

Future Orchards 2012

Orchard walk notes

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AgFirst

Pruning and Training to Maximise Marketable Yields

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## **Pruning and training to maximise marketable yields**

### *Objectives*

**Growing regular, high yields of good sized fruit is the best method for controlling tree growth. Pruning has a big influence on both fruit yield and fruit quality. It will also impact on other orchard husbandry practises such as thinning, harvesting and spraying. Pruning style and tree architecture also has a huge long-term impact on future pruning costs and ease of management.**

Before starting pruning, a suitable pruning system/architecture should first be determined. There are several ways to do this. The first involves having a thorough understanding of the training systems you are going to use. Around the world, there are dozens of training systems used in intensive high-density orchards. These include the Bush Tree system, Spindlebush system, Central Leader System, Mini Central Leader System, Palmette Leader System, The Slender Spindle System, Multi-row Slender Spindle or Bed Systems, the Vertical Axis System, the Solaxe System, Slender Pyramid System, HYTEC System, Super Spindle System, Flat Planar Canopy Systems, Original or “Regular” Palmette Systems, Free Palmette System, Penn State Thin Wall Trellis, Lincoln Canopy, Ebro Trellis, Solen System, Tabletop Bed System, V and Y-Shaped Canopy Systems, Tatura Trellis System, Mini Tatura Trellis, Geneva Y-Trellis, Mikado and Drilling Y Systems, MIA Y Trellis, Mini V-Trellis, Guttinger V, V-Super Spindle. All have their advantages and disadvantages, which I will not go into here.

Having a calm tree is the key to early production, regular and high yields and good fruit quality. This is achieved with little annual growth and therefore most of the trees energy is going to producing fruit not leaves and shoots. The objective may be the same the world over, but how we achieve it can be very different.

To do this, a clear understanding on what we are trying to achieve is required. Being very clear on the required production targets and fruit quality attributes (size, storage potential, colour development etc) and prioritising these attributes will help define the tree to best achieve the goal.

Top performance in any field comes from doing the right thing at the right time and doing it consistently.

“Top performance comes from simple systems.” Tree architecture, pruning and training must be simple to achieve consistency in the task, which in turn will achieve top results.

A simple tree structure allows all other tasks to be carried out and supervised easily.

Two very different examples of good performing systems are:

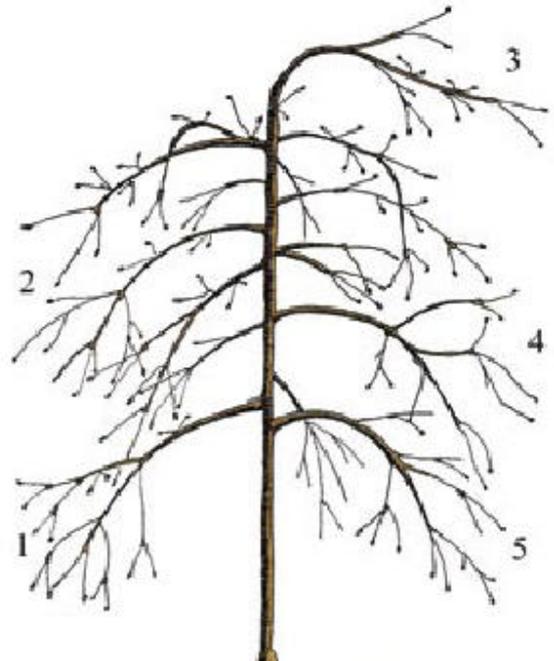
The tall spindle (Italian and recent plantings in NZ)

- Higher densities (2500 -3000)
- Many simple single lined branches,
- Calm tree achieved by minimal pruning and extensive tree training
- Light penetration managed by a narrow tree 600mm and windows in the top of the canopy not a hedgerow.
- Tall tree for the row spacing to increase yield and lower the vigour of the upper tree.
- A very simple tree but the danger is letting the canopy become too dense.



