

## Growing Season Vigour Management

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Cropping is the best vigour control agent available for orchard crops. Once a full canopy has been achieved, annual shoot growth should be in the range of 20 to 30cm. Trees showing annual shoots in excess of 50cm length are excessively vigorous. Branches producing annual shoot growth of this length or more are not carrying sufficient crop load to absorb the carbohydrate being produced by photosynthesis in their leaves, so the surplus is channelled into shoot growth and in extreme cases is also exported out of that branch to fuel vigour elsewhere in the tree, or build an ever-stronger root system that will drive even more vigour next year.

Securing good fruit set is, therefore, critical to tree vigour control as well as ensuring adequate cropping for satisfactory orchard profitability.

Where tree vigour is really excessive competition between growing shoot tips for carbohydrate and the developing fruitlets can suppress fruit set because the growing shoot tips are a much stronger sink for metabolites than fruitlets. Before widespread adoption of dwarfing rootstocks, excess tree vigour was a common cause of fruit set problems, and where orchards contain high vigour rootstocks could still be a factor in poor fruit set.

### Managing excess vigour

We have observed a strong relationship between branch size, expressed as branch diameter relative to branch length and branch vigour. The shorter the branch and the larger its diameter, the stronger annual shoots it will support.

Branch gradient is another factor in tree vigour. The steeper the branch the more likely it will grow long terminal shoots towards its end (Figure 1). This is due to apical dominance, which is very strong in pome fruit. Where you are building tree canopy this is a very positive feature, but once the branch is long enough to fill its allotted space further extension growth becomes a problem.

If there is significant vigour in a tree, branches near the horizontal are likely to sprout excessively vigorous shoot growth more or less along their entire length. This causes much of our within-canopy shading problems, leading to poor fruit colour development.

Pruning styles are critical to setting up the right branch structure for a calm, productive fruiting canopy. As the dormant season pruning should now be completed, this month the focus will be on techniques that can be implemented over the next two or three months to manage vigour.



Figure 1 (left): These upright untrained second leaf branches are showing vigorous extension growth from their terminal buds.

Figure 2 (below): These second leaf laterals were similar to those in Figure 1, but have been trained down to 30 degrees below the horizontal earlier in the spring. Note the better bud break along their length, and weaker terminal extension growth compared to Figure 1.



Once the tree or branch has filled its allotted space, training branches down into a pendant position between 30 and 40 degrees below the horizontal (Figure 2) is an effective way to devigorate them and settle them down into a heavy cropping mode. Late summer or autumn, once terminal shoot growth has slowed or stopped, is considered by some pomologists to be the best time for branch training. In hot climates where sunburn is a major problem on fruit, this may not be the best time for training branches down, unless it is left until after harvest.

Late spring before the weather gets really hot is another time that branch training can be done. The sap is flowing well, branches flexible, and increasing crop weight will often do some of the job for you with a little help to send it on its way. When the trees are in leaf, branches will set in their new position in only two to three weeks. Some varieties tend to be a bit brittle in the crotch and will easily snap out if the training technique is poor. Try not to put a straight pull on the branch. It is much better to wind it sideways into its pendant position. This sideways action puts minimal stress on the crotch union so the branch is less likely to come off in your hand while you are trying to bend it into the new position. Often the branch may split, but this is not a problem because within two to three months the wound will heal.

While late spring early summer is too late to influence fruit set where vigour is excessive the distribution and type of annual lateral shoot growth is much better suited to forming a good fruiting lateral material than the forest of vertical shoot growth that arises from either dormant or pre-bloom branch training.

Incidentally, once branch diameter exceeds about 20mm, branches stiffen up and become very difficult to deal with. This is particularly so with Cripps Pink, which has very stiff, upright growth.

Do not over-train branches towards vertical pendant positions because this can lead to major fruit colour problems due to within-branch shading towards the end of the branch.

### Summer Pruning

Judicious summer pruning can be a helpful vigour control technique if well executed. There are two very useful summer pruning techniques worth consideration:

- Late spring stripping of water shoots.
- Early summer stubbing back, or snapping over stronger growing current season shoots to devigorate them and force fruiting bud development.

Late spring stripping of water shoots is useful for dealing with strong upright lateral growth that will inevitably arise from the high point of a branch that has been trained down, or from excessively strong growing branches. In the case of the latter situation complete branch removal during winter pruning is a much better option. Plucking, or stripping out unwanted shoots is a much better option than cutting them out because it removes the adventitious buds at their base, leading to much less regrowth.

Timing of shoot plucking or stripping is quite critical because if the shoots harden off too much they become too difficult to pull out. Doing the job just ahead of hand thinning is about the correct timing and its best done as a separate job. If the job is done well it will make hand thinning much easier too because the fruiting sites become more visible.

