Trees For Bees

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A GUIDE TO PLANTING FOR BEES

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FOREWORD BY ROSS LITTLE, CHAIR OF TREES FOR BEES NZ

Like many pastoral farmers, our family has valued having beehives on our property in North Canterbury for many years. Pollination of clover by bees plays a vital part in provision of nitrogen to pasture through the nodules on the roots of legumes. In conjunction with phosphate fertiliser and aerial topdressing, this pollination has helped transform New Zealand's hill country.

Of course, bees are vital for the production of many arable and horticultural crops, and it is estimated they contribute over $5 billion to our economy each year!

Bees are under threat around the globe from a number of diseases and other problems. The varroa mite's arrival in New Zealand demonstrated the risk, decimating bee hives and imposing control costs.

Instigated by John Hartnell of Federated Farmers Bees, the Trees for Bees NZ project started in 2009 to encourage farmers to plant species with bee nutrition in mind, and funding was obtained from the Ministry of Primary Industries' Sustainable Farming Fund.

Research was needed to determine the nutritive value of various plant species—a world first in many cases—and our dedicated scientist, Dr Linda Newstrom-Lloyd, has worked tirelessly on this while also identifying species that flower at times to extend the length of the bee's season. Apiculture Officers from AsureQuality Limited, Marco Gonzalez and Tony Roper, have contributed enormously to the success of the project. In 2013, Dr Angus McPherson joined the team as a farm planting advisor to create and oversee planting 18 demonstration farms, thus enabling widespread research uptake throughout New Zealand.

A number of councils and apiculture industry members have also been very supportive and the project has grown considerably. This booklet summarises our efforts on how to plant for bees. Bees are amazing creatures, and much of the world's food production depends on their pollination. They deserve our support.

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WHY PLANT FOR BEES?

Farmers need honey bees for pollinating pasture, horticulture and arable crops. Farms also provide valuable sites for wintering hives and for spring build-up. With the rapid increase in hive numbers in the last five years we are reaching a crisis point in terms of available bee feed, and so additional bee feed needs to be planted. By planting multi-functional trees for bees on farms, you can incorporate bee feed into your on-farm planting for a wide variety of purposes.

The foundation of our work is a large database of bee plants and their characteristics including bee preferences, pollen quality (e.g., protein content) and quantity, flower density and flowering times. The Trees for Bees database contains well over 400 species for New Zealand.

These plant lists then become the starting point for our farm and apiary bee feed designs. Choosing what to plant depends on many factors, including climate and plant tolerances, soil and water, life form, canopy level, plant size at maturity, and planting location.

Not all flowering plants are suitable because of their potential for invasiveness. Some plants are toxic to bees (karaka, some rhododendrons) and should never be planted for bees.

Planting a wide diversity of plant species improves bee nutrition and covers times when a particular species fails to flower in any one year. Bees also benefit from clustering plants of the same species to make foraging more efficient.

This booklet provides an overview of the principles and guidelines for planting for bees, along with practical tips on how to plant. It represents a snapshot of our collective knowledge at this time, and provides a starting point for people interested in planting for bees.

The plants mentioned in this booklet represent a small fraction of the total bee plant species available and readers are encouraged to further research the options. Plant lists and planting designs are available on our website, www.treesforbeesnz.org and are continually updated as the research progresses.

Happy planting.

The Trees for Bees Team
June 2016

A flax flower has 5 mg of pollen on average, so from 25 to 30 flax flowers are needed to grow one bee from egg to adult.

FLOWERING CALENDARS AND BEE FEED BUDGETS

Flowering calendars and bee feed budgets are optional tools to help visualise feed deficits for your bees. They help to show how a proposed list of bee feed plant species can balance the pollen and nectar supply over the year before you install the plants.

A bee feed budget is constructed by making a bar chart based on adding up the monthly columns in the flowering calendar. The totals show you how many species or numbers of plants are producing flowers in each month.

Most of the time, experienced beekeepers have a flowering calendar in their minds based on their observations at an apiary site over the years. They may not be able to name all the plant species used or when they flower exactly but they do know the obvious ones. They will also know from experience how many hives will do well on a given site because they can roughly measure the carrying capacity of the site by trial and error over the years (i.e., adding and subtracting hives until they get it right).

