KĀNUKA HANDBOOK

PUBLISHED BY
HIKURANGI BIOACTIVES
LIMITED PARTNERSHIP

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Introduction

In 2017 Hikurangi Bioactives Limited Partnership (HBLP) successfully applied to the Erosion Control Funding Programme for a two-year project called 'Optimising Kānuka Production'. HBLP had been set up the year before as part of the Hikurangi Group, a cluster of charitable trusts and companies, and commercial entities that were looking to promote economic development for the communities in the Waiapū Valley. With so much kānuka growing on local land blocks, it made sense to find out more about kānuka as both an environmental asset and an economic opportunity.

HBLP believes that kānuka is part of the solution to erosion control, both by stabilising the soil (it is a pioneer species, one of the first natives to grow on cleared or disturbed land) and because of the potential value of its bioactive compounds (scientific testing has revealed antibacterial and anti-inflammatory properties), which might create alternative land use options. 'Optimising Kānuka Production' was designed so that landowners, hapū and businesses interested in creating opportunities with kānuka would have credible and scientifically rigorous knowledge to guide their decisions and planning. The science was managed by Gisborne-based contractors Irene Lopez-Ubiria and Alvaro Vidiella from VLU Science. Originally from Spain, and brought to New Zealand by the avocado industry, Irene and Alvaro have a background in understanding how ecosystems can be managed so that commercial, environmental and heritage values are balanced and protected. They worked with chemists and biologists from Victoria University in Wellington to learn more about the potential of kānuka as a natural health product. The other key member of the team was Bella Paenga, who kept the lines of communication open between HBLP and the scientists and the owners of 16 Māori land blocks who were our partners on this project, along with the wider community who we hope will benefit from our growing knowledge.

Kānuka Handbook is a compilation of what HBLP has learned about kānuka, along with contributions by experts who share our passion for this amazing plant. We are grateful to the Ministry for Primary Industries, who not only funded 'Optimising Kānuka Production' but have also supported the publication of this booklet, intended for landowners who want to know more about kānuka and its ecological and economic value, and why kānuka should no longer be seen as scrub but as a taonga.

DAMIAN SKINNER
MANAGING DIRECTOR, HBLP

The 'Optimising Kānuka Production' project was jointly funded by the Erosion Control Funding Programme (ECFP) and Hikurangi Bioactives Limited Partnership (HBLP), and supported by the Gisborne District Council.

The ECFP fund was established in Te Tairāwhiti nearly 30 years ago to assist planting of highly erodible lands by giving funding to East Coast landowners and community groups to tackle the region's severe erosion problem. Around 26% of land in Tairāwhiti is at risk of severe erosion, and it causes long-term damage to the productivity of rural land. The flow-on effect is economic, making it harder for agriculture and horticulture to turn a profit, and causing damage to infrastructure like roads and bridges. Erosion also ruins water quality as a large amount of sediment makes its way into river systems. The natural and cultural values of land and the coastal environment are under threat from erosion, and the fund has worked with local stakeholders to find solutions.

This Community ECFP Project is a creative use of the funding to seek out new science and opportunities for this abundant native species. The project aims to elevate the understanding of kānuka so that, like mānuka, it might become an economically significant native resource. Thanks goes to HBLP and their community of landowners for the research, trials and resources they have produced. The Ministry of Primary Industries and Te Uru Rākau are very pleased to be associated with the Kānuka Handbook, and hope that sharing this information assists entrepreneurs and landowners to see new opportunities with kānuka.

