Focus Orchard update No. 5: Harvest Management

By Stephen Tancred, Orchard Services

Why is farm management so critical around harvest time? Because only an organised, informed and active orchard manager can get the crop off at an acceptable maturity and at an acceptable cost.

Three things need to be managed to get the best results; the trees, the environment and the people.

It is seldom a problem that fruit is picked too immature, but when it is, it can develop superficial scald in storage, not have enough colour to meet minimum standards or not have enough sugar for optimal taste.

Most management is designed to ensure fruit is not picked too late. The consequences of late picking include fruit that is not firm and won’t store well, fruit with a yellow background colour, or fruit that develops internal browning or other senescent disorders.

Managing the trees

A widely used harvest management tool is the plant growth regulator ReTain®. It is a naturally occurring fermentation product that slows ethylene production on the tree, which delays maturity and allows an increase in fruit size, and improves storage potential. When applied 21 to 28 days before the earliest harvest date all the beneficial effects can be gained. ReTain can also be applied seven days before earliest harvest to just improve fruit quality and storage potential of fruit.

I sometimes refer to ReTain as ‘heat wave insurance’. Application three to four weeks before the harvest of Galas and Red Delicious can slow or prevent the development of a yellow background colour and prevent fruit drop. Many districts in Australia have experienced two heatwaves this season and many Gala blocks not treated with ReTain are not suitable for marketing or cold storage as the ethylene production caused softening and/or yellowing before the fruit could be harvested. Often the growers were waiting for the development of red skin colour before harvesting fruit and the heatwaves provided the double whammy as hot dry conditions (day and night) have a negative effect on the development of red skin colour.

ReTain use is varied around Australia, mainly because it is perceived as a significant cost. Some orchardists only use it when they have a big crop and want to delay maturity to increase fruit size. Others use it when they have been experiencing a hot season (sometimes the horse has bolted by then). Other growers use it every year on specific blocks and use it twice on Galas in hot years and twice on Pink Lady™ when they are waiting for colour development.

As the proportion of highly coloured strains (eg. Brookfield Gala and Rosy Glow Pinks) grown on farms increased, I expected the use of ReTain to fall as growers could naturally do less picks and any yellow background colour was less noticeable. However, this has not been the case. As more of the highly coloured strains are being grown there are more being stored for later marketing and growers are opting to invest more in ensuring the highest out-turn quality by using ReTain and SmartFresh™ rather than letting just the high colour sell the fruit. But as always there is a variety of approaches to growing fruit and the use of plant growth regulators can add significant costs.

Another plant growth regulator used as an on-tree harvest management tool is the auxin NAA. It can prevent pre-harvest fruit drop, but it doesn’t slow maturity, so fruit softens and has a reduced storage life – especially if hot weather follows application. It is applied 12 -14 days before normal harvest timing but
the effect wears off, so a second, half strength application is sometimes needed. NAA is an important Stop-drop tool with pears and is becoming a standard part of managing the Jazz apple in Australia.

Some orchardists are using Ethrel to promote the ripening of fruit and to bring harvesting forward. This is particularly useful if fruit is already grown in an early district (eg the Riverland) and growers want to enhance that marketing advantage. I have also seen Ethrel used to advance the maturity of late harvested varieties when cold days and nights are delaying ripening. I even saw Ethrel salvage a Sundowner crop when birds were causing fruit losses but the fruit wasn’t red enough to harvest yet!

Ethrel will improve red fruit colour but the danger is that if too high a rate is used or hot weather occurs after application, other maturity characteristics advance too much, for example the conversion of starch to sugar and fruit softening, which can both reduce eating quality. Specialist early marketers have been known to use Ethrel, pick the fruit, then apply SmartFresh™ and then pack it straight away for fresh market. Ethylene is used to advance ripening then its production is quickly shut down to preserve quality through the marketing chain. There is also a stalk loosening effect from Ethrel so fruit drop is a danger if the harvest is delayed or high winds occur after application.

Managing the uniformity of harvest begins at thinning or beforehand. Dormex™ is a plant growth regulator used to even-up the emergence of flowers, which will even up the ages of fruit and hence their time of maturity. Targeting late blossom fruit at thinning helps fruit size but also evens up the fruit ages and reduces the number of harvests necessary.

SmartFresh™ is a plant growth regulator that stops ethylene production after harvest. It slows fruit metabolism, maintains firmness and greenness and improves storage potential. However, there is a new product with the same active ingredient being developed called Harvista™ that can be applied as a foliar spray to trees 7 to 10 days before the usual harvesting time. It will provide many of the benefits of SmartFresh™. Growers who attended the APAL conference at the Gold Coast in July were introduced to Harvista™ by Dr Nate Reed and those who attended the December APAL post-harvest seminar in Melbourne received an update from Brad Tukey. It’s an exciting future tool that will help growers improve the quality of their harvested fruit.

Managing the environment.

There are two approaches; speeding up the maturity or by slowing it down. Maturity is usually sped up to capture better prices from early markets. Increasing the amount of direct light reaching fruit by summer pruning will increase fruit colour and allow earlier picking. Reflective materials placed under trees also increase the amount of light that reaches fruit and leaves, improve light distribution and increase temperatures, which all advance maturity. The woven and re-usable Extenday™ product has pigments that maximise reflection of the most useful wavelengths of light and if put out early enough will also increase fruit sizes. There are several good, less-expensive, single-use plastic products that have a silver foil type appearance that also reflect light.