Experienced beekeepers usually know when supply deficits occur at a given site because the colonies start to fall backwards. The beekeeper may have to provide supplementary artificial feed to get the bees through. This is why all of our demonstration farms include the beekeeper and the landowner on the team to design a good bee feed budget.

By making a flowering calendar for an apiary site, it is possible to explicitly confirm that all seasonal demands are filled and the pollen and nectar supply meets the colony requirements without any stressful dearth periods. Then the only artificial feed needed would be due to poor flying weather, when the bees cannot get out foraging for excessively long periods of time and have used up all their stored pollen and nectar in the hive. For example, it may be too cold or too much heavy rain for weeks in the spring.

In general, the pollen demand is extremely high in spring when the colony is rapidly building up bee numbers from a winter population that is only about 10,000 bees to a peak of > 60,000 bees per hive. Peak bee populations are essential in late spring and summer for pollination services and honey harvesting.

Then in autumn, after the honey harvest, bee numbers decline and the bees must restore their honey supply unless the beekeeper has left them sufficient honey. The pollen demand is less strong in the autumn but it is just as critical to have an adequate supply. Autumn bees have to survive the long months of winter when no new brood is emerging to replenish the population. They need to be robust with adequate protein and fat from pollen to make it through the winter.

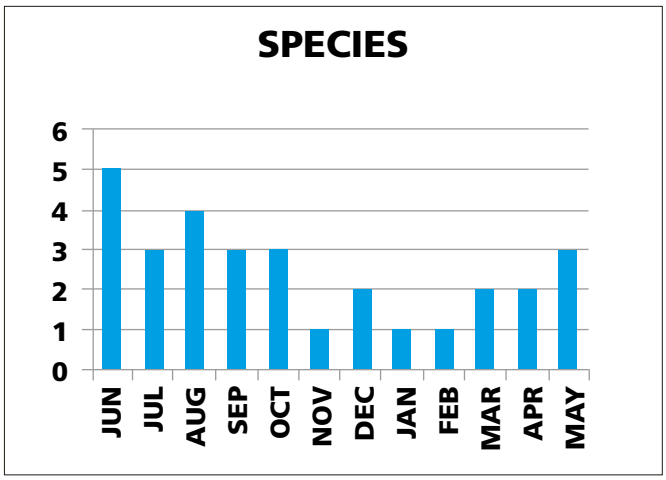
Another feature of creating a flowering calendar is to make sure that there are no major competing flowers during the pollination and honey harvesting times. This is going to vary according what you want the bees to do for you. For example, crop pollination in large-scale monocultures will need to have some diversity of pollen and nectar just to keep the bees well nourished. Kiwifruit pollination will need primarily nectar sources but not too many competing pollen sources. Mānuka will need pollen sources such as tarata (lemonwood) but not too many competing nectar sources. In contrast, bees have been reported to do well on brassica monocultures alone. It ultimately depends on the nutrition provided by the target crop.

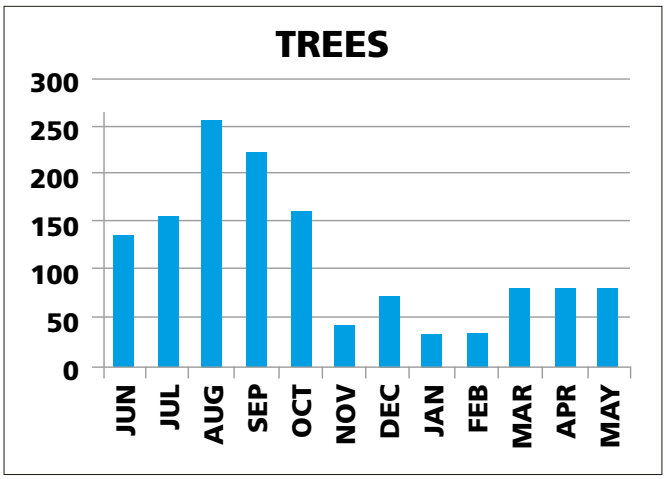
This example on page 5 is based on one planting event of 395 native plants installed in East Cape with Naati Beez on May 2016. The top flowering calendar is based on the number of species planted to check if there is enough diversity of plants in each month (each cell scores 1 or blank). The corresponding bar chart is the Bee Feed Budget for species diversity showing the totals of each column for each month. It shows that the late autumn to early winter period has up to 5 species but the early autumn can be improved. Note mānuka is not counted as it is the target plant. Also, tarata is included as a pollen source during mānuka flowering. Species diversity should reach > 10 species for each major period.