WILLIAM WETERE
SENIOR ADVISOR, TE URU RĀKAU

A Guide to Identifying *Kunzea*

WRITTEN BY

PETER DE LANGE *and* JEREMY ROLFE

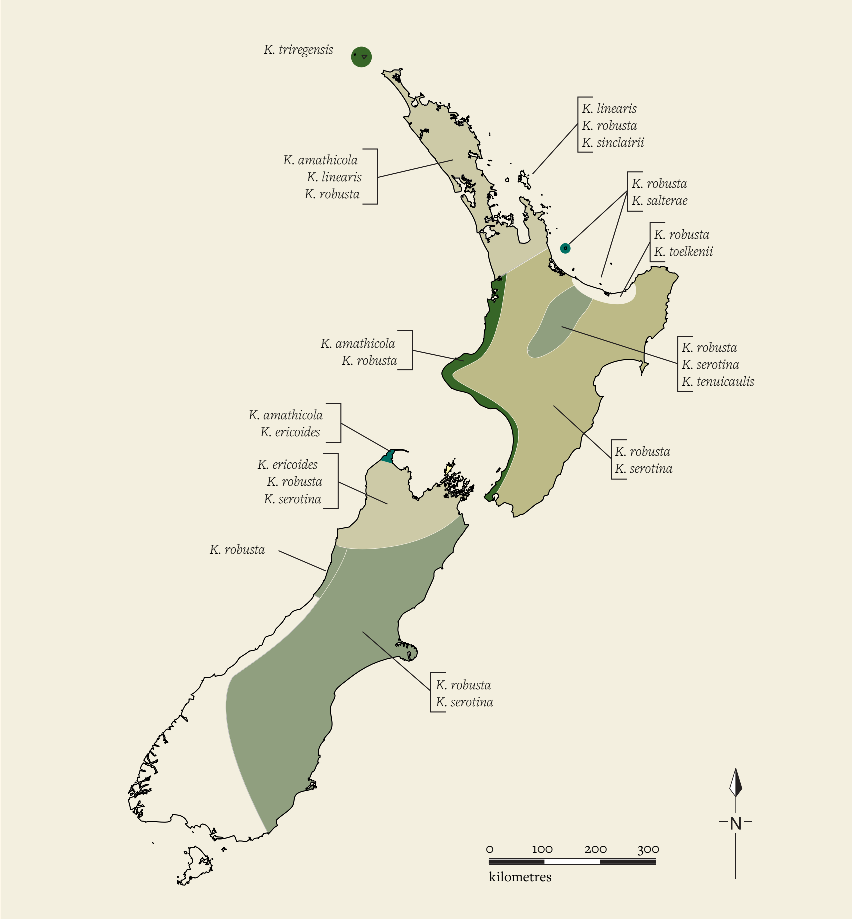
The Myrtaceae are, as a rule, difficult to identify without flowering material. In some genera flowers are essential. For *Kunzea* this is also the cas and, accurate determinations are best made with flowering specimens. Nevertheless, the New Zealand species can mostly be resolved without flowers, using a combination of geographic location, habitat and elevation, and branchlet hair type.

This guide uses a combination of characters for identification in the field, and which will enable (in most cases) an accurate determination. Problems will occur in urban settings and other frequently disturbed habitats, such as roadsides, within forestry plantations and tracksides, because in these situations hybrids between the various species can be locally common. For seed collecting, it is advised to avoid any habitat where there has been repeated disturbance.

Determinations should be done using fresh material. Most species can be quickly identified using a 10× hand lens (for *K. ericoides*, a 20× lens is necessary) to inspect the hairs. This will separate your *Kunzea* into one of two key groups – those with conspicuous 'long' antrorse, antrorse-appressed hairs (i.e. leaning towards the tip of the branchlet, in some cases pressed against it), and those with short bristly hairs (or no obvious hairs at all). For hair determinations it is important that you use young branchlets, and hold these up to the light when examining the branchlet hairs. Once you have worked out your hair type, consider the growth habit and inflorescence type, then look at where you are in New Zealand. Note that only one species, the Three Kings islands endemic *K. triregensis*, grows in isolation from all others; the other nine species usually grow with one or more other species.

The inflorescences of *Kunzea* are all terminated by a vegetative bud, which may or may not become active during or shortly after flowering. In most species the initial inflorescence, though a compact raceme (in which flowers arise at close intervals along the stem), resembles a corymb (in which the flowers appear to form a flattened head – hence 'corymbiform'); as the first few floral whorls open, the vegetative bud may become active, thus drawing up the corymbiform inflorescence into a distinct raceme. Sometimes in good flowering years or in late-season flowering this terminal vegetative growth may flower again, often as an elongate raceme in which the flowers are so widely spaced as to appear 'solitary'. Late-season flowering is seen in all species, but in those with corymbiform inflorescences you will find, if you work back from the branchlet apex, the site of the first flowering of the season retained, usually as a short, compact raceme. Because of these changes to inflorescences during the flowering season, the initial inflorescence is best for identification. *K. sinclairii* is unusual in that it very rarely has late-season flowering, and the inflorescences are mostly retained as corymbiform structures, whilst those of *K. linearis* uniquely resemble spikes, as the flowers have virtually no stem – hence the designation 'spiciform' for this species.

Please be aware that *Kunzea* is 'tricky', so on rare occasions species that are normally hairy will appear hairless, e.g. *K. salterae* and – very rarely – *K. robusta*. Similarly, when ascertaining growth habit, note that some species with a tree habit can on occasion be prostrate shrubs, and some usually shrubby species, such as *K. sinclairii*, can develop into trees. One species, *K. amathicola*, has two growth states. In mobile sand it often occurs as small shrubs with leaves that are small, broadly oblong to egg-shaped with the broadest part towards the tip, and with very hairy margins; these are best considered as 'persistent juveniles' as they retain the juvenile foliage even though they will flower. Sometimes you can find these 'persistent juveniles' growing adjacent to the 'adult' trees of the same species.



Identification characters

1. Inflorescence

A raceme. It is important to look at the initial grouping of flowers on a stem that arises before the new season's vegetative growth has begun. This is because inflorescences that develop on new vegetative growth can have various shapes.