The French Solaxe also adopted strongly in Chile

- Wider spacing's (1200 – 2000) Lower capital costs
- Combined with extinction pruning (spur pruning) to achieve good fruit size.
- Calm tree achieved by Minimal training and allowing the branches to fan out to fingers (each branch described as looking like human arm and hand.)
- Light penetration managed by keeping central chimney clear (i.e. summer pruning at the shoulder and between the base of the fingers.)
- Sometimes too many branches and these becoming umbrellas stacked on top of each other creating low light in the lower canopy.



There are many other systems mentioned earlier. The key is to define the best for each situation and then commit to simple rules.

“It must be remembered that growers can be successful with several high density systems. Growers should focus on achieving high early yields by selecting precocious rootstocks, frost free sites and obtaining excellent early tree growth. If this is combined with proper tree training and minimal pruning, any of several high-density systems can be much more profitable than traditional systems. The specific tree training recipe used in the development of an orchard is less important than the planting density as long as minimal pruning is employed.”

(Quote by Terence Robinson and Steve Hoying, Compact Tree Vol. 36, June 2003).

Once a tree training system is chosen, the next step is to determine how to prune. This can be aided by utilizing bud counts.

### ***Setting up Bud Numbers***

Bud counting is a relatively new practice that has made its way into the pipfruit industry. Its origins are not exactly clear but it is used extensively in the kiwifruit and grape industries and latterly by more advanced growers in the pipfruit industry. It involves pruning to the targeted bud numbers with the objective of lifting fruit quality and size while reducing the thinning job.

Many advanced growers prune to set numbers of buds per tree. It works on many of the main varieties including Royal Gala and Braeburn and is commonly used in fencing/2D/palmette type systems in the USA.

For Royal Gala, the aim is to prune down to 1 -1.2 spur or terminal fruit buds for each fruit they intend to carry through to harvest. Lateral buds on one-year wood are not counted because the intention is to try and not carry any crop on that type/class of bud, except on young trees.

### ***Bud Counting Method***

So how do you determine how many buds to prune down too? There are several ways of doing this but we prefer to use a method we highlighted in earlier orchard walk rounds. Start with the whole orchard in mind first. Ask yourself how many cartons of premium fruit in the desired fruit size range do you want from the block. Next divide this by the number of trees in the block to give you the target fruit per tree. Then divide the fruit number per tree by the bud factor. For Royal Gala we use 1-1.2 buds per fruit. A similar ratio could be used for other varieties that do not suffer extensively from biennial bearing.

For varieties that can be more biennial such as Fuji, Braeburn and Pacific varieties, the bud ratio should be a minimum of 2 or even 3 buds for each fruit harvested. To avoid biennial bearing it is generally agreed that no more than 40% of fruiting sites should be cropped in one year.

Past cropping history is a good guide to sustainable yield capability of a particular orchard block. Crop load is also the main driver of fruit size, usually responsible for 60 to 80% of tree-to-tree fruit size variation found on apples. This means that if fruit size history shows production to be falling outside of market requirements in regard to fruit size range, some fine-tuning of crop load will be required.

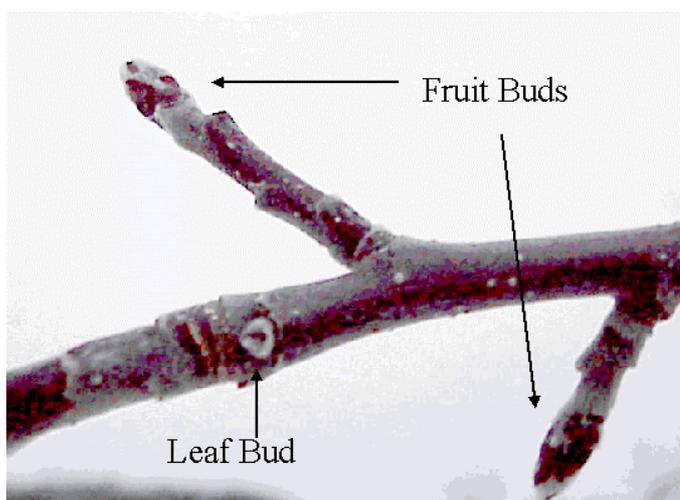
As a general rule of thumb a 10% change in average fruit size requires fruit numbers to change by 20%. So to increase average fruit size by 10%, fruit numbers need to drop by 20%.

