

# Training young walnut trees

Heather North, NZWIG research sub-committee, October 2007

## Introduction

The research sub-committee of NZWIG conducted a 3-year experiment on training of young (pre-cropping) walnut trees, which finished in winter 2007. After the first two years of measurements we published a progress report in Issue 63 (Winter 2006) of *Health in a Shell*. The current article is the final report on the project, and is in three parts:

1. The basic principles of tree training, summarised from David Murdoch's chapter in the *NZ Walnut Growers Manual* and other sources.
2. What we can add to this knowledge from the NZWIG experiment.
3. A description of two new training/pruning experiments established in winter 2007.

## Principles of training

We begin by summarising the main principles of training young walnut trees, with reference to Murdoch (2003), Vavasour (1984) and Ledgard & Giller (1996).

*Why train young walnut trees?* We are aiming for a strong branch framework. The natural vase shape of many walnut cultivars is not well-suited to New Zealand's windy conditions (resulting in breakages), so we train to a modified centre leader system that does not have multiple branches at a single point on the trunk. This training system also allows good sunlight penetration for fruit set. Removing low branches means easier orchard management, and you may even aim for a good timber butt log. To maximise production from your land, the fruiting canopy should cover a large fraction of the area as quickly as possible. Depending on your tree spacing, this usually means training for vegetative growth in early years before switching to a focus on cropping at about age 6.

*What training system to use?* In low density plantings (eg, 10x10m) you will need to promote vegetative vigour as first priority for at least 6 years to get canopy cover (the normal modified centre leader described in the *Growers' Manual* is suitable for this). With medium density plantings (approximately 7x7m) it is fine to allow some cropping to start in year 5 or 6 as you don't need to push vegetative vigour quite so hard (the minimum pruning option of modified centre leader is suitable here). High density hedgerow plantings (eg, 4x7m) can start cropping early. Here you can use centre leader pruning to select the trunk and branches in the early years, then each row is side pruned every few years with a mechanical hedge trimmer. With any system, you will tweak the training according to cultivar, and the windiness and growth rates on your site.

*The basics:* If you do nothing else, and irrespective of the training system you use, you SHOULD each year: (1) remove suckers from below the graft, (2) select a single leader ie. remove any competing leaders, (3) remove any damaged/broken shoots, (4) thin out crossed/crowded branches.

*Tree vigour and canopy removal:* Any removal of canopy means less energy supply from leaf photosynthesis for tree growth. But if you don't do some form pruning, you will get lots of growth in inappropriate/useless places where you don't want it. The key is to

remove a controlled amount of unwanted material each year. The potentially negative impact of branch removal is balanced by the fact that there are now fewer buds (growing points) to be supplied by the full root system – so the remaining (wanted) buds should grow vigorously. A rule of thumb in pruning for timber production is to not take off more than one third of the canopy at any one time. This idea is explored further in our own experimental results.

*Evolution of training:* Training a 1-year-old tree is not the same as training a 4-year-old tree! The pruning cuts evolve as the tree ages, as described in the *Growers' Manual*. In the early years, you are just working on a straight strong trunk, then by about age 3 or 4, you will be starting to choose permanent framework branches.

*What NOT to choose as permanent framework branches:* (1) Remove branches that have bark inclusion or a steeply ascending angle, (2) don't select branches on wood of the same year's growth – and it's even better if branches are two years younger than the trunk as they are less likely to become dominant, (3) don't keep more than one branch at the same height on the trunk, (4) remove branches that are competing with the leader.

*Heading vs thinning:* If you want to promote vigorous growth from a leader or branch, then head it. If a branch is unwanted then remove (thin) it completely. ie, don't head an unwanted branch, as it will only encourage it! If you just want to keep the branch temporarily (to produce energy for the tree) but don't want it as a permanent branch, then it is best just to leave it alone until it is time for complete removal – again, don't head it otherwise it will grow vigorously. If you head a high branch, then also head the leader to ensure it grows vigorously and remains dominant over the branch.

*When to prune?* In general, prune in winter, except for very young/small trees which may be affected by spring frosts, and in areas with late frosts such as Central Otago. In these cases, prune after the worst of the spring frosts are over.

*Pruning cuts and equipment:* See *Growers' Manual*.

## **Results from NZWIG training experiment**

The details of the experimental method can be found in the progress report in Issue 63 (Winter 2006) of *Health in a Shell*. In brief, a total of 216 trees across 3 Canterbury orchards were included in the trial. These trees were 2- and 3-years-old at the start, and the experiment ran for three years. Each year we measured the impact of hard, medium and light training treatments on growth and form of these young walnut trees.

*Hard training:* Remove all branches. Head the leader back to round wood – this usually means cutting below the closely spaced nodes at the top of the early-season growth.

*Medium training:* Remove branches if they exceed half the diameter of the trunk or are directly competing with the leader. Head the leader lightly, removing highly fluted material but staying in the late-season growth above the closely-spaced nodes. Boron levels were elevated on half the medium-trained trees to see if this would improve apical dominance, but we observed no effect so this will not be discussed further.

*Light training:* Remove branches if they exceed two-thirds the diameter of the trunk or are directly competing with the leader. Do not head the leader (but nutlets are removed from terminal bud in spring).

