Plant & Food Research
Rangahau Ahumāra Kai

ALL ABOUT ALMONDS

Almond planting and early tree establishment — a researcher's experience

Part 2. In the orchard — tree staking and tying

A stronger tree shape is produced by planting a taller tree and promoting extension of a central leader.

Plant & Food Research began working with the almond industry in 2014 to help re-design almond orchards. This meant taking a fresh approach to lift productivity above the norms established by Californian growers.

Knowledge generated from this study is helping the almond industry move towards higher profits from new, high density growing systems.

Dr Grant Thorp and Ann Smith

Once growers have received their trees, the race is on to have these planted and pruned/trained to develop a strong fruiting canopy sufficient to produce their first commercial crop. Mistakes made during this phase can create unstable canopies prone to severe limb breakage all of which incurs additional costs for the grower to remove or re-stake the damaged trees.

Our research has evaluated a number of options as alternatives to the traditional "heading cut and trim" tree type and open-vase pruning method for early tree management.

The focus has been on planting a taller tree and promoting extension of a central leader so that scaffold branches are evenly spaced along the trunk rather than condensed into a narrow branching zone that is prone to breakage.

In this article we describe our experiences with these different tree training options and the new approaches we introduced into our research trials. But first we discuss our experience with tree staking and tying.

Tree staking and tying

Most growers will use wooden stakes or wires to support the newly planted trees (Figure 1). Both methods come with substantial cost for installation and removal. If not correctly installed, the stakes or wires themselves can damage the trees by rubbing against the trunks and damaging scaffold branches, creating an imbalance in tree structure which further destabilises the tree. Growers are also well aware of the ongoing cost to come through their blocks during winter to re-stake and/or re-train trees that have blown over or suffered major limb damage from poor staking.

The most promising method we have used in our trials in Australia and California has been to use bamboo stakes (Figure 2) adopting a method developed by John Slaughter, formerly with Burchell Nursery in California. This method became mandatory when planting our central leader trees that required staking up to 2.5 m tall. The key to the method is that the bamboo stakes bend in the wind, with the tree, then return to the upright position when the wind decreases. This continual flexing in the wind can actually encourage the trunks of these trees to more quickly become stronger and more resilient to the wind.

In Australia we used 3 m tall bamboo stakes with 24 mm diameter at their base. With the sandy loam soil at the Almond Board of Australia (ABA) Loxton North orchard already prepared for planting, we were able to push these stakes, widest end in first, into the soil by hand to a depth of 40–50 cm. We found that once in the ground for a few days, the base of the stakes became swollen from soil moisture and quickly became firmly anchored.

Placement of the stake is critical. The rule of thumb was to place the stake 30 cm away from the trunk of the tree in the direction of the prevailing wind, and at an angle leaning into the prevailing wind (Figure 2). We used a plastic non-stretch 28 mm wide flagging tape, often used by olive tree growers, to tie the tree to the stake, although there are cotton tapes available which would be a more sustainable option. The tape was wrapped around the back of the central leader/trunk of the tree, at about 1 m high, and tied off at the bamboo stake. The tape was not tied off at the tree as this would risk girdling the trunk. Once the initial phase of central leader extension growth had formed in late-spring (December), a second tie was used to support this new extension growth.

The bamboo stake and ties lasted until the following spring, after which time the trees were self-supporting, even with the severe dust storms of 2019. The stakes could then be cut off at ground level for removal, rather than trying to extract the whole stake from the soil.

Figure 1. Most growers will use wooden stakes or wires to support the newly planted trees. Both methods come with substantial cost for installation and removal.

Figure 2. Bamboo stakes were used to support young almond trees planted with unpruned central leaders. Trees were attached with non-stretch green tape in the spring and early summer to support extension growth of the central leader (top). Stakes and ties lasted until the end of the season (bottom) at which time it was possible to see the curvature of the stake which is testament to the amount of tension they could withstand without breaking.

Heading cut and trim (standard practice)

As previously mentioned, when planting almond trees it has become standard practice to use a heading cut to head the trees back to 90 cm tall and to cut back (trim) any side branches to two buds (Figure 1). An upside to this method is that as there are no side branches so it is very easy to slip herbicide spray guards over the trees. Also, the heading cut stimulates very rapid and vigorous shoot growth from buds immediately below the heading cut to produce a large leafy canopy by early summer. This tree type is suited to traditional orchards planted with up to 556 trees per ha (3 x 6 m spacing).