Early summer snapping or pinching back current season shoot growth that is not required for further tree structure development is an effective way to devigorate the shoots. It has the bonus of stimulating fruiting spur development out of current season shoot growth, thereby hastening fruiting in young trees. It's also a way to avoid (some of) the need for expensive branch tying.

This late spring, early summer shoot tipping is also the technique that Alberto Dorigoni uses in the development of his fruiting wall concept. The technique helps to control tree form and stimulate fruit buds to build a narrow compact tree form. The APAL Future Orchards® website contains the presentation he gave during his visit to the southern loop Future Orchards field walks and is well worth looking at.

Under South Tyrol growing conditions for orchards planted on dwarf rootstocks with relatively low vigour Alberto found tipping shoots at the eight to 12 leaf stage, which he does mechanically, gives the best flower bud differentiation response.

I did some summer shoot stubbing a few years back on young Scifresh (Jazz™) trees to improve the quality of flower bud available for early cropping and avoid the need for branch training to control vigour. In this instance, the trees were growing on MM106, which here is a moderately vigorous rootstock, and I looked at late December, early January pruning timing. Current season's stronger growth in the upper tree was headed back to three to five buds. This gave a good response with each cut shoot growing two or three weak shoots that terminated in flower buds with the overall effect of compacting the fruiting zone closer into the leader compared to the uncut shoots (Figures 3, 4, 5 and 6). After viewing Alberto Dorigoni's Future Orchards presentation, I think the stubbing could have been done two or three weeks earlier in the season, leaving a few more buds on the stubbed shoots to improve chances of stimulating more short terminating shoots and spurs.



Figure 3: The effect of summer shoot stubbing of stronger current season shoot growth. Regrowth is weak, but still terminates with a strong fruit bud.



Figure 4: The stronger growing shoots in the upper tree shown here were left to grow normally. Note their vigour compared to those in Figure 3.



Figure 5: Summer stubbed shoot regrowth flowering in the following spring. Note the concentration of flowering close to the central leader compared to the three stronger shoots that were not stubbed.



Figure 6 : Close up of flowering on stubbed shoot regrowth.

This type of summer pruning or stubbing is clearly a useful vigour management tool that could be very useful for cultivars that tend to be a little tardy in producing good flower buds, or perhaps varieties prone to growing bare wood such as Kanzi.

Shoot cracking, or breaking in late spring, early summer is another variation on pruning shoots back and can stimulate similar regrowth and bud development responses. It differs in that retaining the distal part of shoot beyond the break which is now weakened leaves a few more potential bud development sites.

Timing for implementing both of these vigour management practices will undoubtedly vary depending on cultivar, rootstock, tree vigour and length of growing season. It is clear, however, that where vigour is already low to moderate the pruning will need to be done earlier in the growing season, than where growth is stronger.

### Trunk Girdling and Incision

These are very powerful vigour control tools when correctly implemented (Figure 7).



Trunk girdling or scoring and cincturing as it is sometimes referred to, involves severing the phloem to interrupt most of the photosynthates being translated down to the roots (Figure 8).

To keep the roots healthy, active and able to source the water and minerals the tree needs, this flow cannot be completely cut off, so some phloem tissue between the upper tree and roots needs to remain intact. This can be achieved by overlapping rather than joining up the trunk cuts, or using the 'Double C' technique, in which cuts through the bark down to the wood are made on either side of the trunk at different levels, with the ends of each of these cuts overlapping the one on the other side. The degree of overlap and distance between the two cuts determines the level of response. The smaller the distance between the two cuts, or increasing the amount of overlap they have, will increase the severity of the treatment. The specification we generally use for the Double C technique is 50mm separation between the cuts, and 50mm effective overlap. This is a good starting point to work from.

By effective overlap we mean the amount of overlap that has visible trunk wood showing, not the superficial bark scratching distance. Usually with the Double C a bark strip is removed, but this is not really essential for it to work. Removing the bark strip makes checking the quality of the work easy.

**Figure 8: To be effective, girdling needs to be done correctly. Only the middle girdle on this trunk would have had any effect. Note the callus response from its wound. The others failed to penetrate the bark. To be effective, the cut must penetrate down to the wood below.**

The Double C technique is usually practiced on trunks over 70 to 80mm in diameter.

For smaller trees the overlapping ring sometimes referred to as scoring made with a knife or pruning saw is preferred. Specifications for this technique are generally 10mm overlap and 5mm separation where they join.

Some of our fruitgrowers have developed tools for mechanising trunk girdling. Generally these work by cutting through the bark to the wood without removing any of the bark. Well adjusted these tools are capable of girdling quite large trunks.