The bottom flowering calendar is based on the number of trees and shrubs planted to try to estimate the supply volume. The corresponding bar chart for the Bee Feed Budget for number of trees shows that springtime has the most trees planted but you would need to assess how much pollen per plant is produced to further refine this quantitative estimate. The method of counting number of trees does not take into account the quantity of pollen for each plant. For example, a mature houhere tree will have far more pollen than a ***Hebe stricta*** shrub. It is nevertheless a useful tool to visualise the supply until we can develop more detailed information on pollen quantity per plant.

This flowering calendar does not include pre-existing plants at the site nor does it specify the range. These could be included ultimately if an estimate was made of what is already there. Meanwhile, each time that plants are added, they can be appended into the flowering calendar to show the gains in the Bee Feed Budget.

NUMBER OF SPECIES		JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
Leptospermum scoparium	Mānuka												
Pittosporum eugenioides	Tarata					1	1	1					
Pseudopanax arboreus	Five-finger	1	1	1									
Vitex lucens	Pūriri	1	1	1	1	1							1
Hebe stricta	Koromiko		1	1	1	1							
Coprosma robusta	Karangū			1	1								
Pseudopanax lessonii	Houpara							1	1	1			
Hoheria populnea	Houhere	0.5									1	1	0.5
Hoheria sexstylosa	Houhere	0.5									1	1	0.5
TOTAL (not including target crop)		**3**	**3**	**4**	**3**	**3**	**1**	**2**	**1**	**1**	**2**	**2**	**2**





NUMBER OF TREES		JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
Leptospermum scoparium	Mānuka												
Pittosporum eugenioides	Tarata					40	40	40					
Pseudopanax arboreus	Five-finger	35	35	35									
Vitex lucens	Pūriri	20	20	20	20	20							1
Hebe stricta	Koromiko		100	100	100	100							
Coprosma robusta	Karangū			100	100								
Pseudopanax lessonii	Houpara							30	30	30			
Hoheria populnea	Houhere	40									40	40	40
Hoheria sexstylosa	Houhere	40									40	40	40
TOTAL (not including target crop)		**135**	**155**	**255**	**220**	**160**	**40**	**70**	**30**	**30**	**80**	**80**	**81**

PLANNING YOUR BEE FEED PLANTING

The purpose of farm planting can include paddock shade and shelter, land stabilisation and riparian/wetland protection, native bush enrichment, amenity and farm beautification, and alternative crops such as timber, firewood, fruit, nuts and honey. With so many other reasons for planting trees and shrubs on farms, feeding bees can fit in perfectly by selecting plants that are also good pollen and nectar sources.

Before embarking on a planting programme on your farm for any purpose, including bees, you need to be aware of a number of factors. These include the site to be planted and any climate limitations such as the likelihood of drought or frost, and the space available for planting to accommodate the size of the mature plants. You also need to consider the time, money and labour you have available to establish and maintain the plants, the best time of year for planting, and how this fits in with your farm work programme. For each candidate plant species, you should think about its potential weediness and its potential toxicity to farm animals or bees. The plants will need to be protected from pests, such as goats, opossums and hares, as well as from livestock. The plants selected should fit in with existing land use and be useful for your other farm operations.

It's important that you have an overall plan for your planting programme. Farm planting advisors, local beekeepers and nurseries can all help. You may wish to make a flowering calendar of what bee plants you already have on site if you know their identity. At least you will know when they flower even if you don't know their names. Then select plants to fill in pollen supply gaps—again, your beekeeper can assist with this.

You can optimise bee nutrition by choosing plants that have plentiful pollen with the highest protein and reliable flowering times.

Use a mix of plant types and sizes, as some plants such as herbs and large-grade trees will flower in the first year, and others such as smaller-grade shrubs and trees may take 2–3 years or more to first flowering. Don't overcrowd the plants, let them grow into the space for their mature size to maximise flower production. Flowers will not be produced if branches are too shaded or covered by another plant. Consider staging the planting over a few years—only plant what you can manage, including ongoing maintenance. Have a plan for weed control before and after planting, and make sure plants are protected from pests and livestock. You should also be prepared to irrigate in dry weather.

