

Future Orchards Article for the Australian Fruitgrower November 2011

Setting the Optimum Crop Load – The most critical step in maximizing orchard profitability

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The Futures Orchards goal in 2011/12 is to “Grow High Quality Fruit at an Internationally Competitive Price”. There are many requirements of the orchard business to achieve that goal and no one believes it will be easy, but it is possible and it’s a great goal to aim for. The Future Orchard walks in November 2011 will break the goal down and develop some specific targets that growers can aim for.

One of the key factors in achieving the goal is to set the “optimum crop load” of every block of trees in the orchard. The optimum crop load will be specific for every grower and every individual block of trees. So how do we define what is “Optimum” in the first place? My definition of optimum crop load is the number and spatial arrangement of fruit that delivers:

- a. The best block profitability
- b. Ensures that the following years crops are not jeopardized.

Background Understanding

To maximize profitability, the most important thing that you can do with each block of trees is to maximize the 3 P’s: production, packout and price. The grower must do everything in his/her power to achieve the best balance of all three parameters. What makes it challenging is that the three parameters are inter-connected; hence the art is in finding the right balance.

To maximize gross production the more fruit you put on a tree the better. However as gross yield increases past the optimum point, there are negatives that become more significant as the gross yield gets higher. These include fruit size, colour, pressure, brix, late harvest, biennial bearing and tree growth. The first five of this list impact on packout and price and the last two on next year’s gross yield.

The consumer is looking for colourful, firm, crisp, juicy apples of good flavour, the latter being determined by the sugar acid balance. They want a good eating experience. It’s not possible to deliver this quality of fruit if it is grown on over-cropped trees and harvested late because you had to wait for fruit colour and brix to come up.

Specific crop load has a profound effect on all of the key quality parameters as Table 1 shows. It also determines fruit size and, time of harvest as well.

Variety	Specific Crop Fruit /cm2	Brix	Fruit Pressure
Royal Gala	9.25	10.9	-
Royal Gala	5.07	12.2	+0.5 kg f
Fuji	12.7	12.5	5.9 kg f
Fuji	8.2	14.7	6.3 kg f
Pink Lady	15.38	13.36	73.44 N
Pink Lady	5.52	15.23	86.69 N
Braeburn	Regular crop	10.9	9.6 kg f
Braeburn	Light crop	11.3	9.8 kg f

Table 1: Effects of Crop Load on Pressure and Brix

High specification fruit needs to be harvested at optimum maturity for good long term storage. With supermarkets demanding higher and higher colour specs there is the tendency to harvest too late, so we need to grow a crop which will meet colour specifications before its internal maturity moves much beyond the ideal long term storage range, typically SPI 1.5-3.0 on the 6 point scale.

With most varieties, fruit size has a large bearing on fruit value. Very simply there is no merit in growing a large crop if the fruit size grown means it is only suitable for a Class 2 market. If it is better fruit size you are looking for, there is a basic rule of thumb which says for a 10% increase in fruit size, fruit numbers need to be reduced by 20%. Each grower must have a very good understanding of the likely returns by size as this knowledge is fundamental in determining the “Optimum Crop Load”.

The crop you carry this year can influence the crop you can carry next year and for many years thereafter. In a young developing tree, the higher the crop load the lower the extension growth. In a young block, maximizing extension growth and developing the canopy to ensure it is capable of high future crop loads is imperative.

All varieties, but more so the varieties with biennial bearing tendencies eg Braeburn, Red Delicious and Granny Smith are prone to setting light crops next season if the crop load is too high this season.

Defining “Optimum Crop Load”

So now that were armed with the necessary background knowledge, what is the best way to define the optimum crop load. As we have discussed in previous Future Orchard walks there are two techniques that you can use.

One is use the history of the block, and select the target for 2011/12 using the blocks history, and your knowledge of the market requirements. As an example of this technique, Figure 1 below is a block of Fuji. The yellow line is the gross production and the blue line the Class 1 production (kg/ha). The data quite clearly shows that the 2008 crop of 92 tonne/ha was the highest gross crop but the best Class 1 crops were achieved at between 82 and 85 tonne/ha i.e. 2004 and 2007. Also notice that being a biennial variety, the 92 tonne/ha crop in 2008 resulted in the trees going off in 2009. Clearly the tipping point has been identified. Based on all that history, the optimum crop load has been identified on this block at 85 tonne/ha gross and 60 tonne/ha Class 1.

