Vigour Management

Apart from the market itself, managing tree vigour is the greatest juggling game on the orchard. It is incredibly difficult to get it right over the whole orchard every year.

Orchard performance, fruit quality in particular, and production costs are all determined by tree vigour in one way or another.

The September 2009 Future Orchards 2012 walk notes by Ross Wilson and myself give a detailed synopsis of managing vigour in the orchard.

In these notes we have attempted to define optimum tree vigour, which for young trees is to grow the tree rapidly over the first three to four years in the orchard to achieve full leader height by the end of the fourth leaf, leading to full canopy volume by six years out from planting.

In reality, from the data we have amassed on orchard performance, yields usually continue to increase in a curvilinear fashion through to at least 10 to 12 years after planting, even though it is theoretically possible to achieve full production six or seven years from planting.

Where vigour has been badly mis-managed early in the life of the orchard, it either falls well short of its production potential because the trees fail to achieve full canopy, or production hits a peak early in its life, then falls away because the canopy becomes too dense due to excess tree vigour. Incidentally, both these problems can occur in the same orchard block and possibly even in the same tree row if there is high soil depth variability.

Optimum tree vigour in the mature orchard can be defined as growing enough leaf to size the fruit and protect it from sunburn, yet allow adequate light penetration through the canopy for good colour development. This requires annual shoot extension growth in the region of 20 to 30 cm. Any more annual shoot growth extension than this can be considered excessive vigour and represents a loss in potential production due to photosynthates being diverted to shoot growth rather than fruit.

Provided fruiting wood can be maintained with adequate light exposure, the productive life of fruit buds in apple and pear trees is really quite long, so even with renewal pruning systems there is no need to replace fruiting wood all that often. In well-maintained canopies, the productive spur life is possibly more than four or five years, so you only need to replace no more than 20 to 25% of the fruiting wood on an annual basis. You do not need a lot of new extension growth to achieve this objective.
This month I will cover some of the other vigour management tools with the emphasis on vigour reduction because last year’s wet growing season will have thrown many orchards off balance into excess vigour.

**Controlling Excess Vigour**

Vigour control options include:

- Branch type*
- Pruning style*
- Crop load
- Trunk girdling or scoring
- Trunk incision
- Root pruning
- Growth regulators
- Regulated deficit irrigation

* refer last month’s article.

**Crop Load**

Cropping is the best vigour control tool provided the correct balance between crop and growth is achieved. It falls down where there are big imbalances in the tree, or factors that limit sufficient fruit set.

Where big imbalances between cropping and vigour exist, other vigour control tools will be needed to bring the crop vigour balance into the range where regular cropping will maintain the balance.

Common factors that limit sufficient fruit set include:

- Lack of adequate provision for cross pollination.
- Biennial bearing leading to inadequate flower for a full crop in “off” crop years.
- Excess vigour itself limiting flower density or causing heavy fruit drop.
- Nutrient deficiency - particularly nitrogen.
- Frost
- Shade
- Insect or pest damage to buds.
- Poor drainage/water logged roots over fruit set period.

Many Australian orchards have been netted and this tends to intensify any pollination problems as there is less cross row bee movement in netted orchards. Presence of steep fruit set gradients away from adjacent varieties, or away from pollinators is a sign that something needs to be done about beefing up the pollination.

Biennial bearing is difficult to break out of once it is established. The best management is to avoid it in the first place by building up crop loads as the orchard develops, rather than delaying cropping, then shocking the tree by suddenly allowing a big crop to set. Losing a crop with frost in established orchards is a common trigger for biennial bearing.
Where excess vigour limits fruit set or bud development, other vigour control measures are necessary before crop load can become a vigour control tool.

Where low nitrogen programmes are being implemented to improve fruit colour, make sure that the tree still has adequate nitrogen for fruit set.

Poor drainage and waterlogged roots in spring will inhibit fruit set on varieties sensitive to this problem. Trees with waterlogged roots will also over-react to certain chemical thinning programmes, particularly those involving ethylene release.

**Trunk Girdling or Scoring**

If correctly implemented, this is a very useful vigour control tool.

The degree of vigour control is determined by timing and severity of treatment.

Timing ranges from late bloom through to the December drop period. Around petal fall shoot growth is reduced by 70 to 80%, falling off to 20 to 30% shoot growth reduction at time of natural fruit drop.

Girdling prior to the natural fruit drop period improves fruit retention and may markedly increase hand thinning costs.

Technique also influences response. In New Zealand we have tended to standardise on the Double C technique, in which a bark strip 2 to 7 mm wide is removed from each side of the trunk with 50 mm overlap and 50 mm separation where girdling is done manually. Narrowing the separation distance, or increasing the overlap will increase the vigour control response, while going in the other direction will reduce response. Girdling is a useful technique in blocks with tree vigour variation, because it can be varied according to tree vigour.