Timing of girdling has quite an impact on its response. The girdling window runs from around petal fall through to about early to mid-December. Petal fall girdling gives the greatest reduction in tree vigour. Depending on technique and level of tree vigour more than a 50 per cent reduction in tree vigour is possible from petal fall girdling.

Vigour response is progressively less with later girdling times becoming ineffective once terminal shoot growth ceases. The down side of early girdling treatments is that the natural fruit shedding process is restricted, so unless vigour is so strong that it is resulting in poor fruit set, it is best to delay girdling until the fruit drop becomes obvious, otherwise hand thinning will be very expensive. Girdling at times of natural fruit drop is still capable of lowering shoot vigour by 20 to 30 per cent, as well as being a powerful tool for improving return bloom.

Incidentally, there is also a later girdling window up to within three or four weeks of harvest. Girdling at this period will have no impact on current season tree vigour or return bloom, but we have some indication that this late girdling could lead to lower vigour in the following season.

One of the effects of girdling is to drop nitrogen levels in the tree. This effect lasts four or eight weeks before levels begin to increase towards levels of un-girdled trees, but even as much as 14 or 15 weeks later leaf nitrogen levels are still less than untreated trees. Where fruit colour development is poor due to excess nitrogen levels, trunk girdling is an effective technique for addressing high nitrogen levels in the tree that are impacting on colour.

Other effects of girdling on fruit behaviour which need to be considered is that fruit maturity can be advanced in some varieties and this can affect harvest dates and possibly storage life. Early girdling can lower fruit size if vigour is shut down too much, or fruit thinning insufficient, as well as increase sunburn risk. Later girdling on the other hand can increase fruit size and brix levels.

Trunk incision, a technique which involves saw cuts into the trunk to sever both phloem and xylem tissue is an even more aggressive vigour control tool than girdling. A saw cut is made either side of the trunk, each cutting between 30 and 50 per cent across and spaced at least 50cm apart to minimise the risk of the tree snapping at one of the trunk incisions. I have seen it done in Tasmania with good effect on trees with very excessive vigour. It is well suited as a last resort to tame down very large older trees that is difficult to girdle, or where girdling has been ineffective.

Trunk incision is also an effective way of dealing with scion rooting.

We do not know a lot about timing of treatment, but have seen satisfactory results where it has been done in the immediate post-bloom period on excessively large trees that have been topped to reduce tree height in the winter pruning.

The effects of trunk incision are much more persistent than girdling and will carry on for several growing seasons. Little is known in regard to treatment intervals, or if retreatment several years later is necessary to maintain vigour control.

## **Growth Regulators**

In recent years growth regulators, predominantly prohexadione-calcium (Regalis®, or Apogee® in North America), have become important vigour control tools for apples.

Where they are well-managed, and an integrated approach with other vigour control measures is taken, they are very effective.

As with all growth regulators, they require skilful management to get the best out of them.

As well as prohexadione-calcium, ethephon and paclobutrazol (Payback®) also retard vegetative growth, although paclobutrazol only has label claims for use on Red Delicious and Granny Smith in Australia.

Prohexadione-calcium is generally not recommended for use on pears because it suppresses flower bud development.

### **Regulated Deficient Irrigation (RDI)**

RDI, which was developed in Australia at the Tatura Research Centre in Victoria, has good potential in Australia's lower summer rainfall environment for vigour control in pears and apart from trunk girdling treatments is probably the only effective vigour management tool for controlling excess vigour in established pear orchards.

As RDI tends to increase fruit cracking in apples, it has not become a widely used tool for controlling excess vigour in apple orchards.

### **Illustrations**

#### **Figure 1**

These upright untrained second leaf branches are showing vigorous extension growth from their terminal buds.

#### **Figure 2**

These second leaf laterals were similar to those in Figure 1, but have been trained down to 30° below the horizontal earlier in the spring. Note the better bud break along their length, and weaker terminal extension growth compared to Figure 1.

#### **Figure 3**

The effect of summer shoot stubbing of stronger current season shoot growth. Regrowth is weak, but still terminates with a strong fruit bud.

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The stronger growing shoots in the upper tree shown here were left to grow normally. Note their vigour compared to those in Figure 3.

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Summer stubbed shoot regrowth flowering in the following spring. Note the concentration of flowering close to the central leader compared to the three stronger shoots that were not stubbed.

#### **Figure 6**

Close up of flowering on stubbed shoot regrowth.

#### **Figure 7**

Trunk girdling is a powerful return bloom tool. This orchard was extremely biennial with an "on" crop last year. The trees on the right were girdled at thinning time. Those on the left were not girdled.

#### **Figure 8**

To be effective, girdling needs to be done correctly. Only the middle girdle on this trunk would have had any effect. Note the callus response from its wound. The others failed to penetrate the bark. To be effective, the cut must penetrate down to the wood below.

