

Crop Forecasting Case Studies

Good crop forecasting - a key to efficient supply chain management

The following case studies look at the different approaches that some of the better forecasters in the industry use to estimate their coming season's crop. No matter what the size of their operation, all of the growers interviewed recognised the importance of having accurate forecasts. They cited the need to have this information so they could plan their harvest and packing labour, packing material and transport requirements with a degree of confidence as well as plan their marketing programs with customers.

They also acknowledged the difficulties in forecasting and the challenges of not getting it right every year. However all were committed to improve their processes and understanding of how it might be done better, as accurate forecasting increased supply chain efficiency and reduced business costs.

Although most of the growers had a different approach to estimating their crop, there were some key elements that were common across most of these operations:

- Good historical records (usually at a block level) are maintained – and these are used as the basis for decision making.
- A systematic approach to counting fruit on trees and apply it consistently year-to-year has been adopted. Usually this involves counting fruit on individual trees in a block and extrapolating this figure to account for production of the entire block. The selection of the sample of trees to be counted may differ i.e. they may be selected for their heavy, medium or light crop loads, they may be considered representative of the block, it may be random or systematic and / or measuring the same trees every year. Often, where trees are larger and fruit is difficult to identify in the canopy a portion of the tree (¼ - ½) is counted properly, taking into account the need to count different sides of sampled trees so that there is no a directional bias.
- Often more than one person completes the crop forecast assessment and a comparison is made so that a more informed / considered crop estimate can be developed.
- A considerable amount of time is spent in the field and having a 'feel' for the crop, how it is performing, especially in comparison to the previous year, is particularly important.

In future years the industry is likely to see new technologies emerge that will assist with crop forecasting, however at this time, the methods outlined in this series of case studies represent proven methods that are serving Australian production businesses well.

This information has been collated as part of HIA Project AV12012: Coordination of Data Management and Avocado Quality Improvement and Extension Program. The crop cycle charts used in these case studies have been developed by the Department of Agriculture & Fisheries Queensland as part of HAL/HIA project AV10002. Both projects have been funded by Horticulture Australia Limited (HAL)/ Horticulture Innovation Australia Limited (HIA) using the avocado industry levy and funds from the Australian Government. More information on crop cycle calendars for different regions is available by accessing the Australian Avocado Industry Best Practice Resources at <http://bestpractice.avocado.org.au/Login.aspx>

Case Studies at a glance

Queensland:

- Central Queensland
 - Donovan Family Investments
 - Sunny Bluff Avocados
- West Moreton - Balmoral Orchards
- North Queensland - Tinaroo Falls Avocados

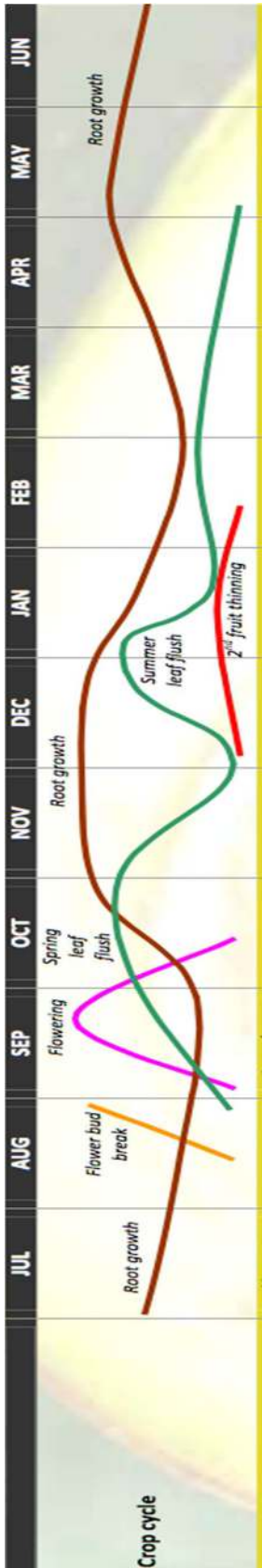
Western Australia:

- Advanced Packaging & Marketing Services
- Delroy Orchards

NNSW/NQLD

- Aussie Orchards Growers and Packers

CROP FORECASTING CASE STUDY—CENTRAL QUEENSLAND



Forecasting the crop

- *Crop forecasting starts at flowering and is updated as the season progresses*
- *Comprehensive historical data is maintained to support decision making*

For the Donovan's, forecasting the crop is a process that starts in September each year with flowering. Over the flowering period, a visual assessment is made as to the extent and success of this event. Based on this assessment and historical performance, a preliminary forecast is developed for the coming season for each block.