The following pages illustrate some planting options for different purposes, and can be used as a framework and inspiration for planting for bees on a range of farm types such as cropping, sheep and beef, dairy, vineyards, orchards and mānuka plantations.

Angus McPherson, Farm Planting Advisor, (at right) planning a native plantation with Rangi Raroa (centre) and Rapata Kaa (left) in Tikitiki, Gisborne.

PROTECTING YOUR BEE FEED PLANTS

Protection from pests, stock, weeds and the elements are all vital to ensure your plants have the best possible chance of survival. There are a range of options to achieve these ends.

Small-grade native plants can be protected from rabbits and hares with plastic sleeves. This area is fenced to exclude stock, and the planting area spot-sprayed against weeds before planting. The plants are now one year old.

The tulip tree at right is being secured with bailing twine and inner tubes to the waratahs. Novaflow has been cut along the length and secured around the trunk to protect it from browsing sheep. Novaflow has also been dug down the side of the root ball for watering.

Plants can be protected from browsing by stock using concrete reinforcing as a surround (above left), and from rabbits, hares and possums with chicken mesh (above right).

Water can be applied from an irrigation system, or for individual trees using a 10–20 litre container with a tap. The container is placed above the Novaflow with the tap set for it to empty over 2–3 hours, allowing water to penetrate deeply. Each plant should get a minimum of 10 litres each time.

Another option where paddock shade and shelter is required is to use a wooden tree guard, particularly when the paddock is to be grazed by cattle or horses. While more expensive, these guards do provide excellent protection, and the area inside the guard can also be established with ground cover flowering species (e.g., clover, ***Phacelia***, wildflowers, herbs).

Larger trees often require stabilisation from the wind for the first 12–24 months. Here we've used a waratah either side of the tree, secured with webbing. Note the trees are protected from stock by a fence, with Novaflow dug down the side of the root ball for watering.

QUEEN AND NUCLEUS PRODUCTION YARDS AND APIARY SITES

The primary purpose of bee feed planting for queen and nucleus production yards and apiary sites is to maximise the quality and quantity of pollen and nectar sources. For apiary sites this might be seasonal (e.g., late summer, wintering and spring build-up), whereas for queen and nucleus production this is year round.

While bees will forage over long distances, if the bee feed can be established in close proximity to these yards, then the colonies will flourish.

The photo above shows queen-raising hives that have been located amongst mature trees in a paddock, with large-grade maple, ash, oak and chestnut trees planted inside tree guards. These large-grade trees flowered in their first year.

Barry Foster (below) plants large-grade ***Michelia yunnanensis*** (in flower) as a windbreak around a permanent apiary site. They provide autumn feed and are planted near spring feed from blossom species and willows along the river.

A mixed shelterbelt of ***Camellia sasanqua*** (Setsugekka) and ***Michelia yunnanensis*** is planted to protect a newly established permanent apiary. In addition to protection from the prevailing wind, these plants provide bee feed from autumn through to early spring.

Along the northern boundary, deciduous spring-flowering species have been established (crab apple, ornamental hawthorn, ornamental pear). By being deciduous they don't shade the hives in winter. Other flowering plants to extend the flowering season are planted nearby.

Queen nucs below a tree lucerne hedge have had koromiko planted to provide low shelter and autumn bee feed, and the tree lucerne cut back to bush up.

SHADE AND SHELTER

Trees for Bees has looked at how bee feed species can be included in traditional on-farm shade and shelter planting.

Farm shelterbelts and paddock shade and shelter are known to improve pasture and stock productivity through reducing transpiration losses in pasture and crops, and reducing heat and cold stress in stock. Stock will often graze longer if they have access to shade and shelter during the day.

Traditional farm shelterbelts in pine and cypress can be problematic when they become over-mature. They can cost a lot of money to remove if there is no ready market for logs or firewood.

We have designed an alternative shelterbelt comprised of three tiers, which incorporates an evergreen species on the windward side, a tall deciduous tree for the middle row, and blossom species on the leeward side. The intention is that this will require little maintenance in the future.