When looking at the crop load effect on fruit size, it is the total number of fruit that count, not just the fruit you harvest and send to the packhouse.

Top paying markets are demanding high flesh pressures, high Brix levels and good acid balance. Like fruit size, crop load is the main driver of these quality attributes. They fall once optimum cropping levels are exceeded.

Viable production in the future will be driven by fruit quality, defined by size, pressure, sugar levels, acid balance as well as fruit colour. Pruning and tree architecture is the basis for getting the equation right.

Individual fruit only reach their full quality potential on terminal buds and well-positioned spurs on two year and older wood. Lateral bud on one-year wood gives lesser quality fruit, particularly in regard to fruit size. Fruit on this class of wood is usually at least 15% smaller than good spur bud fruit and in the case of some varieties, it may be as much as 30% smaller. Lateral bud of one-year wood should only be cropped on young trees that do not have sufficient older wood to meet cropping requirements.



## Fruit buds and leaf bud

The role of one year wood in the apple tree is for canopy extension and replacement of tired fruiting wood, which in many cases is more likely to have lost its cropping capability through shading from unwanted one year old wood and excess growth through high vigour rather than old age. In an established canopy one-year-old wood is not for cropping, so you don't need much of it.

### ***How many buds***

With Royal Gala, if the target Gross yield is 2800 tce/block, and the block contains 667 trees /ha , then the required tree yield is 4.19 tce/tree. The targeted fruit size is 106 count, therefore each tree in the block must carry 444 fruit at harvest. This would equal 533 buds per tree.

With a variety like Braeburn we would use a different bud factor e.g., If targeting a gross yield of 4400 tce/ha, and the block contains 667 trees, then the required tree yield is 6.60 tce/tree. The targeted fruit size is 105 count, therefore each tree in the block must carry 693 fruit at harvest. This equals 2079 buds per tree or 3 buds per fruit at harvest.

Ideally fruit is easiest to manage if it can be grown as single apples spaced far apart so fruit does not touch when ready to harvest. This is absolutely critical for partial red varieties such as Fuji and Cripps Pink for which there is a high colour requirement.

With this method of regulating bud numbers it is important to spread the fruiting sites through the whole canopy rather than one of lateral or fruiting wood shortening as shortening tends to concentrate buds on the remaining wood as well as stimulate unwanted vigour.

However in some cases with weak-growing, runted-out trees, may benefit from a few shortening cuts to stimulate more annual growth to assist the tree fully reach its potential.

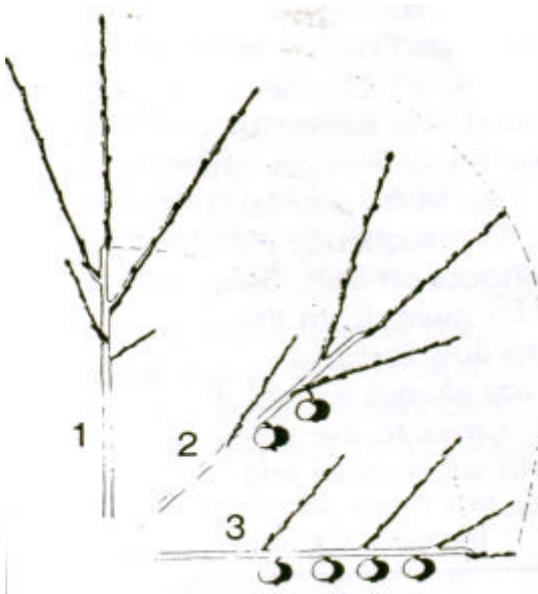
Reducing buds numbers can easily be achieved by removing older, more heavily spurred fruiting branches, provided there are younger settled branches to replace them near by. On two-year-old wood, it is relatively easy to rub off buds, e.g., underneath and on top buds can simply be removed by running the secateurs along the underside and top of the lateral or use a glove to do the same.

Fruiting wood should also be kept in one layer, to maximise sunlight capture and aid fruit colour development.