CORYMBIFORM RACEME
Flowers in rounded bunches

ELONGATE RACEME
Flowers along the branchlet, sometimes widely spaced

SPICIFORM RACEME
Flowers tightly clasped along the branchlet, almost without stems

2. Branchlet hairs

Use a hand lens (at least 10×) to distinguish whether plants have long antrorse hairs (leaning towards the tip of the branchlet) or short bristly hairs, or hairs are not obvious at all. Inspect young branchlets; hold them up to the light. (Hairs may have been lost from older growth.)

LONG ANTRORSE HAIRS
Pointing towards the tip of the branchlet

SHORT BRISTLY HAIRS
Patent (sticking out from the branchlet)

3. Leaves

Consider shape, presence and location of hairs.

SHAPE LINEAR
Long and narrow

HAIRS SPARSE OR ABSENT
In rounded bunches

HAIRS MOSTLY ON MARGINS AND MIDVEIN

HAIRS EVENLY DISTRIBUTED OVER LEAF SURFACE

Species Guide

Kunzea amathicola

DISTRIBUTION	Western North Island, north-western South Island
ELEVATION	Coastal to lowland
HABITAT	Sand country, coastal and lowland forest
GROWTH HABIT	Rounded shrub to spreading tree. In mobile sand country, plants usually shrubs
DIMENSIONS	Up to 18 × 8 m
SUCKERS	None
BRANCHLET HAIRS	Persistent, copious (overlapping), antrorse appressed, straight, tips straight
LEAVES	Non-linear, variably but mostly ovate, obovate to oblong-obovate, usually dark glossy green above with conspicuously white hairy margins (with the leaf hairs meeting at the apex to form a small tuft)
INITIAL INFLORESCENCE	Elongate raceme

Kunzea ericoides

DISTRIBUTION	South Island north of Buller River and Wairau River
ELEVATION	Coastal to subalpine
HABITAT	Coastal forest, lowland forest, beech forest
GROWTH HABIT	Erect tree sometimes with pendulous branches
DIMENSIONS	Up to 18 × 6 m
SUCKERS	None
BRANCHLET HAIRS	Shedding, sparse, bristly, apex straight (hairs minute – 20× magnification)
LEAVES	Linear, hairless, bright green to yellow-green
INITIAL INFLORESCENCE	Corymbiform raceme

Kunzea linearis

DISTRIBUTION	Northland, Auckland, Aotea Island/Great Barrier Island, Coromandel Peninsula
ELEVATION	Coastal to lowland
HABITAT	Coastal to lowland forest, gumland scrub, sand country (on highly acidic soils that were formed under kauri)
GROWTH HABIT	Erect tree with plumose (feathery) branches
DIMENSIONS	Up to 12 × 8 m
SUCKERS	None
BRANCHLET HAIRS	Persistent, copious (overlapping), antrorse appressed, wavy, apices straight
LEAVES	Linear, dark green, usually hairy
INITIAL INFLORESCENCE	Spiciform raceme (flowers attached to the branchlet virtually without stems)

Kunzea robusta

DISTRIBUTION	North Island, South Island
ELEVATION	Coastal to montane
HABITAT	Scrubland and forest
GROWTH HABIT	Stout, erect tree usually with a broad canopy. Sometimes with pendulous branches
DIMENSIONS	Up to 30 × 10 m
SUCKERS	None
BRANCHLET HAIRS	Persistent, copious (overlapping), antrorse appressed, wavy, straight apices. Except: Rangitikei variant – juvenile: persistent, bristly, wavy, apices curled; adult: persistent, copious (overlapping), antrorse appressed, wavy, apices straight. Eastern North Island variant – persistent, mixed antrorse appressed and bristly, straight, apices straight.
LEAVES	Leaves variable, mostly non-linear (linear forms occur in the eastern Coromandel Peninsula and some parts of East Cape), adult leaves mostly oblanceolate (lance-shaped, widest towards the tip) to lanceolate (lance-shaped, widest towards the base), dark green above; leaf margins sparsely hairy (the leaf hairs not meeting at the apex to form a small tuft)
INITIAL INFLORESCENCE	Corymbiform raceme. Corymbiform racemes on old growth (lower section of branchlet), with an elongated raceme forming on new growth.

