Future Orchards – November 2010

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AgFirst

Growing for your Market

The overall theme of this year's Future orchards program is "Growing for your Market".

The orchard business is basically built on individual blocks of trees. The orchardist will optimise the overall business if each block is optimised. This article discusses target setting, looks at some of the key decisions being made on-orchard at this time of the year and suggests ongoing monitoring to finetune your crop as the season unfolds.

Identify the Market requirements for each block

To be able to optimise each block of trees, we first need to identify the market requirements of the variety block. Most orchardists will have an established marketing system. It is imperative that there is a very clear understanding of what that market wants and, in particular, what they are likely to pay for in the coming season. The various fruit attributes that we need to quantify include:

- Fruit size
- Foreground Colour
- Market Timing
- Eating Quality (soluble solids and fruit pressure)

Every orchard and every block will have its own unique requirements. The skill is to identify them early and then have the ability to maximise profit by supplying your market with the fruit they are prepared to pay good money for.

Figure 1: VC40 - February 2009

In this article we are going to use a case study to illustrate the points. Monitor Block VC40 is a Royal Gala block owned by Brian and Shaun Witchell in Southern Victoria (APAL). Shaun and Brian know their market intimately, so have a very clear understanding of the fruit attributes required to maximise return and hence profitability.

With the Gala variety they know that they can consistently achieve $10 per 12 kg box more value for a count 100 (180 g) Gala than a 120

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count (150 g) Gala. Very clearly, VC40 will achieve much better block profitability if the final fruit size averages 180 grams rather than 150 grams.

As with many Australian fruit markets, the Witchell buyers desire and will pay for high colour Gala. Anything less than 80% foreground colour is likely to be discounted. The reason they planted a good strain was to ensure that this high-colour demand was able to be met naturally in most seasons.

The market timing is at both ends for VC40. Not being the earliest Gala block on the orchard and needing fruit for long term storage, the natural harvest date is fine. They will take the first pick for the early market and put the second pick into long term storage.

Being very close to their market, Brian continually receives feedback on the eating quality of his fruit. Maximising Brix and pressure and, indeed, all eating attributes is a must if they want to retain their loyal buyers.

Fruit Size

Your market will pay different values for different sizes. Very rarely do you experience a market that has a flat payment curve by size. The challenge for the grower is to identify the likely returns by size and then grow a crop that maximises the proportion of the crop that achieves the best margin.

Fruit size is driven predominantly (but not entirely) by crop load. As a general rule, a 20% reduction in fruit numbers will increase fruit size by 10%.

Factors other than absolute crop load that can impact on size include:

- reducing to the optimum cropping level as soon as possible
- maximising the position of the fruit on terminals and good spurs
- removing poor 1 yr lateral bud fruit
- thinning to fruit size (the fruit with the largest potential will be the largest fruit at thinning)

Fruit Size Monitoring is a great way of checking your progress throughout the season and finetuning management to ensure you stay on target (weather and season permitting) The Future Orchards (FO) program this year is moving away from the Monitor Block concept to a Business Development Model. Growers who elect to be part of the program will be tracking fruit size of a number of blocks and will be able to compare their fruit size against:

1. Any previous year data
2. Regional average
3. National average
4. Target lines

Shaun monitored his fruit size weekly on VC40 last year and is doing so again this year. The following two graphs show progress to date (NB No regional or national averages were available at the time of writing).