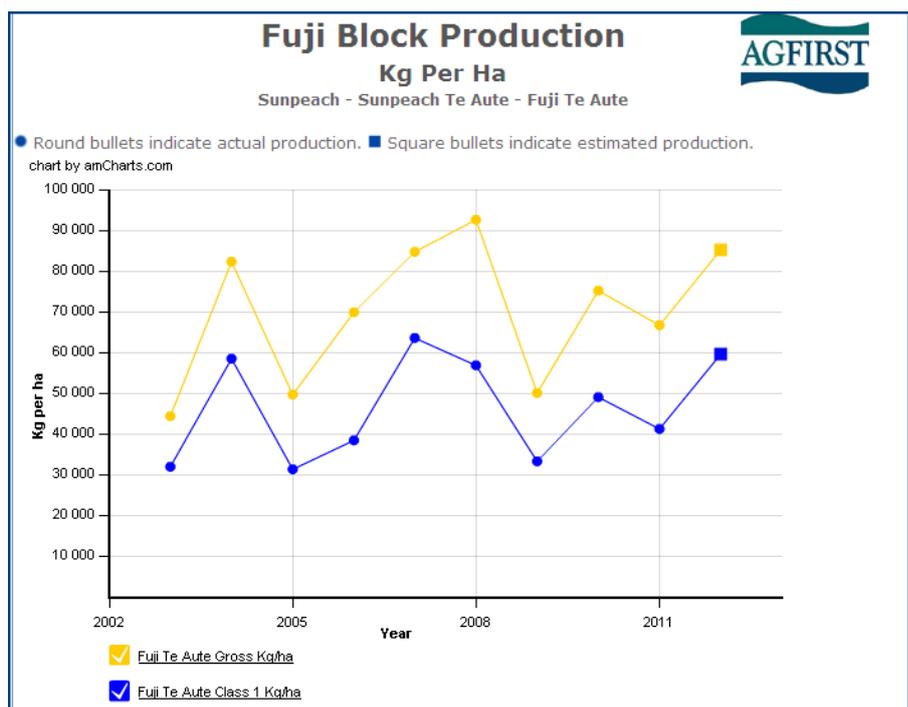


Figure 1 Fuji Home Block Historical Production (kg/ha)

The second technique is to set a target fruit number based on the tree size as measured by the trunk cross sectional area (TCA). This is very useful on young blocks but to be able to use it with real accuracy also requires good knowledge on crop load/cm² on your property or at least your district.

Table 2 below gives suggested crop loadings for trees by variety and rootstocks. Where further tree growth is required crop loads at the lower end of the range shown are required. The fruit no per TCA only works on trees up to a certain age. Once a tree reaches maturity, its trunk continues to grow but its cropping potential remains constant.

Fruit number per Branch Cross sectional Area (BCA) however is a technique of setting crop loads on any age of tree. This technique (which will be demonstrated at the upcoming Future Orchards walk), works best on branches that are not too big and are not overly modified by pruning.

Variety	Rootstock	Fruit No/Trunk cm ² (TCA)	Fruit No /Branch cm ² (BCA)
Royal Gala	M9, M26	7 to 10	4-5
Royal Gala	MM106	4 to 6	3-4
Pink Lady	M9, M26	8 to 12	4-6
Pink Lady	MM106	6 to 8	3-4

Table 2 Fruit targets per Trunk Cross sectional Area (TCA) and Branch Cross Sectional Area (BCA)

Table 2 is a guide only. Targets need to be fine-tuned for individual properties.

The Witchell Monitor Block (VC40) that we used as a demonstration block last year (Figure 2) is a great example of how well this technique can be used. This Galaxy block is on M26, 1587 trees/ha, planted in 2006. Its early yield accumulation has been typical of the Australian Upper Quartile (see Figure 3 below).



Figure 2: VC 40 just prior to harvest Feb 2011

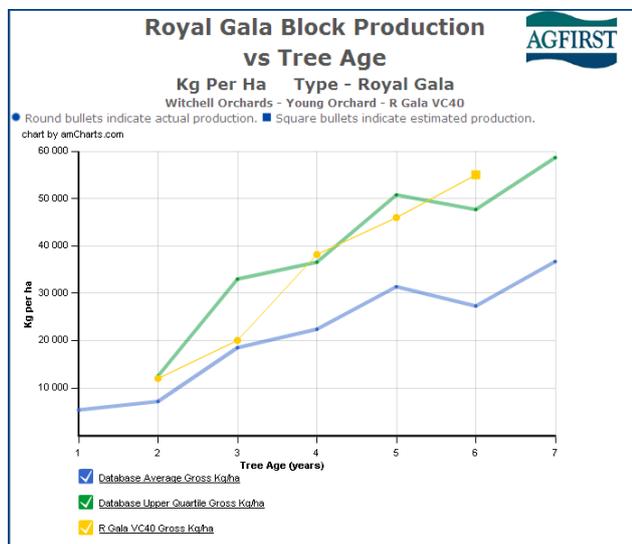


Figure 3: VC40 Yield Accumulation by tree age

Throughout this block's young life, Shaun has been measuring the TCA and was therefore able to calculate the harvested fruit number per TCA since the block started cropping. Figure 4 below shows the last 3 years actual crops and Shaun's "Optimum Crop Load" forecast for 2012.

