Trellis pruning and training

What is tree training?

Tree training sets up the tree structure by pruning or bending limbs into position.

- Pruning trims or cuts branches or stems to encourage growth and removes dead, dying, and diseased branches or spent terminals
- Bending is the process of positioning branches and securing (tying) them in a horizontal or angled position.

Why do it?

Tree training develops a strong tree structure, slows growth, reduces vigour and helps bring a young tree into production earlier.

Types of training systems

The espalier system (Figure 1) is the most commonly used mango trellis training system and trains branches horizontally along the wires (a & b). This system is the simplest and easiest design to implement. Training branches horizontally along the wires is also a very successful method to reduce branch vigour. The palmette system (Figure 1, c & d), trains branches to follow the natural growing habit of the tree into a fan or palm shape that fills in the trellis. A benefit of the palmette system, is that it is similar to natural tree growth, and may more rapidly fill the trellis structure. Problems with this system include the semi-vertical branch training does not restrict branch vigour as well as horizontal training and that the diagonal natural tree growth can be difficult to train onto trellis wires and enable pruning to create regular secondary and tertiary branch whorls.

(a)

(b)

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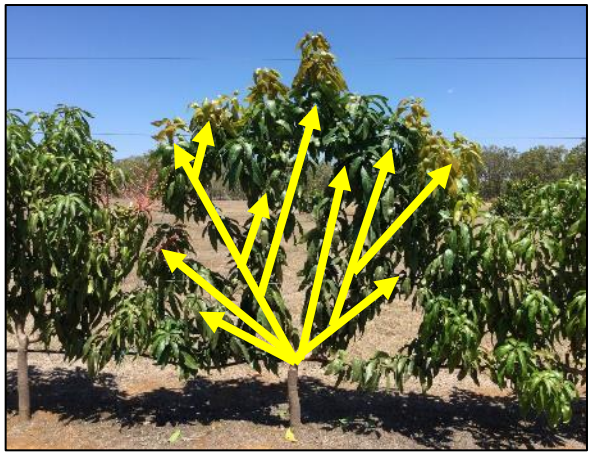
(c)



(d)

Figure 1. Trellis training systems – a & b espalier; c & d palmette

Pruning for trellis designs: Espalier training system

Mango trees grown using the espalier trellis method consist of a primary central leader branch that is trained vertically towards the top wire. Secondary lateral branches are trained horizontally along the wires of the trellis and attached with rubber ties or baling twine. The secondary lateral branches are pruned every 15 to 30cm to produce tertiary branches (Figure 2). For maximum productivity, it is critical to develop numerous tertiary branches along the secondary lateral branches, as these are the sites where flowering and fruiting occurs (Figure 2).

For a video on how to prune and train espaliered mango trees please view the High-density mango orchards: espalier trellis video on the Queensland Agriculture YouTube channel.