Across the 300 hectares of production there are approximately 100 blocks. Splitting the farms in this way allows for a more targeted approach to managing the overall crop.

From the completion of flowering up to the commencement of harvest anywhere up to another 6 visual assessments will be made of the crop load in each block – taking into account both fruit number and fruit size. This information is then used to update the crop forecast as the season progresses.

Lachlan says that he rarely uses the method of counting fruit per tree and extrapolating the result across the block – especially in larger trees. He believes this method is too unreliable as it is too difficult to see the fruit in larger trees and every tree is different.

He believes it's really about having a feel for the crop, knowing how each block performed the previous year and validating this with historical data to confirm crop forecast assessments.

Donovan's have maintained comprehensive farm records of their avocado production over the last 15 years. For each block information collected includes:

- Variety/rootstock
- Year planted/age;
- Trees/block
- Tray equivalents/block
- Tonnes/hectare.

By looking at records it is easy to see trends in the production levels of blocks (and identify issues) and this data is invaluable in helping to develop forecasts from the beginning of each season.

Donovan Family Investments

About.....

Annaleise & Lachlan Donovan have been growing avocados since 1991. Their farms are located at Childers, Isis, Bundaberg and Bellthorpe on the Sunshine Coast.



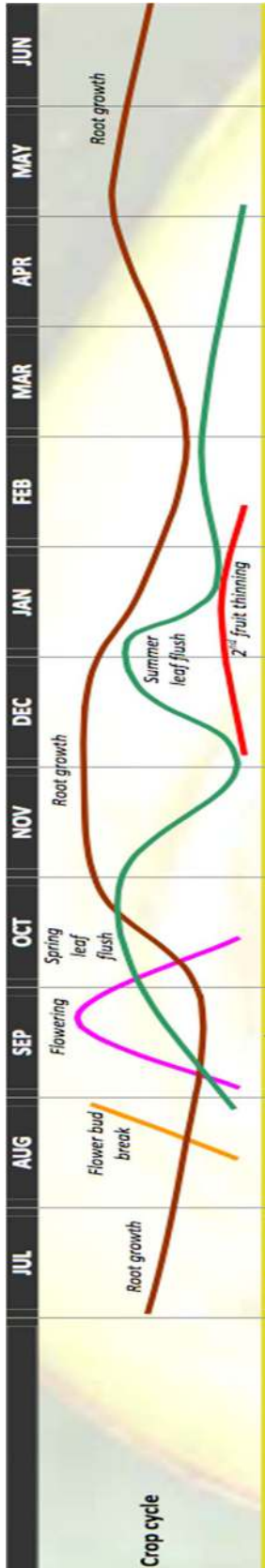
They currently have 300 ha under production, with Shepard, Hass and Lamb Hass being the major varieties.

Most of the production in the Bundaberg region is on deep red volcanic soils with average annual rainfall of approximately 1000 ml mainly occurring over the summer months.

Flowering occurs in September and fruit drop usually occurs in October, December and January. The main harvest period on the farm is April to July / August.

They also have a newly commissioned packhouse where they pack their own fruit and as well as contract packing for other growers.

Crop Forecasting Case Study – Central Queensland



Forecasting the crop

- Forecasting starts about 4 weeks before harvest
- 20 trees per 1000 tree planted are assessed for fruit number and expected fruit size
- Figures are extrapolated to work out expected number of trays per block

The annual crop forecasting process for Tom starts in March each year, about four weeks before harvest starts. Although he spends many hours in the field, and keeps an eye on the impact that fruit drop has on potential yield for the coming season, he believes that trying to accurately forecast the crop any earlier than March in the Bundaberg region, is not a worthwhile exercise.

