Future Orchards Article for the Australian Fruitgrower
May 2012

Pruning – a critical factor in orchard performance.

by John Wilton
Horticultural Consultant, AgFirst

With the harvest season over, it is now time to start working on next season's crop.

Analysing this year's orchard performance is a good place to start. The general impression I have is that the 2012 crop was well above average in terms of quantity and quality in regard to colour and fruit finish. For most of Australia this result has been largely due to a couple of good growing seasons for pipfruit and, apart from Western Australia which was hot and dry, soil moisture has not been the limiting factor it usually is in Australia.

These favourable growing seasons will have stimulated excessive vegetative growth in many orchard blocks. High vigour is your friend when the orchard is newly planted and you want rapid tree growth to fill the orchard canopy quickly, but once you have grown the fruiting canopy vigour becomes the enemy.

Excess vigour represents photosynthetic resource that has gone into fuelling vegetative growth rather than setting, sizing and colouring fruit.

In a mature fruiting canopy 20 to 30 cm of annual shoot length is usually adequate, and where shoot growth exceeds 40 to 50 cm in length the trees are definitely excessively vigourous.

Observations I have made over the years support the view that tree vigour is closely tied to branch strength and pruning styles. High orchard productivity is usually found in orchard blocks that have uniform trees with full canopies and are in a calm state of vegetative growth.

Analysis of orchard performance on a block by block and variety by variety basis is a good starting point to identify where there is scope for improved performance. Those of you who have been using OrchardNet™ and have block data entered into this programme can readily benchmark your block performance by variety against the database upper quartile and average performances.

The table below is a summary of OrchardNet™ data on orchard block performance for the main varieties in the 2011 harvest year.

Table 1: Gross production per hectare 2011 harvest.

	Upper Quartile (tonnes/ha)	Average (tonnes/ha)
Cripps Pink	76.28	47.07
Granny Smith	86.55	58.99
Fuji	69.76	39.27
Royal Gala Types	54.93	33.5

Funded By:

The upper quartile figure is the average yield of the top 25% of the blocks on the database. The top performing blocks have even higher yields than shown in the data. The best Granny Smith blocks, for instance, exceed 100 tonne/ha. As apples are biennial, and this database is only reporting one specific year's production, the blocks that tend to populate the upper quartile are those exhibiting significant biennial bearing behaviour that are in their "on" crop phase. Even so, the database shows that there is considerable scope to lift Australian orchard yield performance.

It is also worth noting that the indigenous apple varieties, Cripps Pink and Granny Smith, are outperforming varieties from offshore. They clearly have an advantage and are better adapted to Australian growing conditions.

Growing the Calm Orchard

When the orchard is young, the objective is to fill canopy space quickly. Last year in this journal I set out some growth objectives for new plantings which were to aim to grow the tree to the desired height over the first four growing seasons. Then, once this objective has been met, turn the tree into a cropping machine by stacking the canopy with slim, slightly pendant fruitful branches.

Figure 1: This tree was planted without pruning. Note the different growth response from the pruned tree. Its feathers were left on and these are the three larger lower branches that have spurred up. Had these feathers been removed at planting, their vigour would have been directed into stronger leader extension. Pruning them off now would also improve upper tree growth without upsetting the good, calm growth balance that has already been established in the tree.

Figure 2: The effect of pruning on tree growth. This tree was dormant headed at planting. The pruning has directed its growth into six competing branches which cannot e used for future tree development without significant cost in tree training to calm down the growth.

Our studies have shown that initial tree growth depends on maintaining optimum soil nutrition and adequate soil moisture with minimum competition from weeds.

Canopy development is dependent on directing growth to where it is required, and minimising growth into unwanted branches and laterals. We have found poor relationships between crop load and tree development, but a strong negative relationship between the amount of competing shoot growth and tree development.

Figure 3: This 2nd leaf Envy™ tree had all fruit removed at flowering. This increased the amount of annual shoot growth, but not shoot length.

Figure 4: This 2nd leaf Envy™ tree was thinned to 10 fruit/cm^2 TCA at 42 days AFB. Shoot growth was adequate for further tree growth and shoot length similar to trees with all crop removed at bloom.

The reason for this is that by the time you get around to thinning the crop off, most of the damage to tree development has already been done. Even flowering places considerable strain on tree growth. The key to maximising canopy development is to limit growing points by pruning out surplus lateral growth in the winter pruning. This includes branches that are too low in the tree to have a long-term future, any unbalanced branches that will become excessively vigorous, or strong laterals high in the tree that will compete with leader extension.

In recent years we have moved on from the idea of having a tree with distinct formal tiers of branches to one in which numerous smaller branches well spread along the leader are preferred. This overcomes the problem of branches choking the leader and stunting its growth, and also enables easy removal of any branches that become over-vigorous without leaving large holes in the canopy.

