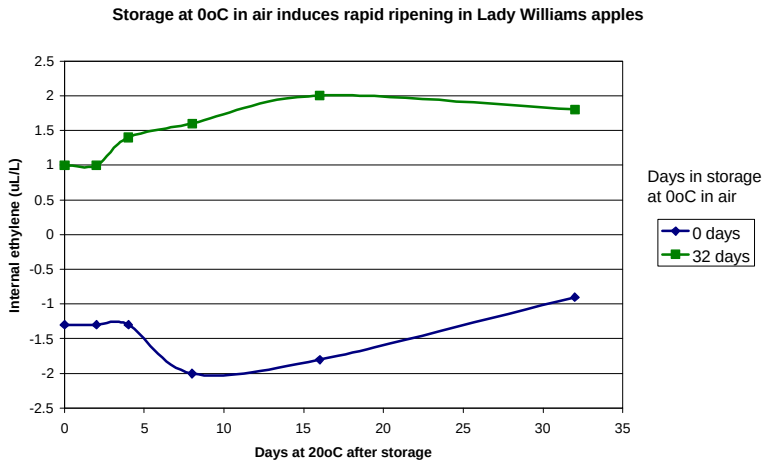
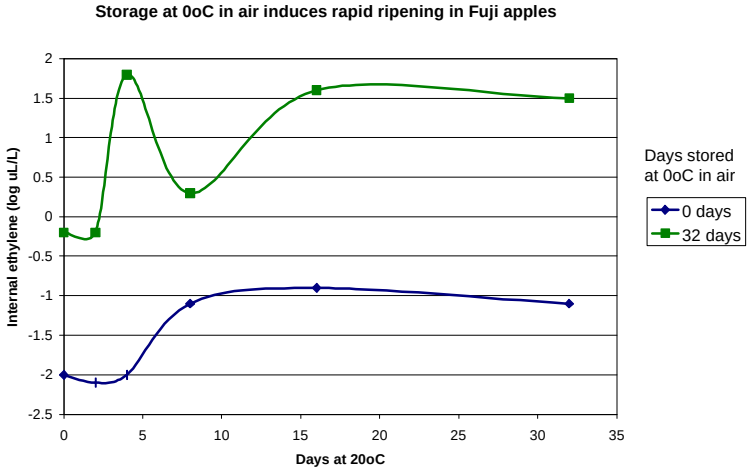


Figure 2: Storage at 0^{o}C in air induces rapid ripening of Fuji apples



References:

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Photographs are from Sydney Postharvest Laboratory Collection.

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