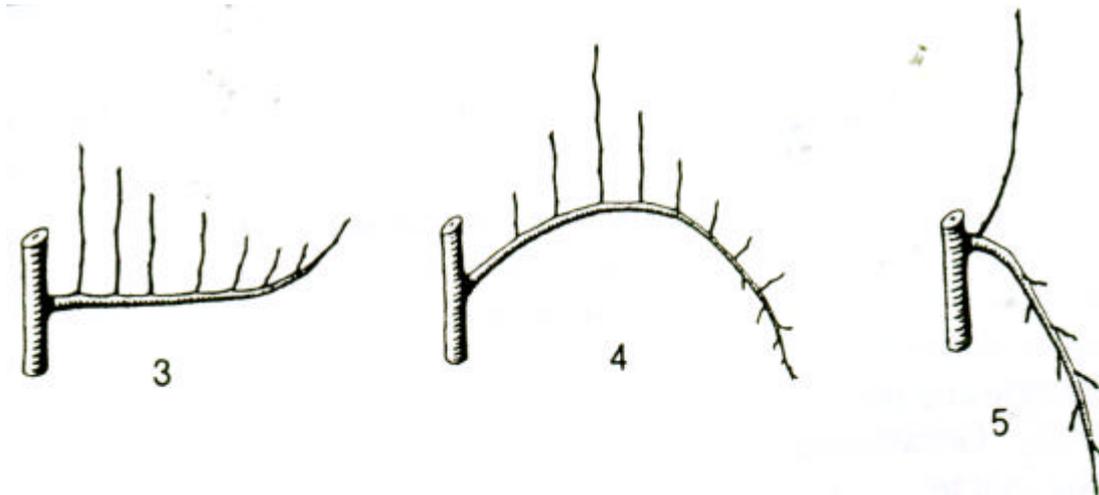
## **Rules of Shoot Growth**

Pruning technique and tree architecture has a marked influence on fruit quality, yield and also overall tree management. Once trees of standard vigour rootstocks have filled their allotted space, tree vigour tends to be counter productive.

Understanding the principle that “**THE STEEPER THE ANGLE OF THE SHOOTS, THE STRONGER THE INDIVIDUAL BUDS WILL GROW**”. This means that they will develop less flowers and will therefore bear less fruit. The more horizontal the branches and shoots, or the more the branches droop, the more fruit their buds will produce.



The steeper the angle of a shoot, the stronger it will grow and the less fruit it will bear. The more horizontal a shoot, the shorter it will grow and the more fruit and flower buds it will bear. (from Fritzche, 1967)



Shoot growth according to the natural rules promoting upper side 3, the apex 4, and the base 5 (from Liedster *et al.*, 1982)

#### **Promotion of Terminal Bud**

On vertical branches, the most vigorous young shoot comes out of the terminal bud and shoot growth becomes progressively weaker toward the base of the tree. Throughout the tree, vegetative growth is always stronger at the top than at the base. The formation of flowers, on the other hand, takes place mainly in the lower region of the branch and of the tree.

#### **On a branch pointing upwards, the terminal bud generally still predominates.**

The first blossom buds may form at the base of the shoot. Here are differences in behavior depending on the variety and whether the tree is a spur type or a standard.

#### **Promotion of the upper side of the branch**

On more or less horizontal branches, several short shoots grow from the buds on the upper side of the branch. Depending on the variety and vigor of the tree, these shoots become more vigorous or weaker from the crotch to the tip.

#### **Promotion of the Apex**

When the branch is bent and forms an arch, the most vigorous young shoots emerge on the top of the arch. If possible, this should be prevented.

#### **Promotion of the Base**

If a shoot has been bent at the crotch so that it points steeply downward then the growth at the base of the shoot is promoted. In this case, of course, the base of the shoot is also the highest point (and the upper side) of the shoot. While branches bent down may quickly develop flowers and fruit, it is often of poor quality and the fruiting wood ages rapidly. Overbending, therefore should be avoided.

## ***Various Pruning Methods affect tree performance.***

### **1) *How to produce a calm tree –***

Winter pruning is used to correct the shape of the tree, if necessary, to contain the tree in its allotted space, and to improve light penetration without overly stimulating vegetative growth. Optimum light distribution is critical for achieving regular yields of high quality fruit.