The important downside to this "heading cut and trim" method is that scaffold branches are crowded into a very short section of trunk (Figure 3). If trees are headed back to 90 cm tall and all branches are removed from the trunk below 60 cm to provide a clean trunk for shake-harvesting then the branching zone is just 30 cm. This compressed branching zone increases the frequency of branches forming with included bark.

Included or "ingrown" bark forms in the junctions of equally dominant branches when there is a narrow branching angle. It occurs when branches are too close together, forcing steep branching angles and uneven bark development around the union between the branch and trunk. These branches are prone to splitting and major limb breakage, especially as once one branch splits and breaks out, then the remaining branches become exposed and can also split, resulting in complete tree collapse.

Growers either ignore this situation and become resigned to some level of limb breakage and associated costs with removing the damaged branches or they undertake a round of scaffold pruning in the first winter after planting to reduce the number of scaffold branches and remove any branches with included bark. Either way, these remedial pruning methods involve additional cost to the grower which we believe could largely be eliminated by planting a taller tree and leaving a longer branching zone to promote stronger branching unions.

Figure 3. Traditional heading cuts at 90 cm on the trunk of young trees can result in a compressed branching zone with weak branch attachment and included bark (left) increasing the chance of limb breakage and tree collapse (right).

Not headed and not trimmed (unpruned central leader)

Our aim with growing unpruned central leader trees was to produce tall, narrow trees suitable for high-density plantings with up to 1,100 trees per ha (2 x 4.5 m spacing) that could be shake harvested. The first step in this process was to cut back the terminal shoot (main trunk) to a strong lateral bud, and to slice off any competing buds in a 15-20 cm zone below this, to promote rapid extension of the remaining terminal bud in spring to form the new leader (Figure 4). The objective was to select a strong lateral bud on the windward side of the trunk and cut back to this bud so the new shoot would grow towards the prevailing wind. The next step was to remove side branches up to 60 cm high on the trunk to provide a clean trunk for the tree shakers to give a branching zone of approximately 90 cm (Figure 5).

Depending on the variety, additional pruning was required at planting with central leader trees to selectively remove any dominant side branches and leave a more uniform set of branches along the trunk (Figure 5). This round of pruning also involved an initial shoot trimming or hedging treatment which involved cutting back by one third all shoots growing out towards the centre of the row to produce a narrow tree. 'Vela' trees required several cuts for this task whereas Shasta® ('BA2') trees required minimal cuts.

Figure 4. Central leader extension growth was promoted by cutting back the terminal shoot to a strong lateral bud and removing competing shoots in a 15 – 20 cm zone below this.