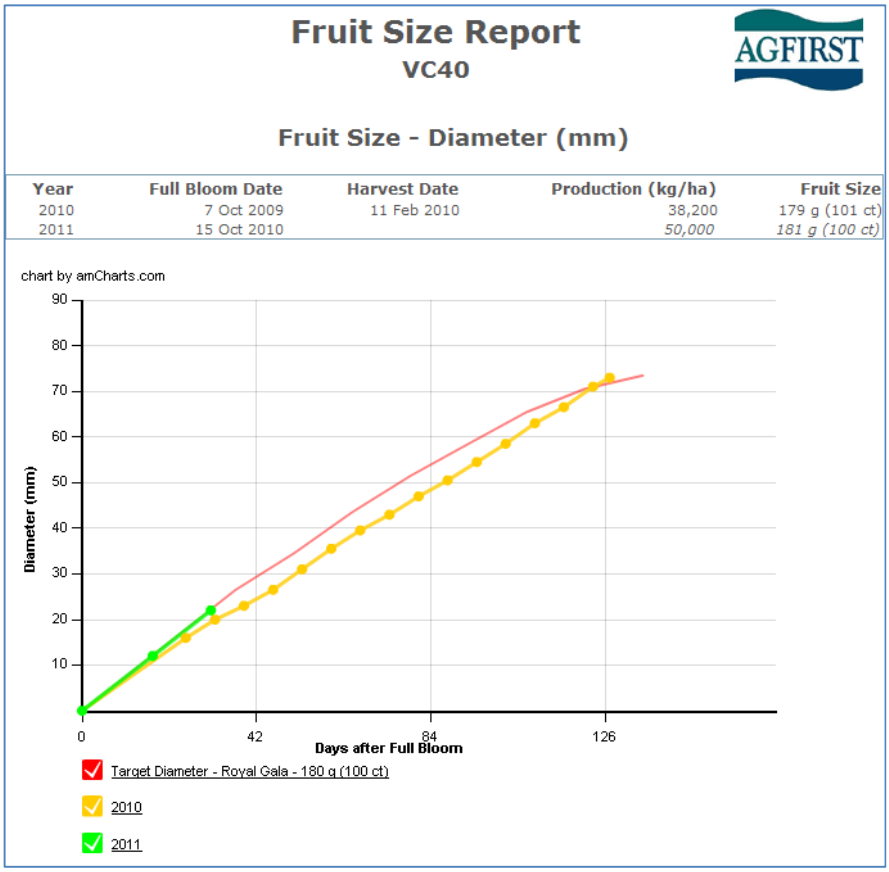

Figure 2: Fruit size report

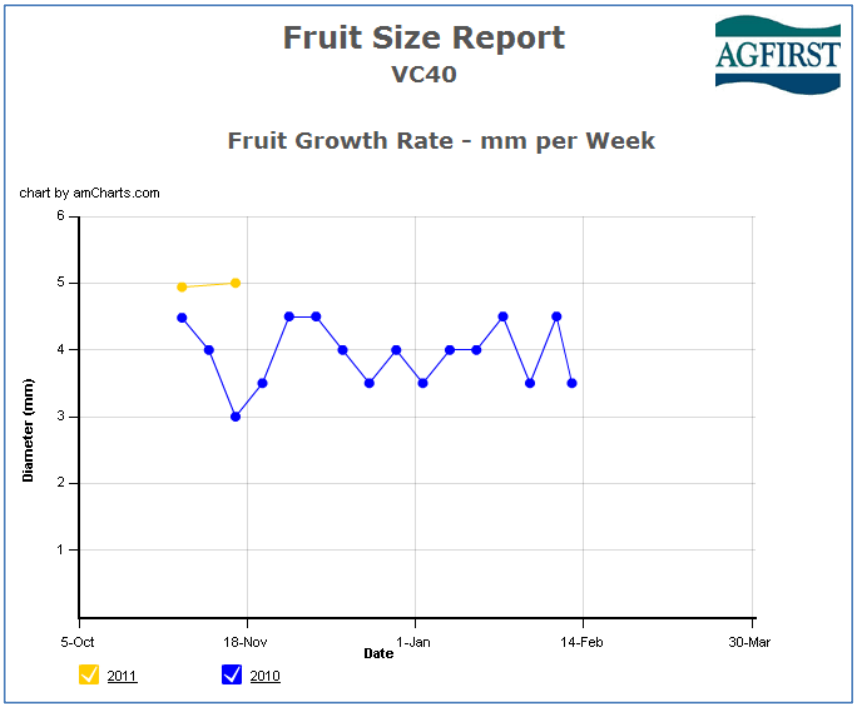

Figure 3: Fruit growth rate report

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Current season monitoring shows VC40 has made a good start and is currently on track to achieve the desired 100 count average. Hand thinning will aim to achieve a crop load of 12.9 fruit/cm^2 (50 tonne/ha). Fruit size monitoring will continue weekly on the same 20 fruit every week and Shaun will act if he can see growth rates are dropping.