Some larger growers have mechanized the girdling using hydraulically operated cutting tools that roll around the trunk. These do not remove a bark strip, but just cut through the bark to the wood in an overlapping ring.

Over the years I have seen high failure rates with girdling due to poor understanding of the technique and poor supervision. To be effective, the flow of photosynthate in the phloem tissue on the inside of the bark needs to be interrupted, but not completely cut off because some photosynthate needs to get through to the roots to maintain their health.
Trunk Incision

This technique involves making two chainsaw cuts into the trunk, one from each side to a distance of one third to one half the diameter of the trunk at a distance of about 50 cm apart.

It is a very aggressive treatment, but very suited to larger trees which are difficult to use the trunk girdling technique on. We do not know a lot about optimum timing, but have seen good results when it is done around the petal fall stage.

The effect seems to last for several seasons, so it probably does not need to be done all that frequently.

Be careful in windy climates because the trunk has been weakened. We have seen trees fall over following trunk incision treatment and this is seen as a risk if upper tree support is lacking, or the incisions are either too deep or too close together.

Even so, there have been some spectacular results from this treatment, particularly when used in conjunction with shortening tree height as well.
In a milder form, using only a hand pruning saw this technique might be a good vigour control tool for scion rooted trees on dwarfing rootstocks in intensive orchards.

**Root Pruning**

This technique is widely used in Europe for vigour control in intensive orchards. Treatment usually begins as the orchard approaches full canopy and is implemented by pulling a cutting blade through the orchard 30 to 50 cm out from the trunk to a depth of 30 to 40 cm to sever the surface feeder roots. Usually only one side of the tree is done at a time.

Typical timing is for the root pruning to be done during the dormant period or pre-bloom period.

Where tree vigour is particularly high, or it appears the first cut has given inadequate vigour control, or the crop has been lost through either frost or biennial bearing, a second root prune to the other side of the tree is done around late spring/early summer.

As root pruning reduces root volume, trees are less able to explore the soil for moisture, so in harsh, hot climates caution and a reliable irrigation water supply is essential to minimize water stress problems if exceptionally hot, dry weather occurs.

**Growth Regulators**

Regalis® and ethephon control shoot growth.

Regalis® is significantly more effective than ethephon and has the advantage of only giving growth control in the parts of the tree that come in contact with the spray.

Ethephon has milder action at the low rates that are normally used, but can be a strong return bloom stimulant.

Regalis® programmes for vigour control need to commence in the early stages of shoot growth before shoot length exceeds 5 cm, and normally needs to be repeated several times at around 3 week intervals over the initial shoot growth flush period.

Where vigour is very high, or shoot growth stalls through stress relatively early in the season, only to be followed ideal growing conditions that stimulates vigorous secondary shoot growth, these shoots can become very vigorous and are not usually responsive to further Regalis® treatment once this secondary shoot growth is underway.

Figure 4: These vigorous 5th leaf Jazz™ responded well to root pruning. The row on the left was not root pruned, whereas the one on the right was.
Where this problem is likely to occur, Regalis® is useful for initial shoot growth control with later season vigour control managed by trunk girdling.

Growth regulators are useful vigour control tools, but need careful and skillful management to avoid undesirable side effects.

They should not be viewed as a replacement for good tree husbandry practices such as pruning and other vigour management options, but as a tool to enhance the effectiveness of these practices.

**Regulated Deficit Irrigation (RDI)**

Under normal Australian growing conditions, this is a vigour control technique ready-made for Australia. It depends on a low incidence of rainfall over the late spring/early summer shoot growth flush period to enable vegetative shoot growth to be shut down by placing the trees under mild water stress through limiting their access to available water in the soil.

In locations which receive good late spring and early summer rainfall, or in seasons when this happens, the technique fails because it is not possible to restrict available soil moisture down to the levels necessary for shoot growth control. Likewise, deep soils with high moisture availability are also unsuited to RDI for growth control.

Pears and most stonefruit respond well to RDI. It is less suited to apples, because it can induce fruit cracking problems once normal irrigation is restored in the run-up to harvest for fruit sizing.
Apples are also more sensitive to sunburn, with trees under water stress more likely to be affected than those with a ready soil moisture supply should unseasonally hot weather occur while the orchard is under a deficit irrigation regime.

**Summer Pruning**

Pruning out excess shoot growth during the growing season has a devigourating effect, because it removes leaf area before it has fully contributed to carbohydrate storage in the rest of the tree. Furthermore, once crop load is coming onto the tree, there will be much less new shoot growth response when structural cuts are made, such as leader topping to bring down tree height.

Summer pruning can be a useful tool for vigour management when used wisely, but a better long-term solution is to cut excessively strong branches prone to excess vigour out of the tree altogether in the normal pruning programme as was discussed last month.