Figure 5: Good upper tree support is essential to enable crop load to be used for vigour control in young trees.

Funded By:

As part of the objective of growing the calm tree, shortening or heading cuts are avoided because they stiffen branches and stimulate excessive side shoot competition at the expense of fruit bud development. Where growth is being stifled by excessive fruit bud development, rubbing out surplus fruit bud is a better option than limiting their number by shortening cuts. An exception to this rule is that where upper tree growth is very stunted, the climate hot and the variety sensitive to sunburn, shortening back to stimulate more shoot growth to provide sunburn protection can be a useful canopy management technique.

Crop load is by far the best vigour control agent, and to obtain good vigour control early in the life of the orchard from crop load there has to be good tree support, because at this stage in its development the leader is incapable of holding up under the crop loads necessary for vigour control. Even with stronger rootstocks such as MM106 or M793, we are finding good upper tree leader support necessary to enable sufficient crop to be carried for vigour control.

Dr Terrence Robinson believes cumulative crop of 150 tonne/ha by year five in the orchard is possible, but does not occur all that often. Cumulative yield of 150 tonne/ha by year five is a good objective to aim for. We are aware of orchards in Australia that have passed this milestone comfortably as the figure below shows.

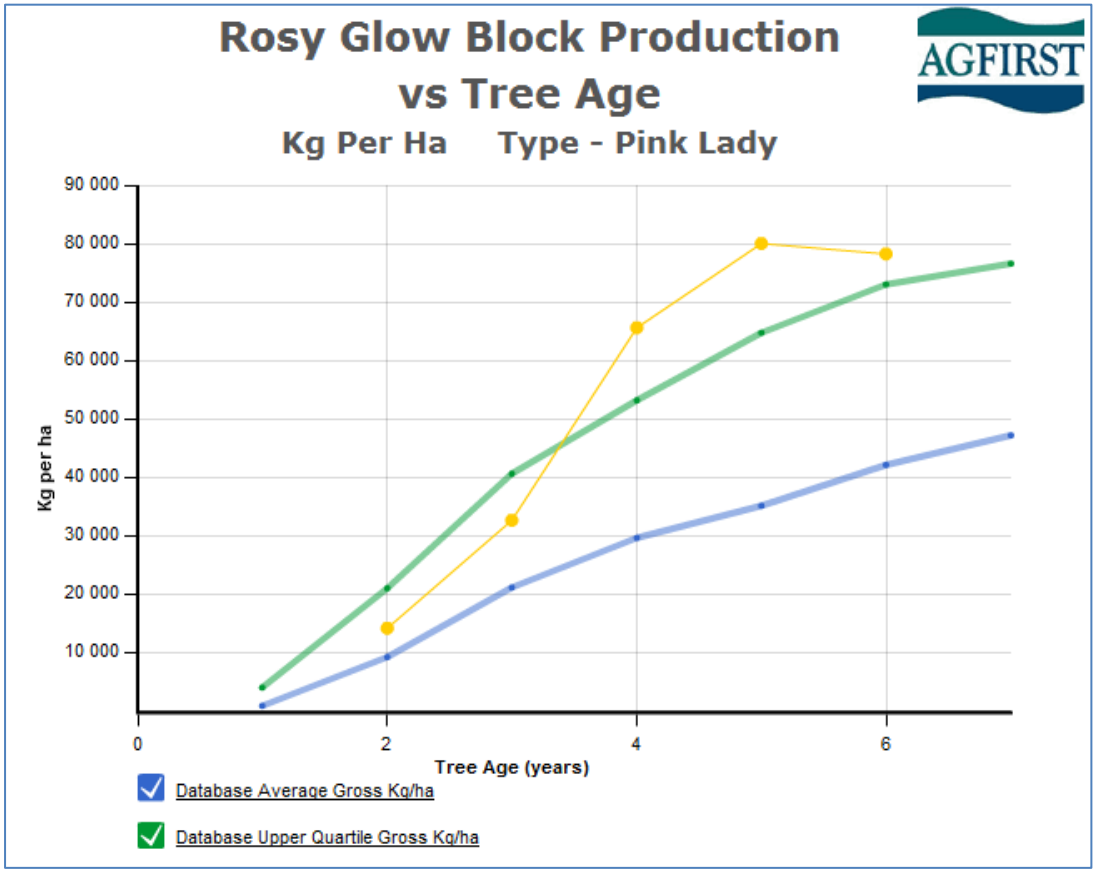

Figure 6: Cumulative yield on this block by year 5 is 192.5 tonne/ha.

Efficient Branch Structure Key to High Performance

Efficient canopies are stacked with simple, low vigour, highly fruitful branches.

Our observations indicate that the relationship between branch diameter adjacent to the leader or main branch and its length determines productivity and its vigour behaviour.

