

Future Orchards Article for the Australian Fruitgrower November 2012

Crop Loading – The Key to an Easy Harvest

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It is estimated that if one considers pruning, pest and disease control and hand thinning costs to be orchard fixed costs rather than variable costs related to production volume then the fixed or overhead costs account for between 70 and 80% of the on-orchard cost structure. This being so, then the most effective way to reduce production costs is to maximize yield of marketable crop.

The value of this crop is also a key to orchard profitability, so one has to also bear in mind that both yield and fruit value are equally important when it comes to setting the production policy for an orchard block.

By now, flowering is over, the bees and chemical thinners have done their work, so the natural fruit shedding should be well underway and when finished leaves the crop that the tree will take through to harvest. This “final” fruit set needs to be carefully assessed to determine the hand thinning requirements to enable a top quality crop to be harvested.

Figure 1: If you get lucky, a chemical thinning job should look like this. This block did not need much hand thinning, but it is the exception. Usually significant hand thinning is needed



Figure 2: This is a more typical chemical thinning result. Hand thinning is needed to break up bunches and space fruit.



Unless you have been extremely lucky with your chemical thinning, and have experienced very favourable growing conditions to date, it is probable that the fruit set and resultant crop load is in excess of the level that can be carried through to harvest to deliver a crop of optimum quality and fruit size for your market.

Fruit quality, in terms of fruit size, colour and internal specification is generally determined by the crop load and resultant fruit to leaf ratio.

Excess crop load delays ripening, dulls down colour development and has a very marked adverse effect on internal quality parameters such as soluble solids.

Even though a lot of the damage to return bloom caused by excess crop load has already been done by the time of hand thinning, there is still a chance to improve return bloom if varieties or blocks with high biennial bearing risk heading for an “off” crop next season are aggressively hand thinned as soon as possible.

Prioritise Your Hand Thinning by Variety and Block

Regression analysis of the fruit size relationship with crop load usually has an r^2 of between 0.7 and 0.8, which means that crop load accounts for between 70 and 80% of the difference in average fruit size among trees in an orchard.

Initial fruit set and speed at which the surplus fruit is thinned off has a huge effect on fruit size at harvest.

As a general rule, then, hand thinning needs to target the heavy set blocks, or those blocks that have a history of small fruit for hand thinning priority ahead of “off” crop blocks, those blocks which have responded well to chemical thinning or varieties such as Cripps Pink strains where large fruit size is often a problem.



Figure 3: The large apple on the right is from a terminal shoot bud. The small apples to the left are lateral bud of one year wood fruit that should have been thinned off.

Varieties differ in their fruit sizing behavior too. A few years back Dr Keith Jones generated data to show that Fuji was very sensitive to initial crop load and this data shows a 10 gram reduction in harvest fruit weight for each week’s delay in bringing the crop down to optimum crop load. Braeburn fruit size, on the other hand, is not particularly affected in regard to crop load until three or four weeks after flowering.

Short stemmed varieties that are inclined to close up their bunches, making hand thinning difficult, also need to be thinned early before the bunches close and hand thinning becomes more difficult. Varieties

which are slow to respond to chemical thinners, such as the Gala group, or generally have large, late natural fruit drops are best left until the natural fruit drop is over before attempting to hand thin them.

In districts which experience high temperatures early in the season that could burn recently thinned exposed fruit, the fruit thinning should be done early when risk of sunburn injury to freshly thinned fruit is low.

Thinning Strategies

Not all fruitlets are created equal in regard to their fruit sizing potential. This fact needs to be recognized when it comes to hand thinning.

As a general rule, the fruitlet arising from the “king” flower in the bunch will be the largest fruit. Among buds there is also a sizing potential hierarchy. The fruiting tip buds of short annual growths usually grow the largest fruit, followed by well-positioned dominant spur buds which have received ample light exposure last season. Auxiliary (lateral) buds of last season’s annual growth has the smallest fruit sizing potential and also most likely to have excess russet. In some varieties this one year lateral bud wood fruit can be as much as 30% smaller than terminal bud fruit.

In the perfect world, thinning fruit down to well spaced singles gives highest potential quality, particularly in regard to fruit colour and will make for an easy harvest. This should be the thinning strategy where fruit set has the numbers and distribution to enable this to be done without compromising yield.

Often there are insufficient good fruiting sites to allow this strategy to be followed, in which case it is necessary to carry some doubles on good sites, such as terminal buds with bourse shoots. Even if it means having to carry some doubles to make up fruit numbers, it is still very sound strategy to thin off all lateral bud one year wood fruit, as well as fruit from weak, shaded spurs that will not colour or size well.

Thinning by Fruit Size

At about 42 days after full bloom (DAFB), it is possible to predict fruit size potential from fruitlet size. Hand thinning, therefore, can become selective and target the removal of the smaller sized fruitlets.

