An overview of canopy management practices in New Zealand

Colin Partridge

Introduction

The trend is for warmer temperatures globally and New Zealand is no exception with the winters of 2020, 2021 and 2022 setting new warm records. Despite this, the current growing areas can still be classified as cool and in some cases, right on the edge of being able to set fruit consistently if cold snaps occur during Spring.

Hass is the dominant variety and because of the cooler climate, NZ orchards very often have previous season's fruit hanging late, overlapping with new flowering and set. Soils in the production areas vary from well-drained, weathered volcanics, to clay in some localised areas and to sands in the Far North. Rain falls mainly in winter and is often abundant, so provided rootrot is under control, vegetative growth can be luxuriant, especially in a seasons if a light crop is set.

If no pruning intervention is made, trees can quickly become very large. This was compounded by the fact that up until about 2009, tree spacings were mainly the traditional 7m by 7m and growers struggled with the idea of thinning out/removing alternate rows to allow more sunlight to surround the remaining trees. Many orchards became very crowded, so much so, that from the late 1900's and through much of the 2000 decade, the joke was that a Kiwi's idea of canopy management was to buy a bigger hydralada!

Pruning and canopy management only really started becoming widely adopted in NZ from around 2011, but now there appears to be universal acceptance that effective light interception on as large a production surface area as possible, is what maximises potential yield.

There are some very productive orchards in NZ. Despite their owners often having some different philosophies and opinions, they are receptive to advice, consistent, adaptive and very actively involved in all aspects of managing their trees. Of those factors, it is the author's opinion, that it is their pruning and effective canopy management that now plays the major role in that equation.

This story has surely not ended yet however, because canopy management is an evolving process and there is still much to learn.

What did not work?

During the development of some of the systems that currently appear to be effective, there were lessons about what did not work, learned along the way:-

a) Neglecting to thin trees as blocks crowd is the biggest error made by a large number of growers. While many of these blocks have been able to be revived and are still in production, it took a very long time to do so.
b) Using staghorning as a method to control tree height. This pruning method should only ever be considered to help rejunevate unhealthy trees. Healthy trees develop excessive regrowth with new limbs developing weak attachment points and prone to breaking during windstorms. It can also take up to 4 years to return to any meaningful production.
c) The ''staghorn lollypop'' (for want of a better term) was a method advocated by a grower who started offering his pruning services commercially. Quite a large number of growers took it up, impressed by the claim that it brought even crowded blocks back into increased production, without having to remove any trees.

   The system involved staghorning a number of the lower limbs of each tree, leaving the most vertically growing ones to continue producing (like a lollypop). The light allowed in was supposed to be to stimulate regrowth on the lower stumps and when it flowered and set fruit, the tall ones would be removed and *voila*, all the trees would be shorter and with none removed.

   The trouble was that, like normal staghorning, the lower regrowth was lanky and took far too long to develop any flower buds, while the fruit at the tops suffered wind and pest damage and were very expensive to pick. Production remained low and this system was slowly abandoned.
d) Mechanical pruning using shelter belt trimmers. Once trees were pruned into whatever shape was desired, the visual result of the trial orchards was nothing short of stunning. The commercial result was unfortunately not impressive - a wall of green shoots sprouted from the pruned area, which shaded out the interior of the tree if not later thinned by hand. In NZ, these new shoots do not develop flower buds the following Spring if the cut is made after mid-November. Also, because the blade cuts indiscriminately, very sharp points on cut twigs and branches are left in the canopy which are dangerous to harvesters. Last, but not least, it can be difficult to make a cut that does not damage any crop hanging at the time.

e) Flat topping. “Flat topping “is a term coined by the author to describe how a row of medium size trees growing under power lines, responded when they had their canopies removed at a set height every year by the power company. These particular trees still had quite a lot of internal leaf canopy to start with when pruned, which was an advantage because sunburn on exposed limbs was minimised. On large trees with ‘hollow’ canopies, sunburn can be a problem on exposed limbs and watershoot regrowth from the cut limbs needs to be controlled aggressively. Quite a few growers were defeated by this aspect.
NOTE: The success of the flat topping method rests heavily on having trees that are exposed to light on all sides before implementing it and on managing re-growth afterwards. The method is still used successfully by a few growers.