One experiment in Italy concluded that:-

- 1) Sunlight is the guarantee for quantity and quality and
- 2) in the shadows grows only little fruit of poor quality. Therefore, we must strive to position our production in the sun.

Vigl J., Italy , Compact Fruit Tree, Vol 37, 2004.

Dr Simon Middleton also spoke at great length about light interception in the February orchard walks. Fruiting wood needs 60% exposure to ambient light to perform well. These comments are pretty much universally agreed upon as being essential to good intensive production.



Open pruned Royal Gala with plenty of light penetration into the lower levels of the tree.



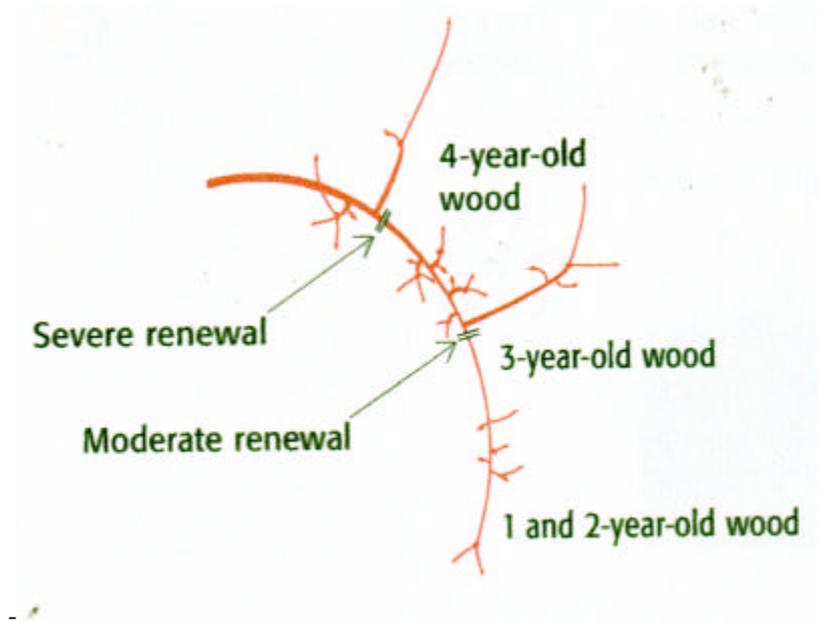
Light can easily penetrate the center of the tree because of the open pruning. Note flowering is relatively even between the top and bottom of tree which can enhance chemical thinning.

Tree height is also important in light penetration. Simon spoke about 1-1.2 tree height to tree row spacing as optimum for light penetration.

(Footnote: For varieties sensitive to sunburn, the canopy needs to supply light as transient light, rather than lengthy periods of direct light, so you do not want too many holes in the canopy.)

For intensive orchard, establishing tree height early in the life of an orchard is critical to bringing the trees into cropping balance and establishing high yields early.

As pendant branches are the key to controlling both tree spread and overall tree vigour, leader height has to be high enough to enable pendant branches to be developed. Growing tree height rapidly gives a long central leader axis on which to hang fruiting branches and laterals.



Renewal pruning promotes growth and vigorous trees. The ideal is to produce a calm tree. Renewal pruning is not the best for promoting a “Calm Tree”

### ***How to achieve a Calm tree.***

There are many ways to promote a “Calm Tree”.

The most obvious is rootstock selection, deficit irrigation, and tree density, trunk girdling etc. Painting NAA to suppress strong growth has been widely used in many parts of the pipfruit world. Often it has been successful, although not all the time.

Another option is to prune around the summer equinox however this method although sworn by in many countries may not suit Australian growers, but could be worth a try.