Growth curve data which can be found on AgFirst’s OrchardNet™, gives a good picture of fruitlet growth by variety and enables fruit measurement data to be compared among different orchard blocks and previous seasons if you have entered historical fruit sizing data into the database, and compares block data with state or national averages.

These growth curves show average fruitlet size by either calendar date or DAFB for the block being measured, and size curves for average fruit size at harvest. Weekly fruitlet growth rates are also calculated.

If we look at Royal Gala sizing in Victoria last season (2012 harvest year), weekly fruit growth rates peaked at around 25 DAFB when the fruitlets were growing at about 5 mm per week, then apart from a

marked drop in fruit growth rate over a ten day period from 48 to 60 days after which the growth rate returned to the established trend line again, fruit diameter dropped steadily from its 25 DAFB high point down to around 1.5 mm per week close to harvest. For this variety, weekly fruitlet growth rates over the hand thinning period were in the range of 3.5 to 4.5 mm per week, so if you were thinning by fruitlet size your fruit size to thin up to would need to be lifted by about 2 mm every 3-4 days to compensate for fruitlet sizing.

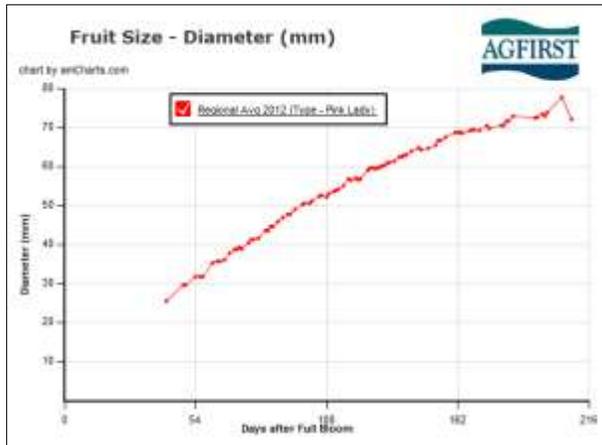


Figure 4: 2012 Cripps Pink growth curve for Victoria.

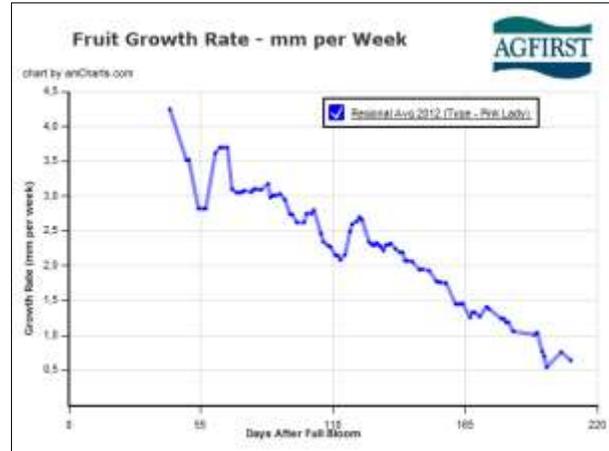


Figure 5: 2012 Cripps Pink fruit growth rate, mm per week, for Victoria.

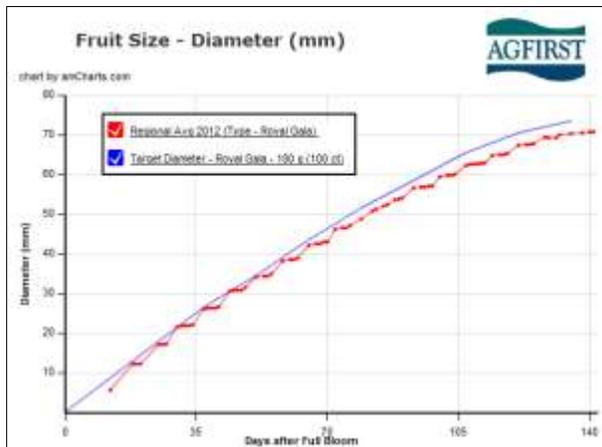


Figure 6: 2012 Royal Gala growth curve for Victoria.

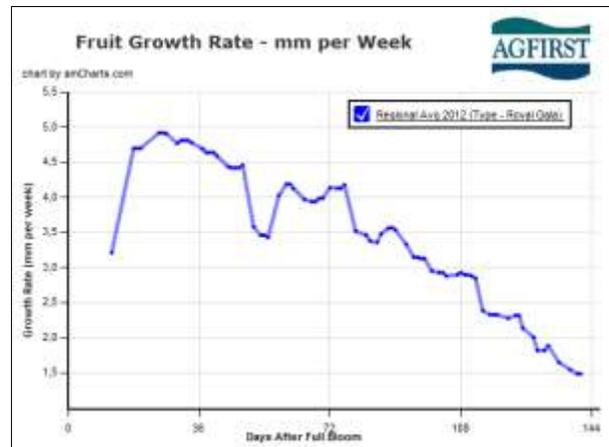


Figure 7: 2012 Royal Gala fruit growth rate, mm per week, for Victoria.