In March, Tom assesses every block on the farm. He selects trees - about 20 trees per 1,000 trees planted - from across an entire block. He aims to choose those that are representative of the overall block in terms of tree health and fruit load. He then counts the number of fruit on each tree and assesses fruit size to determine if the fruit will be predominantly small (count 28+), medium (count 22- 25) or large (count 20 or less) at harvest. Tom admits with the larger trees there is an element of guess work as the fruit can be difficult to spot in the canopy.

Based on the counts he has done on the 20 trees, he averages the number of fruit per tree and based on his assessment of overall fruit size determines the number of trays he expects to pack per tree. He also adds in an allowance for wastage at field and packhouse level. For example, if fruit was predominantly in the medium sized range (count 25) he would take the average fruit per tree figure and divide it by 30 (not 25) to determine the number of trays he could expect per tree. This higher figure accounts for wastage.

The trays per tree figure is then extrapolated out to determine the expected number of trays per block.

As the season progresses the forecast figure for each block is updated, depending on how the fruit is sizing.

Tom believes that experience and firsthand knowledge of the orchard is key to being able to forecast the crop accurately. Although Tom knows how a particular block performed the previous year, he is quick to point out that every year is different, hence it is important to go through the exercise of trying to forecast the current crop accurately.

Sunny Bluff Avocados

About.....

Tom Gorton and his family have been growing avocados in the Mullett Creek area, north of Bundaberg for nearly 20 years.



In total the Gorton family grow 13,000 Hass trees across 57 hectares of mainly red sandy loam country.

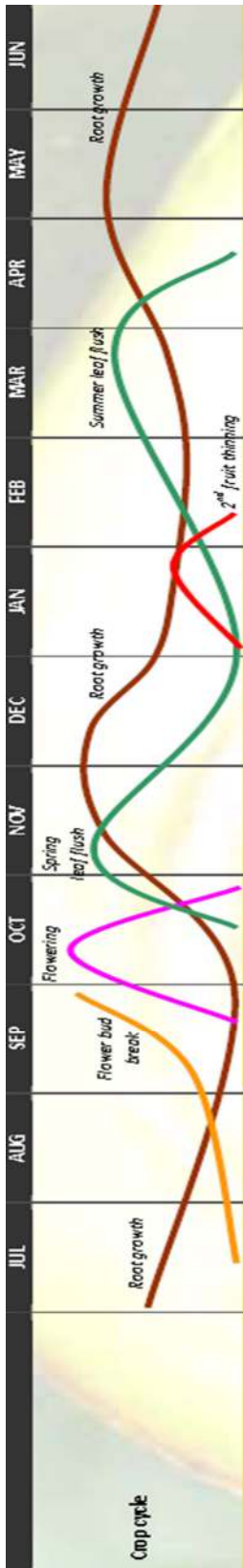
The farm is broken up into blocks of roughly equivalent size which assists with managing the orchard.

Earlier plantings on the property are on 12m x 6m spacing, whereas newer plantings are on 10m x 5m spacing.

Flowering occurs in September and fruit drop usually occurs in October, December and January. The main harvest period on the farm is April to July / August.

Packing is done on-site and their product is marketed under the 'Sunny Bluff' brand.

CROP FORECASTING CASE STUDY – WEST MORETON



Forecasting the crop

- *Experience and knowing the orchard is key*
- *Select 'average' trees across the block as sample trees for counting*
- *Good forecasting allows packing and logistics to run smoothly*

Michael is responsible for completing the crop forecasts for the business. Throughout the season he is consistently monitoring the performance of the crop – looking at flowering, fruit set and getting a feel for how the crop is progressing.

The final fruit drop usually occurs over the January/February period during the peak of Summer heat. After fruit drop, in February/March, when estimates are more reliable, Michael will complete a fruit count and develop a crop forecast.