Through past experience, Shaun believes he can manipulate fruit growth rates with supply of both water and nutrients through the irrigation system. In addition if fruit size drops below an acceptable level at mid-December he will consider a second hand thin, and if things are poor in mid-January he will consider the use of Retain to get another 7-10 days sizing.

For any grower that would like to participate in the Business Development program please contact Richard Hawkes at APAL or AgFirst (deanna.corbett@agfirst.co.nz)

Colour

Most Australian markets pay premiums for good fruit colour.

The colour of the skin is an important quality attribute of most varieties. Colour development is in principle genetically determined but, in addition, cultural and environmental factors play a significant role in degree of expression.

Replacing the lesser-coloured apple varieties with better, high-coloured strains, e.g. Rosy Glow, Buckeye and Brookfield Gala, will have the greatest impact on colouring in the orchard and are clearly the good long term option. However most orchardists are unable to afford the cost of full scale redevelopment and therefore need to use all techniques available to maximize fruit colour on many existing blocks. Marcel Veens paper (Veens, 2009) on the FO website is another great read on fruit colour.

For a number of fruits, such as apple, peach and pear, direct light is required for anthocyanin synthesis. This means that good pruning and thinning are critical to ensure the bulk of the fruit are grown in sufficient light and are not carried excessively in bunches where inter-fruit shading can prevent colour development. To get the required light on the fruit, some form of vigour reduction is also often necessary and sometimes summer pruning or even leaf stripping is necessary on more vigorous trees.

Leaf number per fruit is an important factor involved in colour development in the apple skin. A sufficient accumulation of sugars in or near the fruit is essential. At least 25 to 40 leaves per fruit (depending on the variety) have been found to be needed for the production of high-quality, high-coloured fruit. An excess Leaf Area Index is also negative, as explained by Middleton (Middleton, 2007)

With respect to light quality it has been shown that ultraviolet light and blue violet light are important for fruit colouring. The usefulness of ultraviolet light explains the production of well coloured fruits at higher altitudes. The usually lower night temperatures at greater altitudes can also favour blushing due to lower respiration rates during the night preserving the carbohydrate and athocyanin buildup. In hot climates, night temperature cooling with sprinkler irrigation has been shown to be effective. The combination of sunny days and cold nights during the period shortly before harvest is particularly important in stimulating red

colour development. This is proven in research done under controlled environmental conditions on apple trees.

High nitrogen contents reduce fruit reddening. On the other hand, N deficiency favours colouring. Potassium is regarded as a positive factor in the fruit colouring, as is Phosphorus which also increases the concentration of flavonoid compounds (this gives the red colour). Any nutritional deficiency (other than N) that prevents the plant producing carbohydrate and anthocyanins can be detrimental to fruit colouration. Leaf testing to confirm plant nutrition status is very useful so that you can add elements that are in short supply.

Reflective cloth is a good product to use to get more light in the bottom part of the trees if your natural colour development is lower than target. Reflective mulches can increase foreground colour on average by 10% of the surface area of the fruit. While that might not sound a lot, it can be highly significant. Extended periods of 30°C and above reverse the accumulation of anthocyanins (red coloured substances) and may cause sunburn. In some Australian climates the reflectives, particularly during the hot parts of the year, may be detrimental and may need to be rolled back under these conditions.

Figure 4: Rosy Glow 4th leaf showing high foreground colour enhanced by Extenday™.