Cripps Pink, a variety with a long growing season, has a very similar average weekly fruit sizing profile to Royal Gala, except that it runs about 1 mm less. At 42 DAFB average fruit size for this variety is likely to be around 25 to 26 mm, whereas Royal Gala at this stage of development are 1 to 2 mm larger.

Variable Crop Loads

One crop load problem, which I have seen all over the world, is within block tree to tree variation in crop load. As a general rule, low tree vigour, or variation in pollination levels, tend to be responsible for this variation. Where tree vigour is weak, or fruit set particularly strong due to plentiful pollen supply, the chemical thinning programme removes less fruit. Consequently, there is more to be thinned off to bring fruit numbers down to desired crop load.

Unless very well supervised, hand thinners seldom take enough fruit off heavy set trees.

In this situation, the thinning strategy has to be down to spaced singles.

The Double Pass Option

With higher value varieties, or varieties prone to biennial bearing in their on-crop phase, or varieties with late emergence of russet expression, a quick first thinning pass to bring crop load down to within 80% of final crop load followed by a later crop grooming pass to tidy up the crop by removing small, misshapen or blemished fruit is a good strategy. It is also a way of spreading some of the harvest labour requirement into the pre-harvest period.

The strategy with strongly biennial varieties in the initial thinning pass should be to focus on clearing sites to improve the chances of return bloom there next year. Clearing at least two out of three sites, even if this means carrying the crop as well spaced doubles is sound strategy. The ideal situation, however, is to bring the crop down to singles, if fruiting site numbers allow it, so that it is possible to do a later crop grooming pass without having to break up bunches and expose the singled fruit to sunburn risk.



A double pass option is also a good strategy in situations where irrigation water supply could become limiting later in the growing season.

Figure 8: This bunchy crop should have been thinned before the hot weather arrived. If you try and thin it now, there will be a lot of reject fruit from sunburn injury.

The objective of the initial thin is to set an optimum full crop load on the assumption that there will be sufficient soil moisture supply available to carry the full crop through to harvest. Then, later in the season, if soil moisture becomes limiting, re-thin by fruit size and target exposed fruit likely to suffer sunburn injury to bring the crop load down to a level that the tree can handle in a water stress situation.

Bringing crop loads down to around half normal crop loads when the trees are under water stress has been shown to still produce fruit of satisfactory size.

Regular fruit size monitoring through the growing season will detect if fruit sizing is beginning to stall on a particular block due to excess crop. Where crop loads are excessive, fruit sizing can stall around 90 DAFB. Benchmarking your fruit sizing with other orchards will indicate if the slowed rate of fruit sizing is general and likely to be due to adverse climatic conditions such as high temperature stress, or just peculiar to your orchard block, which would indicate a block specific factor such as crop load or localized water stress.

If fruit sizing stalls due to overcropping and immediate re-thin by fruit size, taking off small, low value fruit, will restore fruit growth on the remaining fruit and allow the crop to finish out well.

Figure 9: A late thinning pass near harvest presents an opportunity to thin off reject fruit such as this apple with excess russet.



Measure and Monitor

Keeping track of what is happening to the growing fruit crop is the key to growing optimum crops of high quality fruit.

This involves setting realistic crop loads which in mature orchards can be based on historical yield, fruit sizes and quality performance if there is good data available.

In younger orchards with rising yield potential trunk cross sectional area (TCA) or branch cross sectional area (BCA) gives a good guide to cropping potential.

The Future Orchards 2012 database contains good data on yield curves by tree age that has been collated during this project.

Pre and post-thinning fruit counts are essential to enable crop loads to be fine-tuned by hand thinning, and regular fruit size monitoring later in the growing season will give early warning of the need for further proactive management to adjust crop load, or step up irrigation supply.

Once crop load has been determined, a few trees counted to confirm trees are carrying the correct crop load, and a thinning strategy set in regard to fruit spacing it is not necessary to continue to count whole trees, but there is still a need to closely monitor the thinners. Random counts on branches and attention to fruit spacing on these branches can be done relatively quickly and will confirm whether or not a good thinning job is being achieved.

Unless the thinning job is being carefully monitored across all thinners, it is quite easy for significant variation to occur among thinners. Remember at best 20% difference is the minimum that can be readily identified by eye. A 20% difference in crop load can result in a 10% average fruit size difference by harvest.