As the trees got older, we also selected and retained the first few permanent framework branches, using the same rules as those for the leaders in each of the treatments above.

*Main findings and recommendations:*

Hard training in the first two years provides strong, straight shoots for leader selection. We observed no significant reduction in growth compared to light training, as measured from trunk diameter and tree height gains. Though the leader is cut harder, the longer shoot growth makes up for this. **Hard training is recommended for the first two years (and possibly even a third year for smaller trees).**

From year 3 or 4 onward, it is no longer a good idea to remove all branches, as we observed a significant growth reduction in the hard trained trees at this age (a smaller increase in both tree height and trunk diameter). There was also significantly more staggy growth and branch twisting and breakage on hard trained trees than on medium or light trained trees at this age, as the current season's shoots are so much longer on hard trained trees.

We believe this is due to the large volume of material being cut off, relative to the size of the tree. For example, the 4-year-old trees were 2.5–3.0m in height, and the hard training treatment required the removal of 8-10m of shoot length (a ratio of over 3 in length of material removed to total tree height). In comparison, the 2-year-old trees were around 1.5m high, and the hard training treatment required the removal of 0.5-1.0m of shoot length (a ratio of less than 1 in length of material removed to total tree height). Thus hard training of the 2-year-old trees was not severe, whereas hard training of the 4-year-old trees was too severe.

If you are able to start retaining permanent framework branches at age 3-4, this should minimise growth reduction from excessive canopy removal. However, in any case, **we recommend you move toward the medium training option from year 3 or 4 onward.** This means you will be retaining the smaller branches temporarily, as long as they are not competing with the leader.

**It is still very important to actively select the leader** (remove the competition, otherwise you will end up with a vase, not a modified centre leader tree). However you will only be removing the biggest of the unwanted branches each year, not all of them. Remove any that are larger than about half the trunk diameter, and any that are larger than 3cm (unless you are retaining them as permanent framework branches).

The light trained trees appeared to be marginally shorter than the medium trained trees by the end of the experiment but this difference was not statistically significant in most cases. They had similar trunk diameter to the medium trained trees. The light trained trees did not look pretty in that they had many large branches down low, and the leader seldom grew from the terminal bud, but from a side shoot overtaking the terminal (note, however, that even with the light training treatment there is still active selection of a single leader). Overall we observed few measurable disadvantages to either growth or form from the light training option during the course of the experiment.

The problem would likely arise if the experiment continued in that (1) the light trained trees will start to fruit heavily leading to less vegetative growth, and (2) the low branches will increase in diameter until you have to take them all off at once, giving the tree a big hit. Medium training is better as you have a steadier programme of branch removal.

However, for trees of 3 years and over, it is probably reasonable to train at the light end for dense plantings (gaining more early production but less growth) and the medium end for medium spacings (more vegetative growth and less early production). We will be testing this idea in one of our new experiments, described below.

## **New experiments**

We learned a great deal from the training experiment above, and now have further questions. So after the final measurements were made in June 2007 for the first experiment, we then set up two new, smaller experiments to answer these.

### *Experiment 1: Refining the medium training method for trees 3–6 years old*

In terms of branch removals and resulting vigour, the medium training treatment appears to be the best option for trees 3–6 years old. However, we have not come to a conclusion about whether the light heading cut in the current medium training definition is sufficient, or whether, as many experts say, the heading cut should be down into round wood. So we have designed an experiment that uses medium pruning rules for branch removals on all trees, but half are headed lightly (as in the original medium train treatment) and half are headed hard (as in the original hard train treatment).

There are 60 trees on one orchard (6-years-old) and 84 on a second orchard (5 years-old) involved in this trial, with both orchards in Canterbury. In June 2007, half the trees on each orchard received the hard heading cut and half the light heading cut (all received medium training of branches). The height and trunk diameter of the trees were measured prior to treatment so we know the starting point. They will be measured again in June 2008, and the treatments re-applied. We will apply the treatments for 2–3 years.

### *Experiment 2: How does pruning affect yield?*

Vegetative growth is the primary interest in the early years, but once cropping starts at around 6 years old, how can we best balance continued tree growth with yield? We understand that there is a trade-off between reproductive and vegetative vigour, but it would be useful to know (quantitatively) to what degree vegetative vigour is reduced if you prune for early cropping, and to what degree yield is reduced if you prune for vegetative growth.

There are 52 trees on each of two orchards (both in Canterbury) involved in this trial (the trees are 6-years-old on orchard and 7-years-old on the other). Under normal pruning they would be expected to produce at least 0.5kg of nuts in autumn 2008 (though the spring 2007 frost may reduce this). In June 2007, half the trees on each orchard were pruned to remove mainly the fruiting wood and half to remove mainly the vegetative shoots. The pruners attempted to ensure that about the same amount of wood in total was removed under each treatment. As with Experiment 1, the trees were measured prior to treatment and will be re-measured in June 2008. The yield from these trees will be measured in April 2008 to see if there is a difference between the treatments.

## **References**

- Murdoch D. 2003: Training young walnut trees. In: *New Zealand Walnut Growers Manual*, NZWIG, Nelson, New Zealand.
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