Branch diameters in the region of between 2 and 3 cm per metre of branch length appear optimum. Once branches thicken beyond this ratio their vigour strengthens and they develop a tendency towards growing shoots rather than fruit.

Branches of this form are developed by running long, slim laterals comprising of short bourse shoots and fruiting spurs. All upright annual shoot growth is either rubbed out during the growing season or pruned off in the winter. At winter pruning any strong annual side shoots are also taken off. Removal of these stronger side shoots is very important because, if left on, the leaf they carry next season is the major contributor to the branch thickening that will limit useful branch life in the tree.

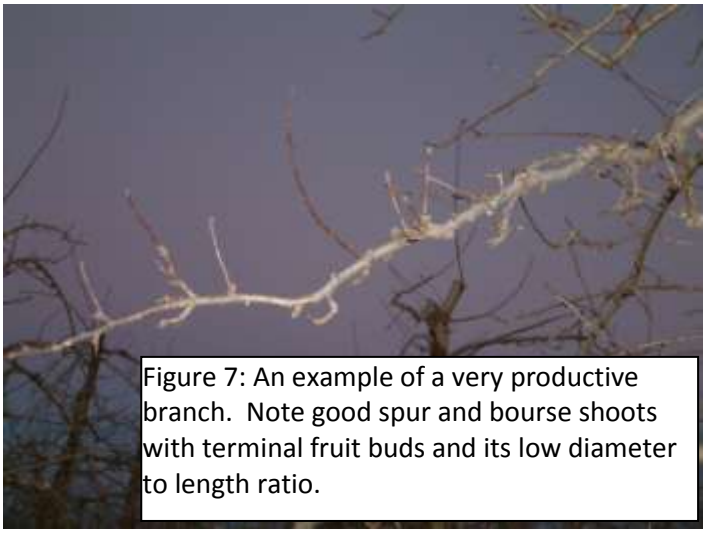

Figure 7: An example of a very productive branch. Note good spur and bourse shoots with terminal fruit buds and its low diameter to length ratio.

These fruiting branches need to be allowed to terminate naturally, so there needs to be sufficient room for this to happen. Containment of branches by shortening where there is insufficient space for them usually destroys the critical relationship between branch length and diameter and this results in turning the branch into a high vigour shoot factory rather than an efficient fruiting unit. Branches that outgrow their space should be removed, not shortened back.

Figure 8: An example of a non-productive, excessively vigorous branch. Note the absence of fruiting sites and vigorous annual shoot growth.

Tree planting density determines branch form. In modern, high density orchards with in-row spacings under about 2 metres, there is only room for simple branches that do not carry sub-branch structure.

Figure 9: Cutting back branches to allow access along the row destroys the fruiting growth balance. This branch will now explode into strong vegetative growth. Don't shorten - take problem branches out completely.

Trees planted at wider spacings, eg, the older semi-intensive planting densities of 5 x 3 metres, lower and middle tree branches may need some structure to enable the canopy space to be filled with fruiting laterals. In this situation the main branch becomes the horizontal equivalent of the leader in the higher density planting with simple fruiting branches of similar form as the high density tree branches falling away to either side of the main branch. Irrespective of planting density, the

upper tree needs to take the form of an intensive orchard type spindle bush in order to allow light penetration into the lower branches between each tree.

How Much Fruiting Wood Do You Need in a Tree?

The answer to this question depends on planting density, variety, tree age, and the ability of the site to support the crop in regard to soil quality and summer water supply. For mature orchards historical performance is a guide to crop potential. In younger plantings, specific crop load expressed as fruit per cm2 trunk cross sectional area (TCA) is often used to estimate crop potential.

Once you have determined the fruit numbers per tree to aim for by one of these methods, it is possible to estimate fruiting wood needed.

There are two methods that can be used to quantify fruiting wood requirements:

I. Fruit per fruitful bud.
II. Metres of fruiting lateral.

Because fruit needs to be well spaced out to obtain high quality, I tend to prefer the metres of fruiting lateral method.

The fruit per fruitful bud method requires good knowledge of return bloom levels, their spacing over the canopy, and likely fruit set details for the site or the variety. Numbers of buds per fruit is usually in the range of 1.5 to 3, but buds need to be well spaced to be usable.

Metres of fruiting wood is easily measured once the parameters of what is fruiting wood have been defined. I usually determine fruiting wood as lateral or small branches carrying fruit bud, with structural wood not included and neither are short laterals under about 10 cm in length.

Fruit density per metre of lateral is usually in the range of 8 to 12. Large fruit that needs to be carried in singles for good colour development have fewer fruit per metre than smaller fruited varieties such as Cripps Pink or the Gala group.

A typical mature intensively planted tree capable of carrying 200 fruit will require somewhere between 16 and 25 metres of fruiting lateral to achieve this cropping level.