Kunzea salterae

DISTRIBUTION	Motuohora (Whale Island), Tūhua/Mayor Island
ELEVATION	Coastal
HABITAT	Coastal forest, scrubland, geothermally heated ground
GROWTH HABIT	Shrub to small spreading tree
DIMENSIONS	Up to 10 × 6 m
SUCKERS	None
BRANCHLET HAIRS	A mix of persistent, bristly and antrorse appressed, straight to wavy, apices curled (occasionally hairs shedding)
LEAVES	Linear to narrowly lanceolate, usually dark green, margins finely hairy, hairs falling well short of leaf apex (very rarely leaves glabrous)
INITIAL INFLORESCENCE	Corymbiform raceme

Kunzea serotina

DISTRIBUTION	North Island – Taupō Volcanic Zone, axial ranges; South Island – inland eastern
ELEVATION	Montane to subalpine, rarely lowland
HABITAT	Frost flats, valley heads, intermontane basins, subalpine scrub, geothermally heated ground often on skeletal soils
GROWTH HABIT	Columnar to pyramidal tree
DIMENSIONS	Usually less than 8 × 6 m, rarely up to 20 m tall
SUCKERS	None
BRANCHLET HAIRS	Persistent, copious (overlapping), straight, patent, apices curved or slightly curled
LEAVES	Non-linear, mostly obovate, dark glossy green or bronze green; leaf margins very sparsely hairy to almost glabrous
INITIAL INFLORESCENCE	Corymbiform raceme

Kunzea sinclairii

DISTRIBUTION	Aotea Island/Great Barrier Island
ELEVATION	Lowland
HABITAT	Rhyolite, gumland scrub
GROWTH HABIT	Prostrate shrub (very rarely a small tree)
DIMENSIONS	Usually less than 1 × 3 m, rarely up to 6 m tall
SUCKERS	None
BRANCHLET HAIRS	Persistent, copious (overlapping), antrorse, wavy, apices straight
LEAVES	Non-linear, broadly lanceolate to elliptic, surfaces silvery grey (due to dense covering of hairs on both surfaces)
INITIAL INFLORESCENCE	Corymbiform raceme

Kunzea tenuicaulis

DISTRIBUTION	Taupō Volcanic Zone
ELEVATION	Lowland to montane
HABITAT	Found only in geothermal sites
GROWTH HABIT	Prostrate shrub to widely spreading tree (often with pendulous branches)
DIMENSIONS	Up to 8 × 8 m
SUCKERS	None
BRANCHLET HAIRS	Persistent, copious (overlapping), bristly, patent, wavy, apices straight
LEAVES	Non-linear, oblanceolate to obovate, dark glossy green, red-green to bronze-green; margins sparsely hairy to almost glabrous
INITIAL INFLORESCENCE	Corymbiform raceme

Kunzea toelkenii

DISTRIBUTION	Bay of Plenty
ELEVATION	Coastal
HABITAT	Sand country
GROWTH HABIT	Shrub to small spreading tree
DIMENSIONS	Up to 6 × 6 m
SUCKERS	Present
BRANCHLET HAIRS	Persistent, copious (overlapping), bristly, patent, curly, apices curved
LEAVES	Non-linear
INITIAL INFLORESCENCE	Corymbiform raceme

Kunzea triregensis

DISTRIBUTION	Three Kings Islands
ELEVATION	Coastal
HABITAT	Coastal forest
GROWTH HABIT	Stout, erect tree with broad canopy
DIMENSIONS	Up to 20 × 8 m
SUCKERS	None
BRANCHLET HAIRS	Persistent, copious (overlapping), antrorse appressed, wavy, apices straight
LEAVES	Non-linear, narrowly lanceolate, usually dark glossy green above, with conspicuously white hairy margins and midvein (the leaf hairs meeting at the apex to form a small tuft). Leaf margins hairy, hairs forming a tuft at the leaf apex
INITIAL INFLORESCENCE	Elongate raceme – usually branched, bearing reduced lateral racemes

This factsheet was first published by the Department of Conservation in December 2017. This version has been slightly edited.

A New Taxonomy for *Kunzea ericoides*

WRITTEN BY
PETER DE LANGE

Sometime in the spring of 1827, the French collected from what is now Abel Tasman National Park a flowering tree in the myrtle family (Myrtaceae). All the plant specimens collected during the second voyage of the *Astrolabe* (1826–29) made their way to the Natural History Museum of Paris, where they were studied and eventually published on by Achille Richard (1794–1852). He was the one who in 1832 described the myrtaceous tree as *Leptospermum* (*Kunzea*) *ericoides*. Even by today's standards his description is excellent, noting among other things the new tree's resemblance to tree heather (*Erica arborea*) – hence the species name *ericoides*. Significantly, he noted that the branchlets of his new species were glabrous (without hairs).

In July 1999, I found myself carrying a torch and walking with the Director of the Paris Herbarium, Dr Philippe Morat, along a gloomy, dusty corridor. At the time, I was backpacking around Europe and I had been granted access to the herbarium. At Philippe's direction I scaled a giraffe (the French term for a ladder on wheels), and high up in a steel cabinet came the type suite (the specimens on which the species was based) of *Leptospermum ericoides*, along with a liberal coating of black dust.