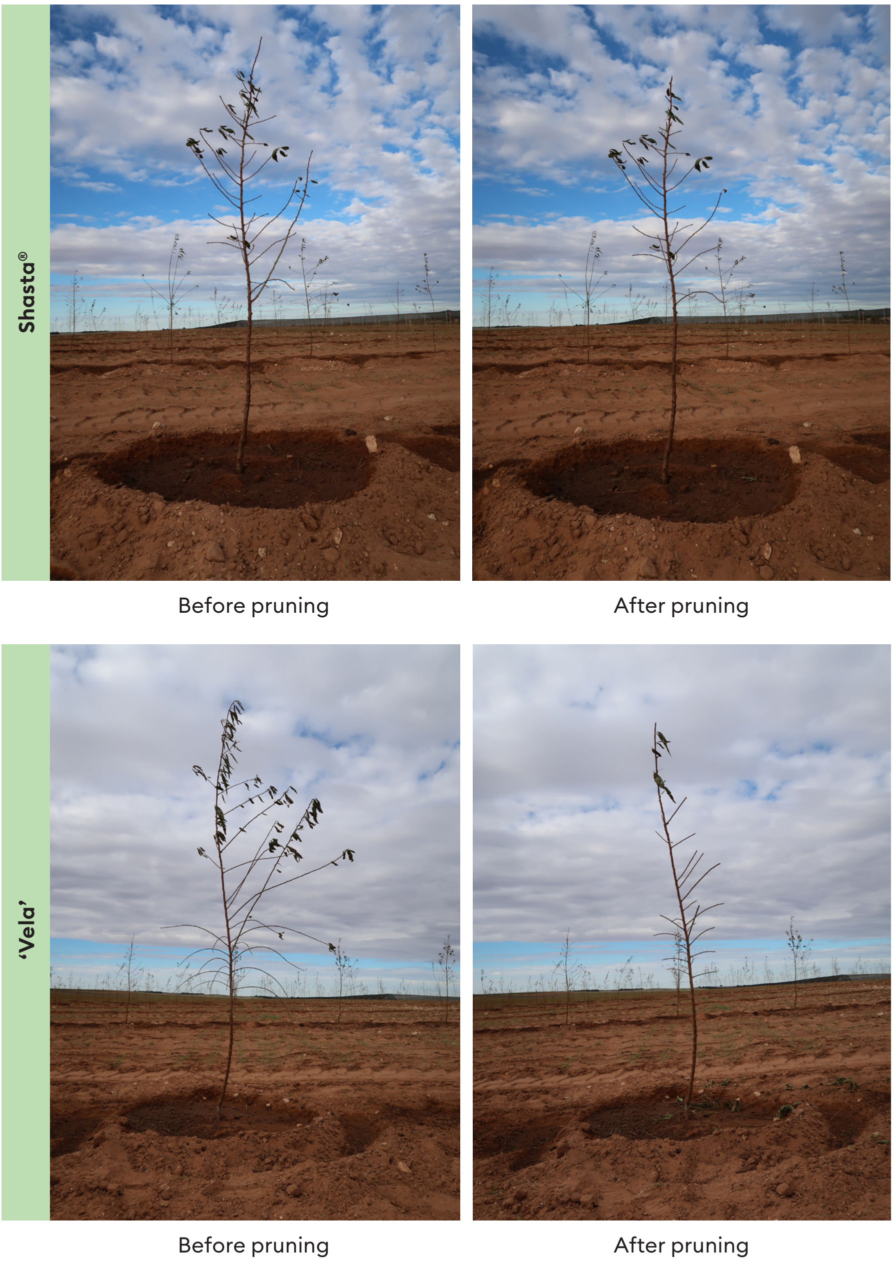

Figure 5. Shasta® and 'Vela' trees planted as unpruned central leader trees before and after heading the terminal shoot back to a strong lateral bud, removing all shoots below 60 cm on the trunk, cutting out any long shoots likely to dominate the central leader trunk, then trimming remaining medium length shoots.

When the “unpruned” central leader tree option was first presented to growers, the first question was “how will I get a spray guard over the branches?” The simple answer was to use wrap-around guards. The best of these we found were the version used by the grape industry in Sunraysia (Figure 6). The grape growers use a 90 cm version, which we cut in half to 45 cm for our almond trees. These guards were easy to attach and detach for de-suckering, but they did cost more than the white plastic sleeves used by most growers.

In many instances we found that during the spring growth flush following planting, several subterminal shoots developed immediately below the terminal shoot, a situation that created congestion and restricted growth of the terminal shoot (Figure 7). We therefore used “leader release” pruning to promote extension of the terminal shoot to form the central leader and reduce the dominance of lower scaffold branches. This pruning was completed in November of Year 1 and involved cutting back any lateral shoots that had formed within a zone 15–20 cm below the terminal shoot to two or three buds.

Figure 6. Central leader ‘Nonpareil’ tree in spring. Note the extended zone of scaffold branching on the central leader and the wrap-around spray guard.

Figure 7. Leader release pruning completed in November of Year 1 involved cutting back to two or three buds any lateral shoots that had formed within a zone 15–20 cm below the terminal shoot and trimming back long shoots growing out towards the centre of the rows. Images are central leader ‘Nonpareil’ trees before (left) and after (right) pruning.

A further round of narrow pruning/hedging was repeated either in spring or the following winter. In spring, this was a very light pruning done by hand using secateurs as in Figure 7 or using a light-weight battery-powered domestic hedge-trimmer. In winter, this pruning was done by machine with mechanical saws working along the rows (Figure 8).

Depending on the growing season, unpruned central leader trees from spring-budding can be from 1.5 to 2.0 m tall in the nursery. When the lower branches are removed up to 60 cm on the trunk, this leaves an effective branching zone of at least 90 cm which is significantly more than the standard tree. This extended branching zone can be seen in winter, two years after planting (Figure 9). With the unpruned central leader growing system, all five cultivars tested, including 'Vela', retained some resemblance of a central leader tree, with branching along an extended zone on the central leader. As with the dormant-budded sleeping eye trees, the variety Shasta® in particular demonstrated a natural tendency, with minimal pruning, to form a distinct central leader growth habit.