On hill country farms native species shelterbelts are being established, mainly in small- to medium-shrub species which include bee feed species. These shelterbelts are not only for honey bees, but also for native and bumble bees.

Access roads and entrances provide an opportunity to establish beautiful avenues of trees and/or shrubs, using bee feed species. ***Fraxinus ornus*** (manna ash or flowering ash) forms one side of an avenue along a farm track. The trees were large enough to start to flower in the first year and are now coming into full flower in the second year.

Large-grade specimen trees such as this maple are established for paddock shade and shelter.

On this farm, in addition to stock yard and paddock shade and shelter, tree guards have been built along stock laneways to protect them from stock as they are moved. Here maples and Rosea horse chestnut have been planted for spring bee feed.

A shelterbelt is planted as a dust screen in front of the homestead beside a gravel road. Along the road edge are evergreen hedge species (***Michelia*** and ***Camellia***) for autumn to spring feed, and on the inside spring-blossoming species (crab apple, ornamental pear, dogwood and ornamental hawthorn), with some specimen trees (scarlet oak, Rosea horse chestnut, red maple).

LAND STABILISATION

Land stabilisation is a significant issue in many parts of New Zealand's hill country, particularly where previous forest cover has been cleared for pastoral farming. Traditional remedies have included poplar and willow pole planting, along with commercial plantation forestry.

Poplars are a source of propolis for bees, and willows are very important sources of spring nutrition for bees. Trees for Bees research has identified willows that extend the flowering period from July to December (***Winning with Willows*** booklet).

While commercial plantation forestry is an option in many areas, where harvesting is economically marginal then it can create long-term issues for land stability as the forests become over-mature. Therefore, alternative land uses such as mānuka plantations are now being considered.

Where land subsidence is extensive, entire paddocks may need to be fenced off, stock excluded and trees planted. In the photo above, a mixture of willows and some poplar poles and rooted cuttings have been planted on the wettest and most active areas to slow land movement. Where the ground remains stable, mānuka has been established for honey production and to provide canopy cover to reduce surface run-off.

With a mānuka plantation you need to have spring build-up bee feed for your hives before the mānuka starts to flower. What you need to be careful of is that there is no gap between the end of willow flowering and the start of mānuka flowering. Using a wider range of willow species and varieties helps, as does planting other species such as maples, oaks, alders and ash.

Some situations don't require the fencing off of the entire paddock, but rather the planting of good land stabilisation species on the wettest and least-stable sites in the paddock. In the photo below, willow poles have been planted in the wettest areas of the paddock, with cattle excluded for 2–3 years until the poles are strong enough. This has been supplemented by spring- and autumn-flowering alders, which are suitable for land stabilisation, fix nitrogen and provide bee feed in spring or autumn. These are protected from browsing by plastic sleeves.

In other situations, it's not the wetness of the site but the steepness that's the issue. In the photo below, the steep face has been fenced to exclude stock, with tree lucerne planted along the ridge line for winter and early spring bee feed. As this flowers it will seed and spread down the steep face. In addition, the native species koromiko and kōwhai have been planted on the less-steep parts for autumn and spring bee feed, respectively.

All these areas shown are adjacent to apiaries and other sources of bee feed, whether it is for summer honey crops or wintering sites. Carefully planned and laid out, land stabilisation planting can form an important component of your year-round bee feed.

RIPARIAN PROTECTION

Riparian planting has come into greater focus in recent years with the emphasis on water quality, nutrient run-off, and the fencing of waterways. Riparian areas are also facing issues in terms of loss of bee feed with the clearing of willows and gorse as part of farm intensification and council weed removal. Both willows and gorse are important bee feed, and their removal is having a negative impact on apiaries. Trees for Bees is developing plans for alternative species and planting designs.

Traditional riparian planting included extensive use of willows for bank stabilisation, as shown in the photo above. While this has been very successful, as the willows grow there is an increased risk of the river flow becoming impeded in floods, of branches breaking into the river, and of trees toppling and blocking off or diverting the river.

In the ***Winning with Willows*** booklet, Trees for Bees has identified a number of species and cultivars that not only extend the flowering period, but also include a number of shrub willows that won't present these problems. Furthermore, if these or larger tree willows are set back from the river margin and the main watercourse, then the risk of that flow being disrupted is reduced.