Market Timing

Market timing can be absolutely critical to the profitability of certain blocks of trees within your orchard. Some growing regions and even blocks within an orchard are capable of producing early fruit, but don't have good storage quality. In these cases setting the block up to maximise earliness will be critical.

In other cases the best markets might be in October-December so early harvest is not the driver, the driver becomes growing fruit that has excellent storability.

In both the above scenarios we should still all be trying to maximise eating quality for whatever the selling season. There is nothing worse than growing early fruit that tastes like cardboard and then having no customers to buy all your later fruit. On the other hand, there is no point placing high SPI, low Brix, low pressure fruit into long term storage. This will also result in very disillusioned customers late in the season.

Harvest maturity can be manipulated by:

- Crop load has a huge impact on harvest timing. The heavier the crop load, the longer it will take to reach maturity. At excessive crop loads colour development is negatively affected, meaning that fruit can't be harvested early and certainly will not be able to be harvested at an SPI or pressure level that will enable good long-term storage.
- Dormancy breakers can advance bud-break and hence bring harvest forward.
- Trunk girdling between petal fall and 4 to 6 weeks prior to harvest will advance maturity. Response is variety and rootstock dependent. Royal Gala is fairly responsive, with four to seven day harvest advancement possible. High vigour rootstocks are more responsive than low vigour rootstocks.
- Ethephon application at commencement of ripening process. Response range in 200 to 400 ppm or higher dose rate. Higher rates adversely affect post-harvest storage and shelf life, so are not recommended. Anecdotal evidence indicates pre-harvest ethephon application suppresses fruit sizing.
- Harvest maturity can be delayed by application of Retain® three to four weeks prior to anticipated harvest date. Royal Gala is particularly responsive. A delay of up to seven to ten days in harvest maturity is possible under optimum conditions. Fruit continues to size following Retain® application.

Eating Quality (Fruit Firmness and Brix)

Optimising the eating quality of your fruit is probably one of the most important targets you should be aiming for. Eating quality is best measured currently by Brix and pressure.

There are vast numbers of scientific papers showing that fruit firmness and sugar levels are strongly determined by crop load as the table below shows:

Variety	Specific Crop Load (fruit/cm2)	Soluble Solids (Brix)	Fruit Pressure (kg)
Royal Gala	9.2	10.9	
Royal Gala	5.1	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 ™	15.4	13.3	7.5 kg f
Pink Lady ™	5.9	15.2	8.8 kg f
Braeburn	Regular crop	10.9	9.6 kg f
Braeburn	Light crop	11.3	9.8 kg f

Brix and pressure increases of up to 18% have been measured in the above data due to reducing crop load. When we look at the grape industry, this should come as no surprise. They almost consistently lower crop loads to maximise the Brix levels of the grapes. Apples are no different. It is a simple carbohydrate balance. The tree is only capable of producing a finite quantity of carbohydrate. The higher the crop load, the less carbohydrate is available to each individual fruit.

However, crop load, although the most powerful, is only one variable that will influence fruit quality. Some of the other variables that can increase Brix and pressure include:

- Better light levels
- Lower vigour
- Cincturing
- Partial root zone drying or deficit irrigation

These tree manipulations are all attempting to either maximise the carbohydrate flow to the fruit or lessen the water flow.

Better light levels: To grow a high quality consistent crop requires a Leaf Area Index of < 2.5 or > 50% direct sunlight to hit the spur leaves close to the fruit. Simon Middleton wrote an excellent paper on this subject for your further reference (Middleton, 2007). In a very dense canopy the fruit on the extremity of the tree might be good eating, but the fruit from the inside of the tree will be tasteless and soft after only a moderate length of storage.

Lower vigour: In a high vigour tree, carbohydrates are needed to feed the growing shoots rather than being available for fruit. If we can reduce vigour but still have enough leaves, more carbohydrates are available for fruitlet carbohydrate supply.