It's hard to describe the feeling of seeing first hand a specimen that has been largely ignored by New Zealanders for 167 years. For me, it was a defining moment. Right then I realised that Dr Hellmut Toelken from the South Australia Herbarium was correct: the commonest *Kunzea* in New Zealand was not *Kunzea ericoides* at all but an unnamed species. My PhD research had well and truly begun.

Since that day, I have worked on revising New Zealand *Kunzea*. Along the way, I have been amazed to learn how often other New Zealand botanists had almost got to the same point of view, only to be criticised, harshly at times, by the likes of Joseph D. Hooker (1817–1911) and Thomas Cheeseman (1846–1923). I guess my story is part of the perennial war between biosystematists in which you are either a 'lumper' or a 'splitter'.

In the 'splitter' camp for *Kunzea* I sit with William Colenso (1811–99), Donald Petrie (1846–1925), Harry Carse (1857–1930), Leonard Cockayne (1855–1934), George Simpson (1880–1952) and most especially Thomas Kirk (1828–98). All these scientists recognised and either tried to describe or succeeded in describing new species or varieties from what others have preferred to call *Kunzea ericoides*. I have been intrigued by how much the influence of Joseph Hooker ran through the early rejection of classifying our endemic diversity. Hooker was a 'lumper', because he needed species to be the same the world over if his views on their global spread were to be accepted. He stomped down hard on Thomas Kirk, though with him he also met his match. Kirk fought back, adding to our flora *Leptospermum* (*Kunzea*) sinclairii and *Leptospermum ericoides* var. linearis (*Kunzea linearis*). Hooker privately agreed that *L. ericoides* could be segregated, but it didn't suit him to admit this in public.

Thomas Cheeseman continued Hooker's 'lumping', firmly rejecting or casting doubt on postulated segregates in *Leptospermum* (*Kunzea*) *ericoides*. For *Leptospermum* (*Kunzea*) *sinclairii* he tried to have it both ways by illustrating it and yet implying it was a dubious species. It did not help matters that Cheeseman also confused this species with another one on the Three Kings Islands. This error led to the perpetual myth that the Great Barrier Island endemic *K. sinclairii* also occurs on the Three Kings; it never has. Walter Oliver (1883–1957) took over where Thomas Cheeseman left off, though on examining *Leptospermum* (*Kunzea*) collections made by Harry Carse he admitted in a letter that he could see at least two distinct entities. He concluded, however, that making new species would be wrong.

By 1961, the treatment for *Leptospermum* (*Kunzea*) *ericoides* recognised two ill-defined varieties called var. *linearis* Kirk and var. *microflora* G.Simps., and another ill-defined *L.* (*Kunzea*) *sinclairii*. So it remained until an Australian revision of *Leptospermum* was well underway. For that revision in 1983, Joy Thompson recognised that four Australasian *Leptospermum* species were incorrectly placed in that genus, and they were in fact *Kunzea*. Being pragmatic (her revision was not after all about *Kunzea*), she dealt with the issue by transferring these 'not'-*Leptospermum* species into *Kunzea*. Since *L. ericoides* was the oldest available name, she dumped the Australian endemics *L. phylicoides*, *L. leptospermoides* and *L. peduncularis*, along with the New Zealand *L. sinclairii*, into her new combination, *Kunzea ericoides*.

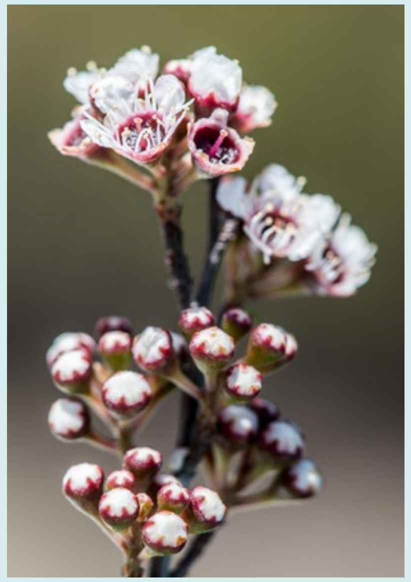
From her perspective, problem solved! At the flick of a pen, our endemic species and varieties were now merged with very different Australian species and unnamed entities, most of which are very aggressive agricultural weeds. Overnight, *K. ericoides* came to be considered one of the world's worst weeds.

Thompson's move enabled her to complete her revision of *Leptospermum*. She was correct that all those species are *Kunzea*, but she was incorrect in that they should never have been treated as a single species. One thing I have learned is that 'bad taxonomy' does kill. 'Lump' away by all means, but global biodiversity will suffer as a result. Thompson's decision led to the widespread clearance of "*Kunzea ericoides*" forests on both sides of the Tasman. I am still waiting to see any peer-reviewed literature that substantiates the claim that our New Zealand endemic *K. ericoides* is truly a serious weed!