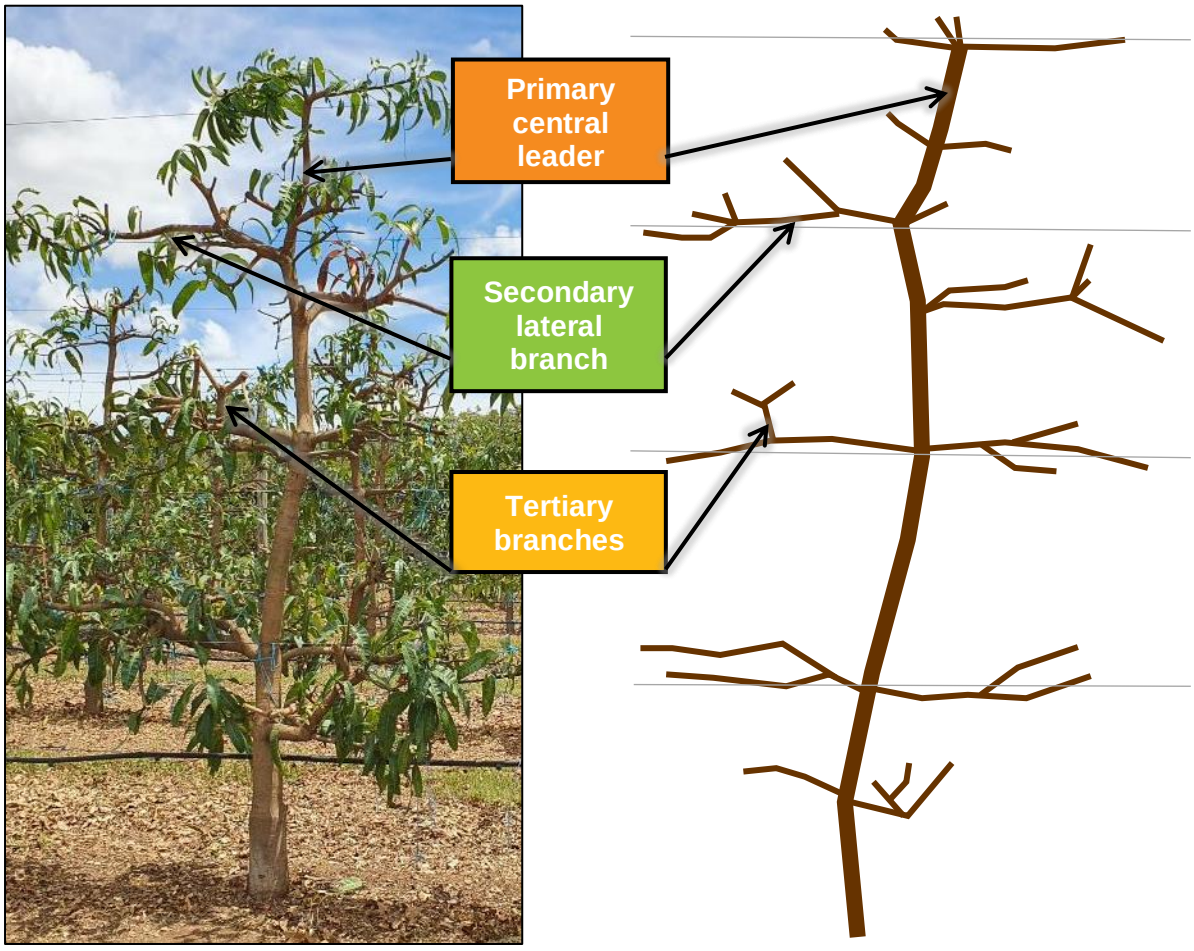


Figure 2. Espaliered mango trees consist of a central leader grown from the ground to the top wire; secondary lateral branches grown along the wires and tertiary branches that emanate from the secondary lateral branches and produce flowers and fruit.

Equipment required

To prune and train espaliered mango trees you will need:

- A good pair of secateurs
- Rubber ties for securing branches to wires (Figure 3a). Rubber ties stretch which reduces the risk of constricting branch growth
- Baling twine or similar for branch training tasks where rubber ties are unsuitable (Figure 3b)
- Scissors or knife for cutting twine. Alternatively, secateurs can also be used
- A ladder. This will only be required once the trees have reached the higher trellis wires

(a) (b)

Figure 3a. Rubber ties are used to secure the tree branches to the wire;
Figure 3b. Where rubber ties are not long enough or unsuitable, baling twine may also be used.

First prune

The first prune should be above the first wire to ensure branching occurs above the wire, not below. The aim is to always bend limbs down to a wire, not up, as bending branches reduces vigour. Pruning above the wire ensures branches are bent towards to the wire. Ideally the first prune will be above the wire and below a whorl of leaves, where there is a minimum of three or more evenly spaced axillary buds present. Pruning here will stimulate the buds to form branches that will become the single leader and lateral branches (Figure 4).

If there are no suitable options immediately below a whorl, trees may be pruned immediately above a whorl. This will result in multiple branches initiating from the same point which could become a weak junction. However, it will provide multiple options for selecting the laterals and central leader. The main aim is for the first prune to be **above** the first wire. Remove any shoots that develop below the first wire and below the graft union (Figure 5).

Figure 4. It is best to wait for the tree to grow above the first wire before completing the first prune. Once there are three or more evenly spaced leaves above the first wire, prune above the topmost leaf, ensuring the axillary bud is retained. Avoid pruning immediately above a whorl of leaves or below the wire.

Figure 5. Remove branches that grow below the first wire or below the graft.