Cincturing makes a cut down to the cambium layer, temporarily blocking the supply of carbohydrates to the root system. The carbohydrates that would have normally been distributed to the roots are now available for fruit. Hence, cincturing will tend to increase fruit size and Brix. As with all good things though, there is a downside. Starving your roots for a period of time can be negative in some situations.

Partial rootzone drying or deficit irrigation implemented carefully can lower the flow of water to the fruit, not impact on fruit size and improve fruit eating quality. Anne Maree Boland presented a very informative paper in September 2009. If you need a reminder go to the paper on the Future Orchards website. (Boland, 2009). Brix is measure of the concentration of soluble sugars. High water availability can dilute the sugar concentration resulting in lower Brix and, in extreme situations, poorly flavoured fruit. Too much water stress on the other hand can turn your fruit into a piece of wood. The skill, as always, is to achieve the best balance.

When you set up your block objectives in 2010/11 you need to be very mindful of your fruit brix and pressure targets. Your own historical results and local experience will be your best guide on the likely result under different crop load levels and various manipulations.

VC40 achieved good brix and pressure in 2010 at a crop load of 12.2 fruit/cm^2. With trees entering their 5th leaf this year, Shaun is conservatively increasing the crop load to 12.9

fruit/cm^2. His expectation at that crop load, is that Brix and pressure will be maintained. No major tree manipulation is required as the M26 dwarf rootstock is achieving a good vigour balance. If rainfall allows, Shaun will back off the irrigation three weeks out from harvest, however, up to that point he will ensure sufficient (not too much) moisture to continue to grow this young canopy.

What is the Optimum Crop Load

Cropping potential is determined by the following:

- Tree size and/or canopy volume
- Market requirement in terms of fruit size range, colour, flavour and selling season
- Limitations imposed by seasonal weather conditions
- Orchard site, soil and micro-climate

Setting Crop Load Targets

The optimum crop load that maximises the block profitability will differ for every block of trees. Your own previous experience and history will be the best guide as to what crop load is the optimum. Growers should know, for each block that they farm, the historical yield per ha harvested and have a good appreciation of the resulting fruit size and quality. Once this data has been built up for a number of years, it allows the grower to set accurate crop loads in the coming season to achieve an optimum outcome of yield, quality and profit.