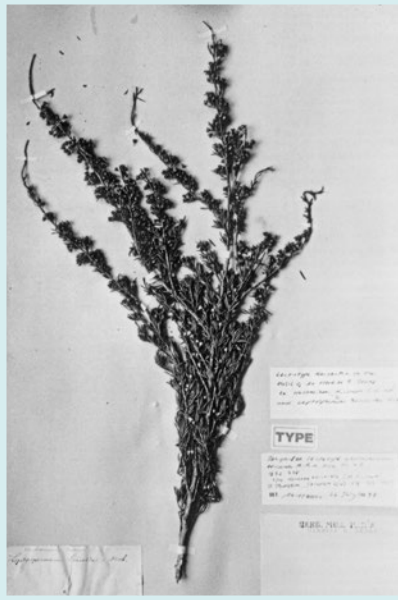
Since 1999 I have worked closely with Hellmut Toelken, who is tasked with revising Australian *Kunzea*. That year Hellmut handed me a rough draft in which he suggested the existence of up to 20 segregates in New Zealand *K. ericoides*. It was a great starting point. For the last 15 years, I have collected New Zealand and Australian members of the *K. ericoides* complex, grown the New Zealand members (and those of the Australian complex in cultivation here), counted chromosomes, examined their shape, made countless experimental hybrids, been inducted into the world of using DNA to determine relationships between species, and published scientific papers on the topic. Over that time, I have concluded that *K. ericoides* is endemic, and that it and its allies are part of a distinct eastern Australian–New Zealand subgenus that Hellmut and I named *Niviferae* (meaning snow covered), because of their tendency to cover themselves in masses of white flowers.

I think it is important to point out that Māori also recognised the diversity in *Kunzea*. My field work often involved talking with iwi, and from many elders I learned that they recognised distinct forms of *Kunzea*, distinguishing them by their growth habits and their wood. I have added the names I obtained from iwi for the various species I recognise in my new taxonomy. Some of these names are now close to extinction, and I hope their use will encourage their resurrection.

None of the elders I spoke to used the name kānuka. They were emphatic on this point. The generic or universal name for *Kunzea* in New Zealand is mānuka, but other names have also been used by different iwi for different species. While it is probably futile to insist that we use mānuka for *Kunzea* and kahikatoa for *Leptospermum* – and reject kānuka altogether – I am grateful to iwi for having shared their kaupapa on these trees, especially as most of my informants have now passed on.



Kunzea amathicola



Type Specimen of *Kunzea ericoides*

Kunzea ericoides

Kunzea ericoides, manuoea, atitire, titire, mānuka

This is now redefined as a northern South Island endemic. It is most common in North-west Nelson but it is the main *Kunzea* you will see north of the Wairau and Buller rivers. In past literature (including my own work) this species has been confused with *K. linearis* because of its narrow, linear leaves. The species can be easily recognised in the field from the observation made first by Achille Richard: its branchlets do appear to be hairless – you will need a 20× hand lens to see the tiny divergent hairs – and even then they are sparsely distributed, and deciduous. The Type Specimen, collected by the French, came from what is now known as Astrolabe Passage, Abel Tasman National Park.

Kunzea sinclairii

To be fair to the 'lumper' Thomas Cheeseman, the 'splitter' Thomas Kirk did a messy job of naming this species, doing it twice, initially as a variety (var. *pubescens*) and then posthumously as a species *Leptospermum sinclairii*. Warwick Harris reinstated this species. Despite the literature perpetuating Cheeseman's idea that this species occurs on Three Kings, and indeed other literature that says it is on the Poor Knights, the species is endemic to Aotea Island/Great Barrier Island, where it is virtually confined to the central highlands. In most cases, *K. sinclairii* presents as a prostrate, silver-grey shrub, but very rarely it can make a small tree up to six metres tall. Although common on Aotea Island/Great Barrier Island it readily hybridises with two other *Kunzea* there (*K. linearis* and *K. robusta*) and less commonly with *Leptospermum scoparium* s.l. The Type Specimen came from Mt Young, Aotea/Great Barrier Island.

I think it is important to point out that Māori also recognised the diversity in *Kunzea*. My field work often involved talking with iwi, and from many elders I learned that they recognised distinct forms of *Kunzea*, distinguishing them by their growth habits and their wood.

Kunzea linearis

Kunzea robusta

Kunzea linearis, rāwiri, mānuka

Treated by Warwick Harris as a variety of *K. ericoides*, this plant is now elevated to species rank. Part of the problem over its status was caused by the somewhat unorthodox way that Thomas Kirk described it, almost as an afterthought, with a scarcely adequate description, a poorly executed drawing and no locations (he did not even indicate it was found in New Zealand). It's hardly surprising that no one seemed to know where this variety grew and that from time to time people collected it thinking they had found a new species. *K. linearis* is virtually a Northland endemic, ranging from its type locality Auckland north to Te Paki. It is also known from scattered sites in the northern Waikato, most gone now due to road works, and on the Coromandel Peninsula and some eastern Coromandel island groups, like the Aldermen Islands. One anomaly is a collection made from Mt Kupukore, the northern most of the Taipo range in eastern Wairarapa. It has yet to be rediscovered there, though hybrids between it and *K. robusta* have been collected from this location. The Type Specimen came from Aha-tawa-pa, on the northern side of the Auckland Harbour Bridge.