Michael looks for 'average' trees in the block and selects a sample of these to undertake fruit counts. He will count a 1/4 of the tree, ensuring he counts different sides of the trees he has selected to reduce sampling bias. Taking into account an expected average size of fruit, he will then extrapolate this figure out to calculate 'trays/tree' and then 'trays/block'. In calculating these figures he usually allow a factor of 10% for wastage.

As the season progresses more fruit counts are completed and the crop estimates refined up to harvest. Not every block is counted every time, particularly when blocks are known to have similar performance.

Although historical records are often a good indicator of the expected crop, there is always a need to validate what is happening in the orchard, particularly if there has been adverse weather conditions during the season.

At the end of the season, Michael will compare his estimates for each block with the actual harvest figures. He says that most years he gets it fairly close, but there are some years where the process just doesn't work. In those years it's always important to understand why there were discrepancies so that forecasting processes can be improved the following season.

When fruit is supplied and packed for others, Michael relies on those growers to provide their crop estimates. Getting good forecasts from the grower suppliers is important as it allows packing and logistics to run smoothly and fruit to be managed appropriately so quality is maintained.

Balmoral Orchards

About.....

Michael Flynn manages Balmoral Orchards. The business is situated at Carbarlah, north of Toowoomba on the Great Dividing Range.



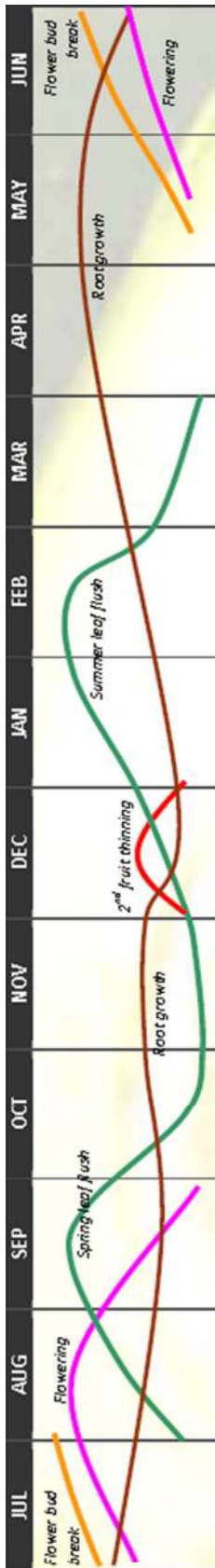
The business grows, packs and markets fruit under the Balmoral Avocados brand.

In addition, it also provides packing and marketing services for other growers in the district.

The production side of the business was established in 1988 and now grows over 12,000 Hass trees planted across 198 hectares.

The orchard is situated approximately 600 metres above sea level, providing a cooler climate and hence a later crop. Flowering occurs during September and October and harvest during late Winter and Spring.

CROP FORECASTING CASE STUDY – NORTH QUEENSLAND



Forecasting the crop

- *Crop forecasting starts at flowering and is continuously updated as the season progresses*
- *The forecast is compared with actuals as the crop is picked – this helps refine the forecast as the harvest progresses.*

From the commencement of flowering each year, indicative forecasts of the crop are established. Having a long history of growing on the same property and knowing how each block has performed in the past helps inform the decision making process.

As the season progresses a visual assessment of each block is undertaken and the crop forecast is updated to take account of climatic conditions and changes in the crop load.

Following the final fruit drop a more thorough assessment of the crop is undertaken. Usually Jim and Ed will do a separate forecast, then compare their estimates and discuss any differences in the figures that they have arrived at. If there are significant difference further targeted assessments will be undertaken.

Jim’s assessment process involves selecting a sample of trees that are representative of the block. The selection of sample trees varies from year to year. Approximately a quarter of each tree is counted and this number is then extrapolated to estimate total fruit on the tree. This figure is then averaged across all of the sample trees. Based on how the fruit is developing at the time of the assessment an estimate of the average fruit size at harvest is also made. Using this information an estimate of the number of bins per block and then trays per block is calculated.