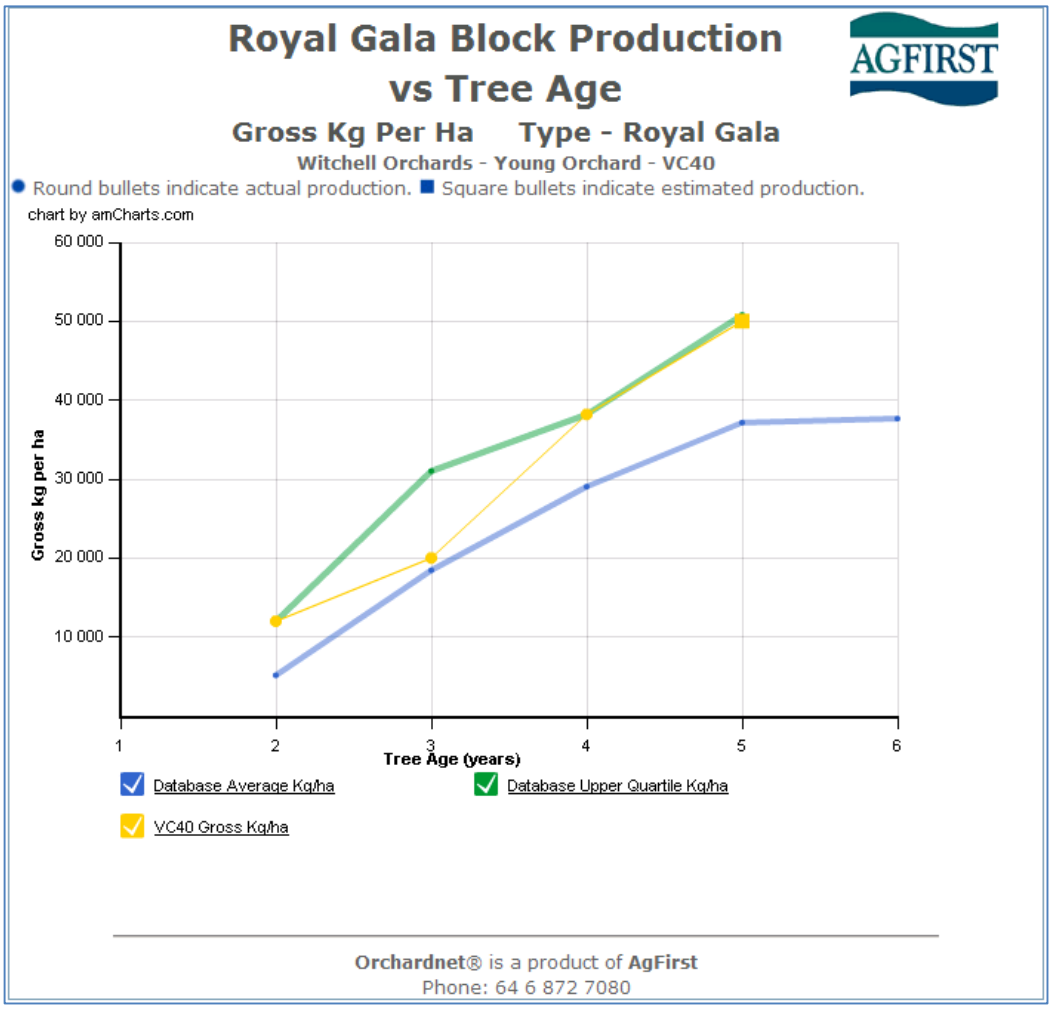

Figure 5: Block production versus tree age report, showing increasing crop load as the trees mature.

In young orchards that have not filled their canopy space fully, trunk cross sectional area (TCA) gives the most reliable guide to cropping potential. Under good growing conditions specific crop loads in the range of 7 to 10 fruit/cm^2 TCA can be carried on two and three year old dwarf trees without compromising tree growth and canopy development. Interestingly, VC40 has produced great crops at at 9, 10 and 12 fruit /cm^2 in the 2nd, 3rd and 4th leaf respectively.

Company: Witchell Orchards
Property: Young Orchard
Block: VC40

Thinning Report
Season Ending 2011

Blockname	Ssn	Gross Kg/ha	Class1 Kg/ha	Fruit Size	Harvested Fruit /Tree	TCA	Harvested Fruit /TCA	Tree Pickout %	Target Fruit/Tree post-thin	Actual Fruit/Tree pre-thin	Actual Fruit/Tree post-thin
Young Orchard											
Royal Gala											
VC40	2011	50,000	42,500	100	174	13.45	12.9	95	183	-	-
	2010	*38,200*	*32,088*	*101*	*134*	*11.00*	*12.2*	*95*	*141*	-	-
	2009	*20,000*	*17,000*	*108*	*75*	*7.50*	*10.0*	*95*	*79*	-	-
	2008	*12,000*	*7,800*	*100*	*42*	*4.72*	*8.9*	*95*	*44*	-	-

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Figure 6: OrchardNet Thinning report