While more detailed pruning could be applied to maintain a formal central leader structure across all varieties, this would involve substantial additional costs. Our objective was to minimise pruning costs, unless there was a clear commercial benefit.

Figure 8. Mechanical hedge trimming Shasta® (left) and 'Vela' (right) trees in winter, as an alternative to pruning by hand in the previous spring.

‘Carina’

‘Maxima’

‘Nonpareil’

Shasta®

‘Vela’

Figure 9. ‘Carina’, ‘Maxima’, ‘Nonpareil’, Shasta® and ‘Vela’ trees two years after planting as unpruned central leader trees showing the extended branching zone along the central leader. Shasta® in particular demonstrated a natural tendency to retain the central leader growth habit with minimal pruning.

Not headed but trimmed (bare pole)

Our alternative solution to the issue with spray guards not fitting over the unpruned central leader trees was to trim all of the side branches from these trees to create a "bare pole", making it possible to slip the standard plastic sleeves over the top (Figure 10).

As with the unpruned central leader trees, the bare pole trees had an extended branching zone of approximately 90 cm along the trunk. The interesting difference in growth response with the bare pole trees was that the scaffold branches developed at a much flatter angle than branches on the unpruned central leader trees, which could mean stronger branching junctions with the trunk (Figure 11). As with the unpruned central leader trees, all five cultivars first planted as bare pole trees, including 'Vela', retained some resemblance of a central leader tree with branching along an extended zone. The bare pole method, however, was not as well suited to Shasta® trees as it appeared to reduce the number of scaffold branches that formed and those that did form became more dominant relative to the original central leader and they produced relatively few secondary branches.

Figure 10. An alternative to unpruned central leader trees was to trim all of the side branches from these trees, to create a "bare pole", thus making it possible to slip the standard tree guards directly over the top of the trees.

'Carina'

'Maxima'

'Nonpareil'

Shasta®

'Vela'

Figure 11. 'Carina', 'Maxima', 'Nonpareil', Shasta® and 'Vela' trees two years after planting as bare-pole central leader trees showing the extended branching zone and flatter branching angle against the trunk especially with the lower scaffold branches. Even 'Vela' trees retained a central leader.

Dormant budded “sleeping eye” trees

Our experience with Shasta® trees planted with a sleeping eye bud was that the trees naturally maintained a resemblance of a central leader (Figure 12). In contrast, ‘Vela’ trees with their decurrent growth habit, when grown with a sleeping eye bud, ended up with several scaffold branches forming in a compressed branching zone. ‘Carina’ also formed a compressed branching zone, while ‘Maxima’ and ‘Nonpareil’ were intermediate.

Figure 12. Growth responses after two years of ‘Carina’, ‘Maxima’, ‘Nonpareil’, Shasta® and ‘Vela’ trees dormant-budded with sleeping eye buds on ‘Garnem’ rootstock.

Research trials

Research trials were established to compare the various tree types described in the previous sections. The most comprehensive of these trials, planted in 2018 at the ABA experimental orchard in Loxton North, is comparing growth and yield responses of five varieties. All trees were budded on 'Garnem' rootstock and planted at 4.5 x 3 m spacing (741 trees/ha). Four different tree type/pruning treatments are being compared (Table 1).

With the varieties combined, kernel yields from the different tree types and pruning treatments were similar, even with the dormant-budded trees that were planted with "sleeping eye" buds (Table 1; Figure 12). So the main treatment differences in young trees could be seen in the aforementioned tree structure and positioning of scaffold branches (Figures 9 and 11) rather than differences in yield.

Tree type (3rd-leaf trees)	**Pruning treatment**	**Kernel yield** (kg/tree)	(t/ha)
Central leader	Control unpruned	3.27	2.42
Central leader	Bare Pole	3.32	2.46
Central leader	Small, late-budded	3.21	2.38
Dormant-budded	Sleeping eye	3.06	2.27
	Significance	*NS*	*NS*

Table 1. Kernel yield per tree and per hectare of third-leaf almond trees with four different tree type/pruning treatments, harvested in 2021. Trees were budded on 'Garnem' rootstock and planted in 2018 with 741 trees per ha. Cultivar treatments were combined so that values are tree averages (n = 45). Significance: NS = not significant.

For more information

Grant.thorp@plantandfood.co.nz
+64 2187 3460

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