At the commencement of harvest the number of bins harvested from a known number of trees provides a good indication of crop performance and what the final yield of the block is likely to be. As harvest progresses, the number of bins picked from each block is checked against the final forecast for the season and an estimate is made of what is still remaining on the trees – if necessary final forecasts are adjusted. This is particularly important so that packaging orders are correct and customers can be informed of expected supply.

Jim and Ed keep good records on the performance of each block and this historical record and the trends that are evident provide helpful insights into how future crops may perform.

Tinaroo Falls Avocados

About.....

The Kochi Family has been farming at Atherton, south west of Cairns, since 1948. Originally crops such as maize, peanuts and pasture seed were grown on the family property. In 1978, the next generation, Jim and his brother Ed, saw the market opportunity and started growing avocados.



Currently there is 80 hectares under avocado production, with Shepard and Hass being the major varieties.

The farm is on deep red volcanic soils and receives an average annual rainfall of 1400mm predominantly during summer and early autumn.

The Shepard usually start flowering in July/August, with fruit drop occurring in December which coincides with the Summer flush. The main harvest period on the farm is from late February to May.

Jim and Ed pack their own fruit on farm and supply both the supermarket and independent sectors.

CROP FORECASTING CASE STUDY – NNSW / NQLD

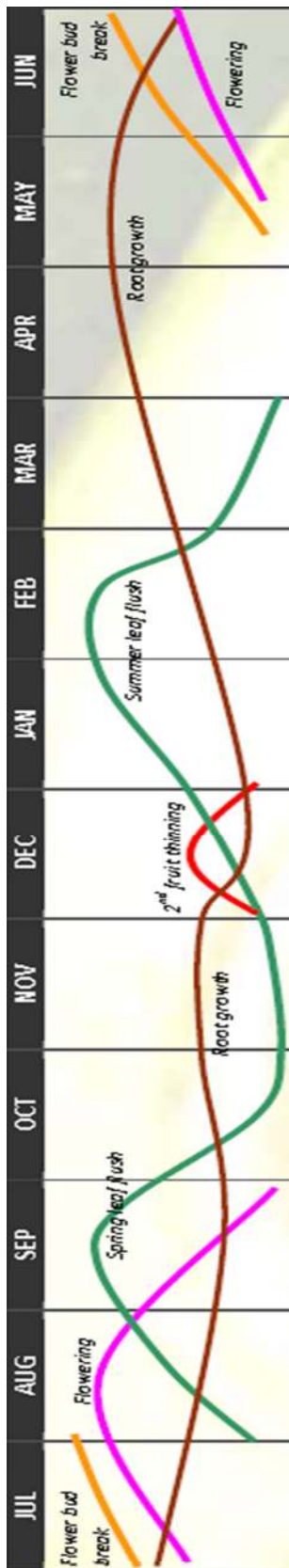


Diagram - North Qld crop cycle

Forecasting the crop...

- Knowledge of orchard performance in previous years helps frame the potential of the coming season's crop
- After the final fruit drop, indicative crop forecasts are made and then continuously reviewed as the crop approaches harvest

Forecasting the crop starts in August each year as trees on the North Queensland orchards come into flower.

Close attention is paid to the performance of the crop as it moves through fruit set and fruit drop phases.

Following final fruit drop indicative yield assessments are made and these are firmed up as the crop approaches harvest. Usually this is based on visual assessment of the trees across the orchard and knowing how different plantings have performed in previous years. Fruit counts are also undertaken on light, medium and high yielding trees and these figures are then extrapolated to validate forecasts already derived.

These assessments are usually undertaken by Colin and each of his orchard managers. The figures are then discussed and refined as the season progresses to reach an agreed outlook for the final expected crop.

At the Pretty Gully, the crop load on trees across the orchard is generally quite consistent, whether it is light or heavy. Additionally fruit size across the crop is also mostly consistent, hence this makes estimating the number of trays a lot easier.

Colin acknowledges that every year is different and from year to year it is a continual challenge to get the crop forecast right.