Company: Witchell Orchards Property: Young Orchard Block: R Gala VC40										
Thinning Report Season Ending 2012										
Blockname	Ssn	Gross Kg/ha	Class1 Kg/ha	Fruit Harvested Weight (g)	Fruit /Tree	TCA Harvested /TCA	Tree Pickout %	Target Fruit/Tree post-thin	Actual Fruit/Tree pre-thin	Actual Fruit/Tree post-thin
Young Orchard										
Royal Gala										
R Gala VC40	2012	55,000	46,364	181	191	16.0	12.0	95	202	-
	2011	46,000	40,480	181	160	13.5	11.9	95	169	-
	2010	38,200	32,088	179	134	11.0	12.2	95	142	-
	2009	20,000	17,000	168	75	7.5	10.0	95	79	-

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Figure 4 Thinning Report for VC40

Note that in the last 2 years, the harvested crop has been stable at 12 fruit cm² of TCA. At this level the fruit size has been maintained at a 180gm average and the fruit quality attributes of colour, brix and pressure have been ideal (Figure 5). Based on this knowledge Shaun has real confidence that in 2011/12 he should set the trees up again at 12 fruit/cm². Because the trees are increasing in canopy and trunk size that means the overall crop load can increase to 55 tonne/ha with confidence.



Figure 5~ VC 40 ~ 2011 harvest

How well the hand thinning is done can have a big impact on crop out-turn. It is not sufficient to thin to the right number of fruit per tree, you must also thin to the best fruit, and spatially arrange them to achieve optimum quality.

At harvest the easiest crops to manage will be those that have been properly thinned. In the perfect world, thinning down to singles with fruit evenly spaced far enough apart so fruit does not touch over the whole tree will give the best result. In the real world, this objective is usually difficult to achieve and often doubles and sometimes triples are required.

Target the Right Fruit

We learnt from the PIP's researchers in June 2011, that the best fruit is fruit growing on strong spurs and terminals, which receive at least 50 to 60% of ambient sunlight exposure. Therefore we want to maximize this fruit position and minimize the amount of fruit carried on inferior lateral bud of 1 year wood. With Gala, lateral bud one-year wood fruit can be 20 g to 30 g smaller than good spur fruit.

There is a lot of research data to show that by 50 to 60 days from full bloom, relative fruit size at harvest of individual fruits within the crop can be seen. Smaller fruit at this stage of development is likely to still be small by harvest. Likewise large fruit will be large at harvest. Thinning by fruitlet size when it's done well with good supervision will go a long way towards grooming the crop into the optimum size range.

Hand Thinning Priorities

Thinning priorities need to be set for each variety block. Where chemical thinners have worked well, hand thinning of these blocks can take a lower priority than those with heavier crop loads.

Long stemmed varieties with heavy late natural fruit drop, such as Royal Gala should not be hand thinned until after the natural fruit drop. Short stemmed varieties, such as Cox Orange, bunchy Braeburn and Fuji need to be given thinning priority because the job becomes very difficult once the bunches close up and tighten.

Fruit which has been well exposed for its whole growing season to light becomes "conditioned" to higher temperatures and will develop much less severe sunburn than fruit suddenly exposed in midsummer when temperatures are high. This is a major reason for early hand thinning in high-risk sunburn varieties.

Dr Keith Jones working with Fuji in Tasmania showed that for every week delay in hand thinning between full bloom and 56 days after full bloom (AFB), fruit size at harvest diminished by 10g. Where hand thinning was delayed beyond 49 DAFB, return bloom was also affected.

"On crop" biennial bearing varieties suffer poor return bloom if hand thinning is delayed beyond about 50 days AFB. This means your "on" crop Red Delicious need to be down to crop load by seven weeks after full bloom.

Launch into hand thinning as soon as you are sure that the chemical thinners have done their job. Where flower levels are marginal for an economic crop, dropping the chemical thinning program altogether so that the hand thinning can be started straight after bloom is an option worth consideration.

Thinning of russet sensitive varieties can be delayed until the russet becomes obvious. However, where crops are heavy a general hand thinning may be needed prior to russet appearing to be followed up by a cosmetic thin in the New Year.

Get the Thinning Message Simple

All very well to use your knowledge and science to derive the optimum crop load but that's only 20% of the job done. The real hard part is to turn your theory into a very simple instruction that the thinner can follow easily. Thinning Monitor trees prior to the thinners getting anywhere near the block is critical. This allows you to do the counts and come up with that nice simple instruction, hopefully in 6 words or less.

Quality Control

Thinning as we all know is a difficult job to maintain attention for an 8 hour day. Thinners will tend to drift and before you know it you'll have one row with 600 fruit per tree and the next row with 300 fruit per tree. Quality control to ensure the job is kept close to target and is consistent across the block is critical to the success of the block.

The person in charge of quality control needs to have a good appreciation of how to judge fruit numbers and quickly identify if someone is moving away from target. There's nothing a thinner hates more, than being pulled back to redo a row particularly if they're on a piece rate.

Counting the odd complete tree can help give the QC confidence. Being able to relate the branch cross sectional area to a fruit no is also a very useful quick QC check that the job being done is of a high quality.

Follow-Up

These techniques and many others will be discussed in the field at the Nov 2011 Future Orchard walks. We hope to see you there.

Most of the reports used in this article are taken from the OrchardNet system. This is available to growers registered with the Business development program through APAL. Contact Jesse Reader at the APAL office if you're interested.