Kunzea amathicola, rawiritoa, mānuka

This species was actually recognised several times over. Northland iwi (Muriwhenua) already knew it as rawiritoa, a name they used to distinguish it from their rawiri (*K. linearis*) and rawirinui (*K. robusta*), all of which often grow together within their rohe. The first European botanist to recognise its distinctiveness was Harry Carse, who collected it widely but discarded his idea of naming it. It was then 'rediscovered' by Geoff and Diana Kelly who collected it from Puponga, North-west Nelson, in the 1960s. But again, despite excellent herbarium specimens, it was ignored until Hellmut Toelken 'found' it again at Puponga in 1989. This species, as its name suggests, is most commonly seen in sand country, though around Wellington and some parts of North-west Nelson it also extends into clay country. It is one of two species possessing greatly elongated inflorescences (the complete flowerhead of a plant, including the stems, stalks, bracts and flowers) such that the flowers almost appear to be solitary (monadic). The Type Specimen came from the car park at the track access to Wharariki Beach, Puponga, North-west Nelson.

Kunzea robusta, mānuka, mānuka rauriki, rawirinui, kopuka

The most widespread and common of the New Zealand *Kunzea*, this is the species that has erroneously been called *K. ericoides* for so long. Among its many differences is the fact that its branchlets are distinctly hairy, while those of *K. ericoides* are not. However, this remains a variable species and there are some potentially distinct geographic units that I informally noted in my revision but elected not to formally name. In its typical state, this is a forest tree, the largest in the genus, occasionally reaching 30 metres high, with trunks up to one metre in diameter. The young branchlets are copiously covered in long, antrorse-appressed silky hairs, but in some parts of its range these hairs can be much reduced, and can even occur in mixtures of antrorse-appressed and divergent. It will take a braver man than I to split the species further. Incidentally, this was one of the species William Colenso tried to convince Joseph Hooker about. Colenso of course was influenced by the *K. ericoides* he knew from the Bay of Islands, most of which is in fact *K. linearis*, so it is understandable he thought his collections from the Pahaoa River Gorge in the eastern Wairarapa were a different species. The Type Specimen came from Papatea Bay, south of Te Kaha, on the western side of East Cape.

Kunzea tenuicaulis

Kunzea toelkenii

Kunzea salterae

Kunzea serotina

Kunzea tenuicaulis

This species is the same one as the geothermal *Kunzea* that people thought had been described by George Simpson as *Leptospermum ericoides* var. *microflora*, and which was reinstated at the rank of variety in *Kunzea* by Warwick Harris. I have redescribed it at the rank of species, using a new name and type, because of the confusion surrounding the description of var. *microflora* by Simpson. For that variety, Simpson used material collected from a garden plant grown by Norman Potts of Ōpōtiki. Popular legend is that Potts collected his garden plant from Maungakakaramea (Rainbow Mountain) near Waiotapu, Rotorua, and though this is probably correct, Simpson's description repeatedly stated that Potts's plant came from 'Rainbow Mountain, Nelson' (there is no Rainbow Mountain in Nelson). To make matters worse, the Type Specimen cited by Harry Allan in the first volume of the *New Zealand Flora* is, as far as I can see, a prefabrication: it bears no evidence that Simpson used it for his description. The actual type was found by accident in the Auckland Museum Herbarium but was in such a poor condition that I decided it was better to start over, describing this plant at a different rank using a new, unambiguous, wild collected type.

K. tenuicaulis now has a very different circumscription from the one people used for what they thought was *K. ericoides* var. *microflora*. That past concept equated only with the dwarfed and/or prostrate shrubs found growing near active fumaroles. My research has shown that in most cases such plants, when transplanted, grow into small trees (some do retain the dwarf rambling habit) and that all these forms were unified by growth habit, vegetative and flora characteristics, and also by their chromosome number, size and shape, and also using the DNA markers I had employed in my studies. The past confusion also relates to the abundance of *Kunzea* hybrids found in geothermal areas, most of which have been disturbed by human activity. In the vicinity of these you usually find *K. robusta* and *K. serotina*, with which *K. tenuicaulis* freely hybridises. The Type Specimen comes from Te Kopia Geothermal Reserve north of Atiamuri.

