Pruning lays the foundation for next year’s crop.

In this series, we have reviewed and highlighted the key points that we made on the Future Orchards 2012 walks and seminars.

This month, we will discuss the role that pruning has on orchard performance and fruit quality.

Dr Simon Middleton, in the paper he wrote for the Future Orchards 2012 programme, February 2007 titled “Maximising the Light Interception and Productivity of Australian Apple Orchards” pointed out that:

“Low productivity in Australian apple orchards is due to either (a) insufficient canopy volume (tree row volume) or (b) excessive tree vigour and internal shading”.

He went on to state:

“Capture 60% of mid-summer light interception. Maintain good light distribution within the tree canopy for high fruit quality and packout (high marketable yield).”

Dr John Palmer went on to reinforce this message later in the Future Orchards 2012 program with this summary:

“Light Interception

High yields cannot be achieved without high light interception. Light interception can be increased by closer planting, taller trees, closer row spacings. Use the light you have to your best advantage.

Light Distribution

High quality fruit cannot be achieved without good light penetration to the fruit.

Excessive tree shading results in: smaller fruit size, less fruit colour, lower soluble solids, delayed maturity, fewer flower buds.”

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Pruning is all about maintaining effective canopy volume, and more importantly avoiding excessive shading within the canopy.

Much of Australia has just been through an exceptional growing season with abundant and sometimes excessive soil moisture levels. With the limiting factor of water stress removed, large numbers of Australian apple and pear trees will have become excessively vigorous, which, if allowed to continue, will adversely impact on future yields and, particularly, fruit quality.

Our experience has been, even with dwarf rootstocks, that if vigour happens to get out of control, it is usually not just a one year event, but can carry on for several growing seasons into the future, unless pro-active measures are taken to overcome it.

Pruning, especially with older, established trees on standard rootstocks, is a key tool for managing excess vigour.

**Leaf to Fruit Ratios**

Leaf to fruit ratios determine fruit size and quality. Weak growing trees with heavy crops usually do not have enough leaves to support the crop. Conversely, higher vigour trees generally have surplus leaf and the excess leaves once the crop load demand for the photosynthates they produce has been met, contribute photosynthates to root growth, further shoot growth and branch thickening.

Dr Terrence Robinson in his visit as part of the Future Orchards 2012 program pointed out that the key to managing higher density plantings is to furnish the tree with small, fruitful branches and laterals on which leaf numbers matched the crop load requirement, so that there was little surplus photosynthesize available for export out of that fruiting unit to fuel unwanted growth elsewhere in the tree. Somewhere around 20 to 30 leaves per fruit is considered to be the optimum leaf to fruit ratio.

Leaf area index (LAI) is another way of expressing canopy efficiency. In their study of Australian apple orchard productivity, Dr Middleton and his team measured leaf area indexes in apple orchards and found it to range from 0.5 to over 3.5. In his paper he quotes that:

“Despite the wide range of varieties, rootstocks and planting densities evaluated, the most productive systems (regular annual yields of 50 to 88 tonnes/ha) were characterized by:

- Diurnal mid-season light interception of 55 to 62%.
- LAI of 2 to 3.
- Yields increased as light interception increased from 55 to 62%.
- Marketable yields increased as LAI reduced from 3 to 2.
- Marketable yields improved as tree height reduced from 1.2 times to 1 times between row space.

We have also observed that, as well as the importance of tree height relative to between row spacings, within row light penetration into the lower canopy is important, so above about 2 to 2.5 m height in the row, there needs to be gap between the trees to allow light into the lower canopy.

These are important factors to consider when pruning.

**Tree Architecture**

Because apple and pear trees generally show strong apical dominance, some form of conical or pyramid shape gives the most efficient tree form.

Vertical leader systems have become dominant around the world because from an engineering standpoint it is much easier to support crop loads as the leader itself is strong enough to support its crop.

Systems with sloping leaders require robust structural support systems because the leader is no longer able to support most of the crop load.

To establish your pyramid tree form, a branch hierarchy made up of largest branches in the lower tree with branches becoming progressively smaller higher up the tree so that in the upper tree branches become little more than fruiting spurs, and short, weak fruiting laterals.

There have been many studies done on branch numbers and form.

Our experience indicates that for most orchard canopies 20 to 25 branches, with any lateral more than about 20 cm coming off the lateral being counted as a branch, per tree are sufficient.

For tree spacing below about 2 m along the row, simple branches with no significant sub-branches are all that is needed.

![Figure 3: An example of a long, slim, pendant branch which because it is largely made up of well spaced strong fruiting buds will be very fruitful and make minimal shading annual shoot growth.](image-url)
At wider spacings, lower and possibly middle tree branches may need some sub-branching which should take the form of slightly pendant structures similar to the simple branches higher in the tree coming off at right angles to the main branches.

Branch strength is a key determinant of branch and tree vigour.

Branch strength is determined by its gradient, and diameter at its base relative to length.