Significant time is invested in crop forecasting process as good information is critical for logistics and supply planning in the business. The information is also a critical for developing and delivering against their direct marketing program each season.

Aussie Orchards Growers & Packers

About....

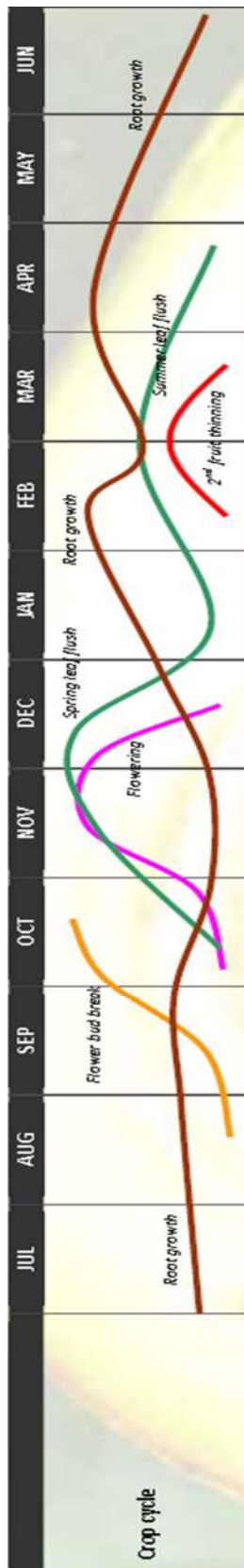
Colin and his family are sugar cane, macadamia and avocado growers based in Northern NSW. They farm avocados at Pretty Gully (N NSW) and at Mutchilba and Arriga on the Atherton Tablelands, North Queensland.



The Pretty Gully orchard has deep red volcanic soils which are high in organic matter and an annual average rainfall in excess of 1750mm. In total there are 20,000 mature Hass trees planted over 90 hectares.

In comparison, the Mutchilba orchard is predominantly granite sand and in a low rainfall area. In total there are 80 hectares of Shepard on the property which have been planted since 2009. One of the biggest challenges in growing avocados in this region is the prevalence of Fruit Spotting Bug and access to water.

CROP FORECASTING CASE STUDY – WESTERN AUSTRALIA



Forecasting the crop...

- *Knowing the crop and keeping good crop records is essential*
- *Managing crop forecasts at a 'block' level assists in the process*

Being a packing and marketing business, having good crop forecast figures is critical for Advanced Packaging & Marketing Services (APMS). The figures underpin the development of sound marketing plans with key customers as well as assisting in managing fruit through the supply chain.

Wayne deals with the grower suppliers throughout the season, providing advice on growing practices and assisting with crop forecasting.

He encourages growers to manage and analyse their crop at the 'block' level. This includes developing crop estimates for the block, which are recorded as bins/block.

APMS request grower suppliers to provide crop forecast throughout the season, which begins with flowering in late October to early December and then continues through to harvest in the following spring/summer period.

Estimates are often calculated by counting fruit (full tree) on a grid pattern and then extrapolating these figures to obtain an estimate for the block.

In addition to this Wayne will also undertake his own visual assessments of their crop through the season. Having a crop forecast from two different sources provides the opportunity to validate estimates or if there are significant discrepancies, provides a trigger for further investigation.

In addition, as APMS keep good planting and production records on their supplier's orchards, they are also able to extrapolate historical data to support the crop estimate process. They also encourage their growers to do the same and have recently developed proprietary software to assist their growers with collection and recording of key orchard data for decision purposes. This includes crop forecasting and historical production data.

At the end of the season, APMS provide grower suppliers with comprehensive pack-out data based on production blocks, so a comparison can be made with the crop estimate and information can be retained to inform the following year's estimates.

Advanced Packaging & Marketing Services

About....

Jennie and Wayne Franchesci are based in Western Australia and have a life time of experience in growing, packing and marketing avocados.