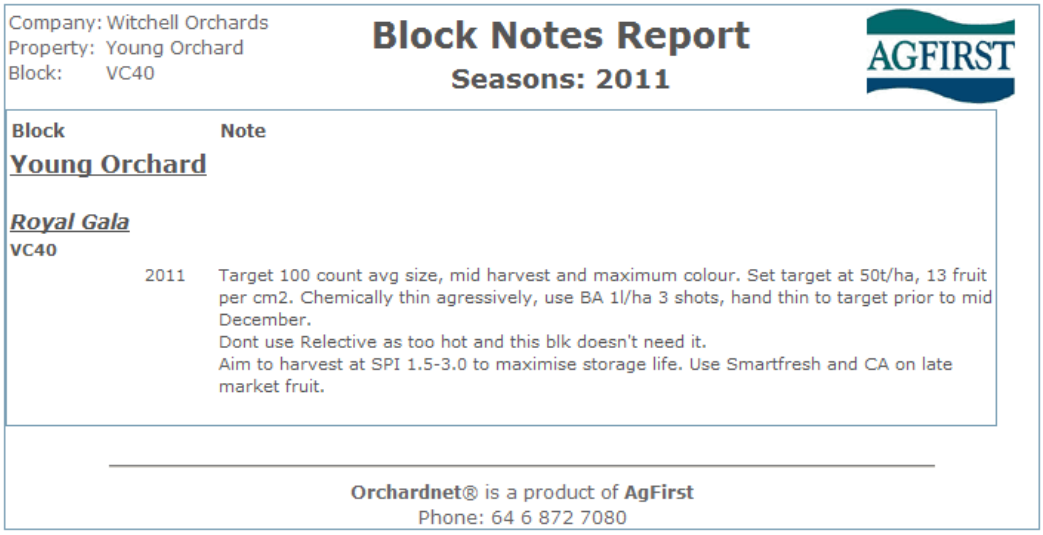
For mature canopies, the best approach is to select a cropping level in kg/ha based on previous experience. A previous Future Orchards paper refers to this in detail (Wilson & Wilton, 2007) . Once the harvested crop load is set, you then need to factor in the loss of fruit from thinning to harvest to be able to calculate fruit number per tree required at thinning. The thinning report shown in Figure 5 illustrates how this can be calculated for VC40.

Fruit/cm^2 of branch cross-sectional area (BCA) can be used to describe crop load, provided the branches or sections of branches are in the range of 2 to 5 cm in diameter. BCA can also be used on developing orchards too. As a general rule, optimum crop loads for branches are about half that of TCA levels, usually in the range of three to five fruit per cm^2 BCA. Thinning to specific crop loads on a branch basis is a quick effective QC method for obtaining a consistent thinning job over the orchard.

The method is easy to set up by simply measuring a few branches, then thinning down to fruit numbers that give the target crop load for those branches. This quickly gives a visual picture of what the target crop load looks like in regard to fruit density on the branch. It also makes checking the thinning relatively simple and quick. Branches in the size range 2 to 5 cm diameter can be selected at random, fruit counted and checked against tables giving fruit number for these branch sizes at the desired specific crop load. When using BCA as a basis for thinning its necessary to check the numbers on a few whole trees to make sure that the crop load is within the target range.

Summary

The Witchells have researched the market and set very clear targets for VC40 (see Figure below)



Company: Witchell Orchards
Property: Young Orchard
Block: VC40

Block Notes Report
Seasons: 2011

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Block	Note
Young Orchard	
Royal Gala	
VC40	
2011	Target 100 count avg size, mid harvest and maximum colour. Set target at 50t/ha, 13 fruit per cm2. Chemically thin agressively, use BA 1l/ha 3 shots, hand thin to target prior to mid December. Dont use Relective as too hot and this blk doesn't need it. Aim to harvest at SPI 1.5-3.0 to maximise storage life. Use Smartfresh and CA on late market fruit.

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Figure 7: Block notes

From this point forward Shaun will monitor the thinning job accurately to ensure his target fruit number is within 5-10% of target. He will monitor closely fruit size throughout the season and make appropriate management adjustments.

Time will tell whether his management system is successful, but I for one would put money on his success.

Sources

Figures 1 and 4, block photos, courtesy of Shaun Witchell.

Figures 2, 3 5, 6 and 7 (Fruit size and growth rate reports, thinning report, block production vs tree age report and block notes) are produced from AgFirst's OrchardNet® online database (http://www.hortwatch.com/orchardnet).

Works Cited

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