Branches with positive gradients over the primary shoot growth period will have their strongest annual shoot growth from that terminal bud and the steeper the gradient the stronger their terminal shoot growth.

Horizontal or pendant branches will have their strongest annual lateral shoot growth coming from the highest point on the branch.

Branch thickening is determined by the amount of non-fruiting shoot growth foliage on the branch.

In high vigour situations minimizing this non-fruiting leafy shoot material on branches by pruning it off as annual laterals delays branch thickening and prolongs the useful branch life in the tree.

Stacking the tree with slim, well-budded, simple branches is the key to a productive canopy.

Once branches begin to produce excess annual shoot growth, they lose their efficiency as cropping units and should be removed, irrespective of their position in the tree canopy.

Figure 4: This excessively vigorous tree had an out of balance unfruitful lower branch largely responsible for most of the excess vigour in the tree. Now that it has been cut out, its place will be taken by the weaker pendant more fruitful branches above it.
This usually means taking out the biggest branches in the tree on a rotational basis. Do not be afraid of removing large lower tier branches with poor productivity, because they will readily be replaced by weaker, more productive branches nearby that receive better light exposure once the larger, shading branch is gone.

**Tree Containment**

As orchard canopies mature, the trees tend to outgrow their allotted space, leading to shading problems and lowered production of high quality fruit.

Training branches into pendant positions as they reach the desired length is the key to limiting further branch extension. In well-balanced cropping trees, crop load will usually do this for you for most varieties. The exceptions are varieties with a stiff, upright shoot growth habit such as Cripps Pink. Branches in these varieties need to be tied or propped down before they thicken up.

Branches need to be high enough up the trunk to enable them to come down into pendant positions without interfering with orchard floor management practices such as herbicide application or mowing.

As canopies begin to mature, lower branch removal is a key pruning objective. Initially, lower branches below 1 to 1.25 metres are removed. Then, as the higher branches become longer and need more room, the lower ones among them are also pruned out. In mature canopies it is not unusual to have the lower branches somewhere between 1.5 and 2 m up the trunk.

Try not to limit branch length by shortening or “lifting” cuts. If they are too large, cut them out. The exception to this rule is where vigour has become very weak and a little shortening is required to stimulate some active shoot growth.

Branch gradients need to be somewhere between 30 and 45 degrees below the horizontal. In this range, vigour is under control, and still enough light reaches their fruit for good colour development. Steeper pendant gradients tend to suffer too much fruit to fruit shading, resulting in poor colour development.
Excessively strong vegetative branches can be distributed throughout the canopy. These need to be removed irrespective of their position. The idea is to rotate branches out of the canopy as they outgrow their allotted space. This process begins while the trees are relatively young, so that the canopy is made up of mixed age branches, so that there is always a younger replacement branch nearby when stronger shading branches are removed.

The axis of a branch needs to be kept straight. This can be achieved by simply ruthless pruning out of any vertical laterals along the branch. Similarly, the branch can be kept slim by removing any significant side shoots at the end of their first growing season.

Where shortening is necessary, always shorten into a weak downward pointing lateral.

Minimising Sunburn

In warmer climates with bright, high energy sunlight, sunburn is a serious and continual fruit quality problem. The key to minimising sunburn, while still maintaining adequate light exposure to fruiting sites, is to try and set up a fruiting canopy in which there is dappled light and transient movement of sunlight across the fruit as the sun moves around, so that no fruit is exposed to direct sunlight for long periods of time.

This is best achieved by having a canopy stacked with numerous slim, simple branches that move in and out of direct sunlight as the sun moves across the sky.

Also, remember that unless extreme heat occurs, fruit that has been consistently exposed to the sun throughout the growing season develops better tolerance to the sun than fruit that is suddenly exposed to bright sunlight in mid or late summer through either branch movement or summer pruning that suddenly lets the sun onto it.

Managing Fruiting Wood

For most varieties, the best fruit is grown on stronger spurs and terminal buds. Weak, shaded spurs and later flower of one-year wood have lower quality, and in the case of the latter more russet-prone, fruit.

Now that orchard plantings are becoming more intensive there are huge advantages to developing a systemized approach to their tree management, including pruning to bud numbers.

In the ideal world, the best quality and easiest to harvest fruit is that which has been grown as single fruit per site, positioned on sites spread far enough apart so that adjacent fruit do not touch one another.

Setting up the tree to achieve this objective involves having sufficient length of fruit bearing lateral to achieve target crop loads with fruit hanging in singles. Depending on fruit size, crop loading in the range of 8 to 12 fruit per metre of lateral is about optimum. To minimize hand thinning, effort spacing spurs out by pruning is worth considering. This is mostly easily done at the 2nd year wood stage, when spur systems are single buds and easily flicked off by brushing the secateurs or a gloved hand along the underside of the shoot.

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Where spur systems become complex, it is time they were pruned out, or at least thinned down to one or two buds.