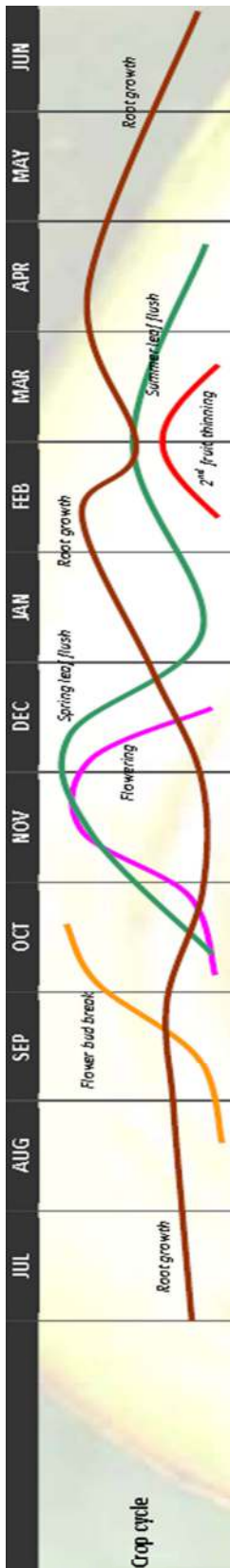


Through their packing and marketing business, Advanced Packaging & Marketing Services, they work closely with their grower suppliers and provide a range of support services to ensure the fruit they are sourcing is the best quality.

The business markets product under the brands 'West N' Fresh', 'Gotta Luv 'Em' and 'Avolicious'.

They are also active in developing export markets for Australian avocados through the Avocado Export Company and have recently made significant investments in high pressure processing to value add local produce including avocados.

CROP FORECASTING CASE STUDY – WESTERN AUSTRALIA



Forecasting the crop

- **The same trees in each block are counted every year to develop an estimate of the crop**
- **More than one person does the counting and a comparison is made**

Having a good crop forecast is essential, not only to inform decisions about the marketing program for the coming season, but also to plan for supply chain and logistics requirements for the crop. It is an on-going challenge to make sure the forecast is as accurate as possible and one that the business takes very seriously. In an ideal world, Russell would like to have accurate figures six months out from harvest.

The starting point is having good records of the performance of each block over time. Over the years different approaches have been tried in an attempt to get more consistent figures.

Each season, indicative forecasts of the crop are established early based on the prior performance of the block and the previous season's crop. However, it is not until after the last fruit drop, which usually occurs around mid-April that efforts become more focused.

A grid pattern is used to make a selection of trees in each block. These trees are then marked with white paint so they are easily identified. The same selected trees, which represent approximately 2% of the total planting, are then counted every year.

Physically counting the number of fruit on the whole tree is in itself challenging. A process has been developed where counting starts at the base of the tree. As fruit along each branch is counted, the branch is marked to ensure that it is not double counted or missed. Russell is also hopeful that new canopy management practices they are adopting across their operation will mean the process of counting trees will become more accurate and less time consuming in future years.

Usually the count across the block is undertaken by two people separately and the figures are then compared. If the two figures are not within 10% then a further check is made of the block. As well as counting fruit, a method to estimate expected fruit weight at harvest is being refined – this will assist in more accurately determining the size profile and the yield of the block.

All of the collected data and knowledge of the block's prior performance is then used to predict the coming season's crop. Russell admits that even with all the time and effort, forecasting the harvest can still be a challenge and one that requires on-going investment.

Delroy Orchards

About.....

Russell Delroy and his family farm at Pemberton, about 320 km south of Perth. They started planting avocados in 1987. Today they also grow kiwifruit and tamarillo.



Twelve years ago Russell had just four hectares of productive avocado trees on the first of their farms near Pemberton. Today they have 250 hectares under production, with more plantings planned over the next 2 years.

The Pemberton orchards have deep karri loam soils and receive an average annual rainfall of nearly 1200mm, predominantly over the Winter months.

Flowering usually start in October through to early December, with the last fruit drop usually around mid-April and the main harvest period from October to January.

Delroy Orchards also runs its own packing shed at Donnybrook, south of Perth. They are significant suppliers to Coles, Woolworths, Aldi and Harris Farms.