Alternatives to willows include species such as oaks, maples, ash and alder. The photo to the left shows a ground cover of borage beneath the trees to for spring bee feed that will also control weed regrowth.

Native species are extensively used in riparian planting, particularly where encouraged and subsidised by local councils. This provides a realistic option to include native bee feed species in your planting plans for riparian zones. In the photo above, which is on a dry and exposed site, native grasses have been included to provide quick shelter for bee feed species such as cabbage tree, flaxes, ***Coprosma, Hoheria***, matagouri, ***Hebe*** and ***Olearia.*** Mānuka is also included here as a bee feed and hardy shelter species for nearby queen-raising yards.

On the site shown in the photo above, a mild climate allows the use of a wide range of species, including ***Pittosporum,*** kāmahi, wineberry, putaputaweta, koromiko, tree fuchsia, North Island ***Hoheria*** species, ***Pseudopanax*** and ribbonwood. The river is being progressively fenced off, with the riparian planting providing bee feed support to nearby mānuka bush, as well as shade and shelter to the adjacent stock laneway.

Note that in both of the above examples, the bee feed plants are kept back from the stream margin, with the exception of some flaxes and ***Carex*** grasses, so that the water flow isn't impeded.

NATIVE PLANTS

It's an old beekeepers' saying: "We're OK for wintering hives because we have native bush." While this source might be under pressure today from significantly increased hive numbers and pests in the bush, being able to winter your hives near native bush is very useful. In addition, native bush is critically important for our native bees.

If you have native bush blocks on your property, the best way to improve their overall health and flowering capacity is to protect the bush. This includes fencing to exclude livestock (see photo below), which will result in a significant increase in regeneration. Pest control for possums and rats is also vitally important, whether through trapping, shooting or bait stations, and will also help with native bird numbers. Wasp control might also be required, and the development of the Vespex bait stations will assist here.

There is also the option of extending your existing bush though new planting, as shown in the photo above where native plants have been established adjacent to existing bush.

Another option is to include native bee feed species as part of your apiary planting, as shown in the photo above with five finger being planted on an East Cape apiary site. Included in this planting were (1) summer and autumn-flowering species ***Hoheria populnea, H. sexstylosa, Hebe stricta*** (koromiko) and ***Vitex lucens*** (Puriri), (2) winter and early-spring species ***Pseudopanax arboreum*** (five finger), (3) spring build-up species ***Coprosma robusta*** (karamu) and ***Pittoporum eugenoides*** (lemonwood or tarata) and (4) summer species ***P. lessonnii*** (coastal five finger). Other species will also be added.

As with all bee feed planting, it's important to ensure that there are no gaps in the flowering calendar. When planting native species it is best to use plants that are local to your area, as they will be adapted to the climate and this promotes the practice of 'eco-sourcing' for conservation.

MĀNUKA PLANTATIONS

The expansion of the mānuka honey and medical products industry has been a key driver in the doubling of hive numbers in the last five years. Much of this is based on existing natural resources, but there has been a significant increase in the planting of medical-grade mānuka plantations in the past few years. Mānuka plantations have emerged as a viable alternative land use, particularly on marginal hill country.

To produce the high grade of honey in your mānuka plantation, it is important to confirm that the biological activity and flowering time, which varies throughout New Zealand, will manifest in your plants in your location. This is because soil, moisture and temperature have an effect on nectar flow and quality, as well as flowering time. Obtaining the best genetic stock for your region is critical. Mānuka plant breeding is ongoing with test trials throughout New Zealand.

The short duration of mānuka flowering in summer means that, unless hives are moved to off-season sites elsewhere, pollen and nectar sources need to be provided for the majority of the year. Until recently the required spring and autumn pollen and nectar supply has been managed from existing floral resources, but the huge expansion of the industry has placed these resources under significant pressure.

To manage this overstocking issue, landowners can easily plant bee feed to cover spring and autumn. Installing native or exotic bee support plants beside the mānuka plantation will gain the advantages of a residential hive system. If the bees must be moved to a wintering site elsewhere, the problems of competition for such sites and the costs and transport labour need to be factored in.

What to plant for the bees depends on the region. For marginal land near native bush, the best option is to amplify populations of native plants that are locally sourced by nurseries or that you propagate from seed or seedlings from the area.