The situation today

It is important to note that NZ is a country of widely varying micro-climates, with wind a constant enemy. There are widely differing opinions on what constitutes the best spacing or what the optimum tree shape and height is. Each grower has different financial circumstances, access to equipment or available time.

The grower community can broadly be grouped into:-

- Those that have owned orchards for a long time, or bought an old tree orchard and hence, have large tree blocks. Most of these have established shelter and so taller tree height is often desired.

- Those that have old trees but are also planting new blocks. Most growers planting new blocks plan to maintain tree height lower than their old tree blocks.

- Those that have planted in the last seven or eight years or are starting from scratch on bare ground with no established wind shelter. Almost all have to use expensive, artificial shelter while shelter belts grow to effective heights and they all plan to limit tree height.

It is estimated that 50% of NZ avocados are currently produced in the Bay of Plenty and the majority of this is from old tree blocks. This picture is set to change dramatically in future as newer planting come into production.

The widely spaced, large-tree old blocks

While some of the earlier plantings, mainly in the Bay of Plenty, have been gobbled up by urban spread or sold when owners retire, many of these 20 - 25+ year old blocks are still thriving and producing. Prior to 2011 when pruning started taking off, the best blocks were those that had been thinned on time, leaving huge, free-standing trees some spaced 11m by 11m, with well-lit outer canopies and anything up to 10 metres tall. However, it was mostly dark and unproductive inside the spherical canopies of those trees and they were expensive to harvest and difficult to spray.

Conversely, blocks that were not thinned, had canopied over with limbs growing vertically to support a relatively flat bearing surface area at huge heights of up to 12 metres. It was dark under the trees and no weeds or grass grew on the ground. Production per ha was low, fruit was sometimes out of reach or very expensive to harvest and spray. They were good picnic spots on hot days.

Many of these blocks which are being actively pruned and well managed, are now amongst the most productive orchards anywhere. Tree spacing varies considerably from 12m by 12m to 9m by 10m and the most effective pruning systems developed over time on these blocks, are *mostly a combination of window pruning and selective limb removal*. Some flat topping is also thrown into the mix on a few orchards. Whatever system is employed, the main aim is to try and create a three-dimensional bearing surface area through the canopy of each tree, by allowing light right through the canopy. Tree shape is a less important consideration.

'NZ Avocado' have written a series of informative papers and has produced videos describing the important elements of the window pruning/selective limb removal process for growers to refer to. Phillip West kindly provided the author with copies and while the volume of information is too long for this overview, the following excerpt is chosen to describe the canopy management strategy for one particularly productive large-tree block as an example:-

Choose main limbs that will be kept, then pruning is focused on managing smaller growth from these main limbs. Main limbs should be spaced well enough to allow easy picking, good light along each main limb and adequate spray penetration and coverage.
Encourage and maintain multiple points of mature productive growth along the length of major limbs. This provides options on length reduction to maintain spacing without a complete loss of production from the limb.

Sunlight filters through the sides of the canopy as well as the top. This allows light to filter through the tree for the majority of the day as opposed to only a certain time of day. Well distributed light supports the multiple points of growth mentioned above.
Maintain enough light penetration in canopy to support at least a 2m wide swath of grass between trees. This is a good indicator that the tree has enough space around it and all aspects of the tree are receiving adequate light.
Produce and maintain new productive wood, in turn utilising as much area within and around the tree maximising available fruiting areas.
Manage the canopy of the block/orchard rather than tree-by-tree. When making cuts consider things like how it will benefit the neighbouring tree and how the canopy in a block is maximised to capture the available light.