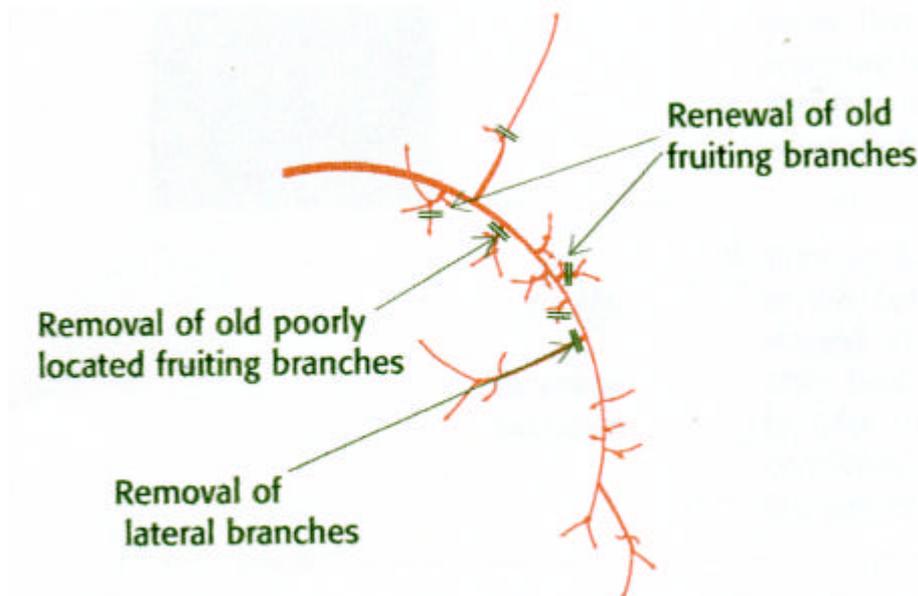
Spraying growth retardants such as Regalis have recently come to the fore and good results are occurring. However this can be costly and may limit their uptake by many growers.

Over cropping is not recommended because of the detrimental effects on fruit quality.

### **Pendant Wood**

The method we most favour to produce a calm tree is to aim towards producing pendant branches that droop over and point towards the ground. Training with string can assist

branches to do this or simply letting the branch grow long and bend over under the weight of fruit and leaves can also work. However before a branch can bend over, it must follow some simple rules. It must start growing from a desirable location in the tree, preferably on the side of the trunk or the side of a main scaffold branch in the bottom of the tree. Shoots that start growing on top or underneath a scaffold branch should be removed as they will either be too strong or too weak (underneath). Next the shoot must be kept long and skinny (long pruned) so that it grows long but not wide. If width is allowed to develop through side branching etc, these can cause excessive shade which limits fruit bud and fruiting potential. Many growers do not leave this to chance and will tie down branches to horizontal or below horizontal to encourage fruiting.



Pendant wood that is long and skinny –less shading and less vigour.



String and long pruning used to pull branches below the horizontal to promote fruit production and reduce vigour in this Jazz orchard on M793 rootstock.



Same Jazz orchard showing tree openness and what can be done by training and utilizing string.

## ***Basics to pruning***

To do this there are several steps.

1. ***Start with the end in mind:*** From the outset, have a target for the block, fruit number per tree and fruit size. Use these to determine bud numbers. Try not to focus solely on last years problems as you should be thinking ahead at what is likely to come up, and not so much on what has been.
2. ***Harvest Light:*** Growing quality fruit is all about harvesting light, eliminating large wood in the top of the trees then focus on creating one layer of fruiting limbs by removing shoots causing growth that is in the underneath or on top of your branch (over's and under).
3. ***Quality Wood and Attention to Detail:*** Pruning is the first point in growing big fruit and thinning out of the small fruit. Check bud numbers with your target and then thin wood if your bud numbers are too high.
4. ***How much 1-year old wood is required.*** One-year old wood (annual shoots) is usually where the most amount of hand thinning is required and these shoots also contribute significantly to shading other desirable fruit in the tree. One-year old wood should mostly be used for replacement of older less productive wood.
5. ***Communicate and Monitor.*** It is easy for all us to prune a few trees well, but it is important to communicate clearly what you want your staff or contractors to achieve and always monitor progress regularly (daily).

Further reading.

Wilton, J. 2006. The pruning job lays the foundation for next years' crop. "The Orchardist", (May 2005) p 14 to 19

Compact fruit tree, volume 36, special issue, June 2003:. Description of orchard planting systems.

Good fruit grower, April 15 2004: A calm tree is a productive tree.

Pruning notes, Hornblow and Spark, AgFirst, 2005