In effect you are engineering the composition of the native floral resources to maximise spring and autumn supply but also to minimise competing nectar production during mānuka flowering. Many high-performing native plants have flowering times that do not overlap with mānuka (refer page 12, East Cape planting).

One question remains for constructing good mānuka support plantations. Mānuka has only small amounts of pollen and nectar per flower. Native bees avidly collect both pollen and nectar from mānuka (photo above), but the primary interest for honey bees is in the nectar. Our observations and those of beekeepers indicate that honey bees rarely, if ever, bother to collect pollen from mānuka. So a good mānuka support plantation would also supply suitable pollen sources in summer to keep the colonies thriving. These summer support plants should not have too much attractive nectar which could distract the bees away from mānuka.

Honey bees forage from 5–12 km away from the hive, so any highly attractive summer nectar sources in that range will compete with mānuka. For example, co-flowering clover, kāmahi, tāwari and several other summer-flowering plants are preferred by honey bees. Competing clover flowers can be grazed off by livestock but other plants will be less manageable if abundant. The scale of your land to control these factors will be an important consideration for investing in mānuka plantations.

AMENITY

While all farm planting should strive to have some beautification value, what is described here as amenity planting is primarily for that purpose alone. Amenity planting therefore allows you to experiment with form and colour and flowers, whilst keeping the importance of bee feed in mind. Mature specimen trees have the value of large amounts of flowers and hence pollen and nectar, for a relatively small footprint, and are a valuable component of any bee feed planting.

The two photos above show a mature tulip tree (***Liriodendron tulipifera***) in a homestead garden. It is a graceful tree and provides exceptional bee feed and stunning flowers.

Farm homesteads provide an excellent framework around which to establish amenity planting of trees. The photo at bottom left includes a number of maples, linden (***Tilia*** spp.), ***Gleditsia***, eucalypts and oaks.

This high country station has an entrance avenue of hybrid English oaks (***Quercus petraea x robur***), beside a parkland of oaks, maples, beech and linden trees.

In the photo above, pin oaks (***Quercus palustris***) have been planted along the edge of a drain by an internal farm track.

Amenity planting can also be around the house. The photo below shows mature Rhus in autumn colours (***Cotinus coggygria***), behind a rock wall covered in ***Cotoneaster horizontalis***. To the side are rowan trees, with poplars and crab apples in the background.

ORCHARDS, NUTTERIES, VINEYARDS AND EDIBLE GARDENS

Fruit trees, nut trees, vegetable and herb gardens are all excellent sources of pollen and nectar. Bees play a crucial role in pollinating these crops. Bees are even useful around the vineyard, which can be a great location for bee wintering sites.

A home or farm orchard is a good way to provide early spring bee feed. Pears, apples and citrus are all producers of very high quality pollen (> 25 % protein) and, depending on the cultivar, flowering can extend from early to late spring.

Nutteries can provide important spring bee feed, such as this walnut orchard on a pastoral farm. Hazelnuts are also an excellent source of pollen for bees. Depending on how warm your climate is, hazelnuts can start producing pollen from late autumn through winter. Where you have a colder climate (e.g., inland South Island), the catkins will form in autumn and they won't start shedding pollen until it warms up in the spring.

While bees are not required for grape pollination, vineyards do make a great location for wintering sites if you have the right bee feed plants established. Bees are useful in the vineyard because when a bird pecks a ripe grape, the damaged grape can produce acetic acid, which taints the bunch and the wine. Bees are not able to poke a hole through grape skins, but they can use the holes made by birds and will clean out the fruit pulp and juice from the damaged grape, removing the risk of acetic acid building up. They also take the juice from damaged leftover grapes post-harvest, which helps prevent the breeding of pathogens that cause diseases in grapes.

The honey bee's best friends in the vegetable garden are herbs, particularly oregano, rosemary, lavender, borage, sage, and thyme. Keeping a border of lavender or rosemary will greatly help bees. If you periodically cut back your lavender it will keep flowering through the summer, while rosemary often flowers twice—in spring and autumn. The more flowering plants in your garden, the more the bees will be attracted to provide pollination for your garden plants.

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Manatū Ahu Matua

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TREES FOR BEES PLATINUM SPONSORS

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