Make the majority (60%) of structural cuts along with any flower pruning needed in spring with follow up pruning of regrowth and any additional structural cuts deemed necessary (40%) in autumn to maintain light into parts of the tree that you want. These percentages can vary from year to year depending on crop loads and ability to manage pruning around picking schedules.
Cuts made in autumn maintain good light intensity into the parts of the tree where new growth has been encouraged. In spring the latent bud break is quicker than the response to spring pruning giving leaves more time to harden off and more chance to become floral the following spring.
Not all cuts need to be made or are likely to be made in the first year if in a remedial situation. Compromises can be made by pruning enough to encourage some regrowth within the canopy while maintaining production on a limb. Once the new growth points have matured and become productive the outer part of the limb that was kept for production can be removed.
It's important to take a longer-term view of production when pruning. Having an understanding of the trees phenology will help you identify what is productive wood this year, what will be productive wood the year after and where the productive wood will be coming from the year after that. Don't be tempted to keep fruit on part of a tree this year if it will mean it won't have fruit for the next two years. Some pruning decisions can be delayed and compromises can be made but having a basic understanding of the tree will help identify the potential implication of any compromises, informing the decision about whether the compromise is worth it or not.
Flower pruning of excessively flowering trees is important to manage stress on the tree and produce enough spring leaves for next year's flowering.

The younger, smaller tree, closely spaced blocks

The adoption and use of clonal rootstocks and a desire to orchard using the latest intensive practises, has resulted in most new plantings from about 2015 onwards, to be at closer spacings, with the perfect spacing yet to be decided.

One planting at 3.5m by 3.5 was made in the late 2000's but was eventually found to be unmanageable and was thinned. Most are now made at 6m by 3m or 5m by 4m. A wider 8m by 4m is also a popular spacing with some growers who plan to do both ground and hydralada harvesting.

The common thread with all these closer spacings is that pruning the canopy starts early at around year 2 and once started, cannot be stopped. Soil preparation has assumed more importance and most plantings run North/South for best sunlight interception and trees are planted on raised beds or mounds even in well drained areas. Because they are planted in rows, soil compaction can be minimised as machinery only runs down rows, never crossing them.

There are two main canopy management systems used:-

a) Annual structural pruning as soon as possible after harvest to limit tree height to around 3-4 meters and improve light penetration into the canopy, *but* to no particular tree shape. Some growers also remove central branches. The main aim is to allow sufficient light penetration to make the trees capable of setting fruit three dimensionally through the canopies.
b) V or M -pruning as soon as possible after harvest. The aim is to limit height, but also to create a roughly V or M shaped canopy when viewed down the row in either a North or South direction. This is to replace undesirable canopy height, to a more desirable lower height by the notching of the V, but still maintain bearing surface area.

Both systems require watershoot grooming later in the season to remove unwanted, or to shape new growth.

The young, closely spaced, small tree, wire trained or covered blocks

There are a small number of growers determined to find a way to train avocado canopies into a productive bearing surface area by training tree limbs to wire or other permanent structures. They also plan to limit tree height, with the optimal limit yet to be determined.

A few others are growing avocados under expensive plastic tunnels or shade cloth houses of up to 8 meters height over the trees, hoping to improve production and fruit quality.

None have yet proved that their plans are commercially viable, but the level of enthusiasm and attention to their tasks is impressive.

Flower pruning

This term is a misnomer because it is actual branches that are pruned, not the little flowers and it would be useful if a better description can be found for what is becoming an increasingly common pruning practise in NZ.

Because heavy fruitsets can result in many determinate shoots and very few indeterminate or vegetative shoots able to flower the next Spring, the result can be severe alternate bearing. Flower pruning is therefore carried out, *usually before the set of an expected on-year*, to balance an orchard's fruit carrying branches with vegetative growth.

In NZ, the best time to prune is Sep and Oct and perhaps sometimes up to mid Nov, because the new growth stimulated by the prune requires time to harden off sufficiently to flower the next Spring. If pruning is done after mid Nov, regrowth takes place, but it often does not flower the next Spring.

There is an element of chance involved in the process, because pruning does not guarantee the remaining flowers will set if weather conditions are not conducive to do so. If they do set however, there is no doubt that the process improves chances for a good set the following Spring.

A description of the process, is:-

- Just prior (usually) to an expected on-year, when massive flower bud development is visible, growers will cut off branches of between 5 – 15cm in diameter, all around the canopies of trees.
- Unthrifty looking or tall branches are targeted first and so the process becomes a part of general canopy management.
- Larger trees will have more thicker branches suitable for removal, but even thinner branches can be cut in smaller trees.
- It is however, a process more suited to somewhat larger trees that are less vigorous than smaller ones.
- The cuts must not be made too far back into the tree canopy as direct light on the cut surface is needed to stimulate vegetative shoot growth.