The first limb training

The first limb training should be completed after flush has matured. Young flush is delicate and can easily snap, so it is important to wait until flush is fully developed. Select the most vigorous branch to be the central leader, preferably a branch that emanates from the middle of the tree (c). The central leader can be left free growing if it is growing vertically towards the second wire, or baling twine can be used to encourage upright growth (d).

(c)

(d)

Select one to two branches on each side of the central leader to become the secondary lateral branches. Attach these to the wire using rubber ties or baling twine (e). The key to remember is not to tie the branches too tight. The plant is *encouraged* to grow along the wire; not *forced*. Tying it back too tightly only restricts movement and growth and can cut into the branches. If there are two lateral branches on each side, tip one lateral branch at 15 cm and the second branch at 30 cm to produce the tertiary branches on each side of the central leader. If there is only one secondary lateral branch on each side, tip each at 15 cm (f). If there are more than four branches, thin branches back to four branches by removing water shoots and vertically growing shoots, retaining downward or outward facing branches where possible.

(e)

(f)

The second and subsequent limb training

Once the lateral branches have produced shoots and they have hardened off, choose one to continue along the wire as the lateral and tip-prune the remaining branches to form the tertiary branches. As with the first limb training, remove water shoots and vertically growing shoots. The preference is for downward or outward facing tertiary shoots as these will produce the tertiary branches that produce the flowers and fruit. Upright branches can become dominant if not removed. This can starve the secondary branches which in turn provides fewer resources to the tertiary fruiting wood.

After the second growth flush has matured, again select one branch to continue along the wire, prune it at 15-20cm and tip-prune the remaining branches to form the tertiary branches. Pruning in this way will result in tertiary branches evenly spaced along the secondary branches giving rise to well-spaced fruiting terminals along the entire wire. Mangoes are terminal bearers, meaning they only produce flowers and fruits at the ends of their branches. If the secondary branches are not tip-pruned frequently along the wire but are instead left unpruned to elongate along the wire, the likely outcome is fruit bearing occurring only at the end of each branch.

When the primary central leader has grown above the second wire, prune again to produce lateral shoots and follow the same process as for the first wire. Both vertical and lateral pruning and training can be carried out at the same time. i.e., it is not necessary to wait until the tree has filled out the first wire, before undertaking pruning and training at the second wire.

Annual maintenance

After harvest, prune tertiary branches back to the first or second growth flush from the lateral branch. In older systems, a hedging machine can be used first, to remove most of the biomass, however hand pruning will still be required to complete the pruning process.

Inspect ties and baling twine regularly to ensure they are not restricting plant growth or cutting into branches and remove any that are no longer required. If in good condition, rubber ties can be reused.

Pruning and training once tree shape established (5+ years)

After the trees are mature and all laterals and sub-laterals have been established, pruning is required twice per year – once, after harvest to bring branches back to the sub-laterals and remove water shoots (Figure 6) and once after flowering and fruit set to remove unfruitful branches and control excessive vegetative growth. Avoid removing too much foliage close to harvest as this can cause sunburn on the fruit (Drinnan *et al.*, 2018).

Figure 6. Mature espaliered mango trees should be pruned back to the first or second growth flush immediately after harvest.

Limb training: when to do it?

Pruning encourages a heavy vegetative response and should be conducted regularly over the first five years to develop the desired branching structure, as quickly as possible. If pruning is not conducted regularly then a lot of vegetative growth may be removed (and wasted) when cutting branches back to achieve the desired 15-20cm branch length. Avoid training branches before flush has hardened off, as the developing stems and branches are fragile and prone to breaking.

Training fundamentals

Lateral branches should be kept smaller than the leader. The main branch can become starved if the subsequent branches become too dominant or vigorous. A good rule of thumb is that laterals and sub-laterals should be no larger than ½ to ⅓ the diameter of the branch from which it originates. Leave companion branches to replace dominant branches over time with ones that are less vigorous. Gravity will assist with maintaining horizontal branches over time, especially once trees start to flower and fruit.

Remember to check rubber ties and strings regularly to ensure they are not cutting into developing branches (pictured). Remove or replace ties before they cause damage, as this can provide entry points for disease.

Key references

Drinnan, J., Wiltshire, N., Diczbalis, Y., Holden, P., and Thompson, M. (2018). Improving the capacity of primary industries to withstand cyclonic winds. AgriFutures Australia, New South Wales.