Slowing down the maturity is done by cooling the

![Figure 1: Reflective foil under Pink Lady trees is enhancing fruit colour in lower portions of the canopy](image)
environment and reducing the light that reaches leaves and fruit and is often associated with preventing heat stress and sunburn. Hail netting and bird-netting usually delay maturity by 3 to 7 days. Sunscreen products like Surround™ and Parasol™ are particularly useful at preventing sunburn on low coloured varieties eg Granny Smith and Pink Lady, and can also delay maturity slightly. Overhead misting irrigation is being used in the hotter districts to lessen the effects of heatwaves but hasn’t been observed to delay maturity – in fact the less-stressed trees are healthier and often have the ability to mature fruit on-time and in better condition.

Managing the people

At present the majority of the Australian apple crop is not harvested by Australians but by overseas back-packers. This has its challenges; farmers often have to help with transport and accommodation, language barriers can mean slow training, pickers may only stay for part of the season, and if government policies change, the supply of pickers is not assured.

There are significant benefits to growers and workers if the seasonal workers can return to the same industry or farm in the following years. New Zealand has a very good scheme to facilitate this with 8,000 Pacific Islanders participating in its Government sanctioned scheme. Australia piloted a similar scheme from 2009 to 2012 and 1,623 Pacific Islander workers participated. Interestingly some 82 % of all the workers came from Tonga. Only 337 of workers returned for more than one season but the industry is hopeful that the scheme will grow. By comparison the Working Holiday Makers (backpackers) provide most of the seasonal labour. In 2008 there were 5,684 such workers in horticulture (mostly from Korea, Germany, UK and France). The Pacific Islander scheme was highly regulated and had as a core principle that Australian workers not be displaced. By comparison the backpacker workforce has very little Government involvement other than the issuing of working Visas and market forces seem to sort out the rest of the arrangements.

As farms get bigger and the list of varieties grown has got longer, the harvest period is now a much larger part of the orcharding year than it used to be. This in itself leads to stresses in managing the workforce as what was a 10-12 week harvest period is now 14 – 22 weeks depending on the varieties grown. An unexpected twist to the growing of Pink Lady and Sundowner apples is that they are harvested in late autumn and early winter which is exactly when the backpackers want to move onto warmer climates!

Harvests are never going to be easy as more than half of Australia’s orchards are planted with Gala and Pink Lady and these are both multi-pick varieties. Often this is due to variable and extended flowering which in-turn leads to a wide age range of apples on trees and inevitably a range of maturities and an extended harvest season.

Red Delicious apples usually have a more compact flowering (sometimes too compact to ensure good pollination weather/bee activity) which means most of the apples are of the same age and mature together and harvesting them is more efficient and quicker than for Galas and Pinks. For about 20 years after the introduction of the highly coloured strains of Red Delicious the main problem was they were
picked too green and had good texture but low taste. In most cases this was a risk management decision as Red Delicious is a high ethylene variety and harvest problems can develop if fruit starts to mature on the trees too quickly. An over-ripe Red Delicious is a pretty bland item and it was better to store and market a firm bland apple than a soft sweet apple. However, the use of the anti-ethylene plant growth regulators (ReTain and SmartFresh™) has seen a global resurgence in the quality of Red Delicious, and a maintenance (and growth in the USA) of their market share. Unfortunately in Australia the prices paid for Red Delicious is becoming consistently lower than for other varieties.

Monitoring maturity

Judging optimal fruit maturity is an elusive beast! There are six indices commonly used; starch, sugar, skin colour, skin background colour, firmness and seed colour but the difficulty is that the six don’t always correlate. When asked for the most important maturity indicator the late Colin Little always said starch for storage and sugar + skin colour for fresh market. Colin and Robert Holmes’ book “Storage Technology for Apples and Pears” is still one of the best reference texts in the world, and is a must read for every orchardist and cold store operator.

Starch converting to sugar is measured by cutting and staining apples with an iodine solution. All that is required to monitor this conversion is a knife, a cutting board (or the tray of the ute), a squirt bottle of iodine solution and the interpretation chart. The most common rating scale used in Australia is the one with six categories as represented on the SmartFresh™ maturity indices poster that most cold store operators have.

The optimal starch pattern for picking for storage is between 2.5 to 4 for most varieties, but because of the vagaries of the warm Australian climate, the variation within trees and the logistics of harvest, a lot of fruit for storage gets harvested at a starch plate of 4 to 5. Picking forward fruit increases the importance of good temperature, atmosphere and ethylene management during storage. Starch slowly converts to sugar and other carbohydrates as the apple ages and the initial amount of starch is an indicator of the “energy in the fuel tank” of the apple, or in other words its storage potential. AgFirst have created a good webinar on apple maturity
monitoring that can be viewed on the “Future Orchards” website.

Getting through harvest requires orchardists to;

- Be attuned to their trees and make the right decisions on applying plant growth regulators, laying reflective mulches, monitoring fruit maturity indicators (particularly starch) and knowing when to start picking.
- Be a human resource manager who can coordinate and train people with a range of languages, sort out accommodation and transport issues and can keep up with visa, immigration, tax and superannuation changes.
- Be a meteorologist who can predict heatwaves and an engineer who can alter the orchard environment.

No one said it was easy......