- The ideal amount of canopy to remove is a matter of opinion, but at least 25 35% should be considered. Many growers have said they should have taken more off in retrospect.
- As stated above, timing the prune is important, with Sep – Oct the ideal.

The picking debate

Picking costs are estimated to constitute around 30% of on-orchard costs. Large tree orchards have to accept using hydraladas to harvest, but increasingly, the newer more closely spaced orchards are aiming to only harvest from the ground. In preparation for this handout, the author interviewed a number of growers and picking/pruning contractors for their latest views.

A recurring theme that all agreed upon, was that canopy management had to address the need to keep picking costs down by improving efficiency. There was much less agreement on whether ground picking was more efficient than using hydraladas, with some very strongly held views expressed.

Many felt that hydraladas could pick faster than ground pickers, particularly if crop loading and fruit size is good. Others held the view that good hydralada operators are difficult to find and high maintenance costs and health and safety issues make it imperative to concentrate on being able to ground pick.

Some interesting or common threads noted were:-

- Large tree orchardists think that around 6 - 8m is the maximum suitable tree height, with 6m the most frequent choice.
- The 6.4m hydraladas are the most efficient or useful.
- It was stated more than once, that the very first structural prune and cleanup, is the biggest job. Everything after that, is easier.
- An average hydralada picker will pick 4 bins per day (about 330kg per bin) but some can do up to 6 per day.
- Picking from a hydralada is less tiring than ground picking.
- Very good ground pickers can pick up to 4-5 bins per day, but the rate is usually more like 2-3 bins per day.
- Ground strip picking costs were quoted as $120 - $198 per bin.
- Hydralada strip picking costs were quoted as between $130-160 per bin. Select picking cost was up to $250 per bin.

It is an interesting topic with many interrelated factors. The production of any block will have a large influence on picking costs per bin and because the production/cost situation varies enormously from orchard to orchard, no single situation will suit all. A combination of ground and hydralada picking is done on many orchards.

Some personal thoughts on pruning pollenizers

There is no doubt in the author's mind, that pollenizers improve fruitset in some years when spring temperatures are less than ideal. They are a good insurance policy. Fortunately, the use of pollenizers is again becoming more common in NZ, with Zutano, Bacon, Ettinger and Edranol being the most widely used. These cultivars are all effective provided a good flowering overlap with Hass occurs, but unfortunately this overlap varies from season to season.

All the above cultivars have a relatively upright growing pattern and to maximise space for the Hass, most are heavily side pruned by growers to form a 'lollypop' which grow above the surrounding Hass. The trouble with this is, that most of them naturally start flowering earlier than Hass and flowering even earlier is encouraged by full exposure to sunlight.

It is my opinion that it would be better to encourage growth all way from the ground to the top of the pollenizers such that some of their flower buds get partial shade. This would extend the flowering pattern and increase the chances of overlapping with Hass.

General notes

Humans seem to have limitless ability to see things differently from one another. During the interviews, some interesting and amusing comments were made. Here are a few:-

- Even when training is provided and clear instructions are given, two pruners will soon do things differently and even one pruner will often revert to what they 'see' or feel is optimal. You have to keep checking up during the week''.
- ''Any time is a good time to prune''. A cynical quote made by a contractor who is very busy, but which is partially true.
- ''Big trees give some insurance against poor fruit set''. This was said by a grower who like many others, has experienced having a 'tide mark' set in

some years, caused by temperature inversion at night causing poor fruitset low down on the trees, but which still set well higher up.

- ''After a structural prune, you have to see dappled sunlight on the ground under the trees''.
- ''I would never space 7m by 7m or closer again! Any new plantings would be at 9m by 10m".
- ''I want to pick 25% of my crop from the ground, the rest by hydralada''.
- ''When we started, big was beautiful. Then we got greedy and planted 10m by 3.5m which is difficult to manage. Anything that we plant from now on will be at 8m by 4m''.
- ''A spacing of 6m by 3m is ideal''.

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