Kunzea toelkenii

This species was recognised as a distinct species only after it had been lost from 98% of its former range. A sand-dune endemic of the Bay of Plenty, *K. toelkenii* was first noted as potentially distinct by Sarah Beadel. The ecology of the species was subsequently studied by Mark Smale, who noted the peculiar nature of the vegetation association it formed at its main site near Thornton. *K. toelkenii* has features suggestive of a hybrid origin between *K. robusta* and *K. tenuicaulis*, but it forms a stable true-breeding population that is well marked from either suggested parent by its tendency to produce widely spreading lower trunk suckers (shoots that emerge from the trunk base), and also by cryptic features of its branchlet hair shape. The suckering habit is unusual within New Zealand *Kunzea* but is seen in several of the Australian members of the complex, though those species also possess lignotubers (a rounded woody growth occurring at or below ground level, containing a mass of buds and food reserves; they are often seen on shrubs and trees growing in drought- or fire-prone habitats). Lignotubers are absent in all of the New Zealand species. *K. toelkenii* is further distinguished by its habit of occasionally producing 'male' flowers toward the end of its flowering season. The Type Specimen came from Walker Road, just west of Whakatāne.

Kunzea triregensis

This is the species Thomas Cheeseman thought was *K. sinclairii*. As the species epithet implies, it is known only from Three Kings Islands where it is the dominant tree species on Manawatawhi (Great Island). It is known but not common in the much smaller North-East, South-West and West islands. Its abundance on Manawhatawhi is an artefact of the gross disturbance the island suffered from human occupation and the liberation of goats to feed castaways. *K. triregensis* has many features suggestive of a hybrid origin involving *K. amathicola* and *K. linearis*, both of which have yet to be found on the Three Kings. Notably, like *K. amathicola*, this species produces greatly elongated inflorescences, forming the impression it has a monadic flowering system. This is also the only *Kunzea* I distinguished that grows completely in isolation from one or more of the other species I described. Cheeseman evidently thought *K. triregensis* was the same as Thomas Kirk's *Leptospermum* (*Kunzea*) *sinclairii* on account of the fact that when he visited Manawatawhi (then overrun with goats), he saw it as small and/or prostrate shrubs whose leaves had distinctly hairy margins. The Type Specimen came from Manawatawhi (Great Island) in the Three Kings Island group.

Kunzea salterae

This species is something of an anomaly, currently known only from Tūhua (Mayor Island) and Moutohora (Whale Island), young volcanic islands off the eastern Bay of Plenty coast. On both these islands *K. salterae* grows with *K. robusta*. *K. salterae* was a latecomer to my revision. I had long considered such plants as evidence of a hybrid swarm involving *K. linearis* and *K. tenuicaulis*. Indeed, I had even made this hybrid, and my artificial cross was a dead ringer for the Moutohora plants I had been sent by DOC botanist Paul Cashmore. Imagine my surprise when I visited Moutohora in 2005 and found only *K. salterae* and a small number of *K. robusta* present. Further, despite what had been said by others, there was no *K. tenuicaulis* on that island, or on Tūhua from where it had also been reported. All the past records of *K. tenuicaulis* from these islands stemmed from the widespread yet erroneous belief that any flat *Kunzea* growing in geothermal areas was this species (as *K. ericoides* var. *microflora*). The Type Specimen came from Moutohora (Whale Island).

Kunzea serotina, makahikatoa, mānuka

This is another species that William Colenso picked up and tried to convince Joseph Hooker to name. Long known to Central North Island iwi as makahikatoa, *K. serotina* was also briefly mentioned by Harry Allan as a 'thicket forming' variant of the Marlborough mountains. Horticulturists have also long recognised that the Central North Island 'kānuka' was distinct, but it was left to Hellmut Toelken to 'rediscover' it. In the North Island at least, *K. serotina* is very much a species of the Central Volcanic Plateau, main axial ranges and frost flats. It was probably more wide-ranging than this, as there are occasional pockets of it in eastern Wairarapa, and it has left its footprint in hybrids along the Hawke's Bay side of the Ruahine and Kaweka ranges and within the Rangitikei River catchment. In the South Island, it is more widespread, especially along the eastern side of the Southern Alps, extending down across the Canterbury Plains, where it is replaced by *K. robusta* in the north, south and on Banks Peninsula. It also occurs within Central Otago and, together with *K. robusta*, is the most southerly occurring of the New Zealand species. (Stewart Island has no naturally occurring *Kunzea*.) The Type Specimen came from the Rangataiki Frost Flats, near Iwitahi.

The Role of Kānuka in the Ecosystem

Kānuka as a Pioneer and Nursery Species in Forest Regeneration

WRITTEN BY
IRENE LOPEZ-UBIRIA *and*
ALVARO VIDIELLA-SALABERRY

Today there is an increasing interest in re-establishing indigenous forests on land that is marginal for pastoral use, whether because of isolation, steepness or low productivity. Kānuka has proven to be an important tool for revegetating bare or eroded slopes where other species cannot be established. Once it grows and creates shade and shelter from the wind, kānuka provides an excellent nursery for other slower-growing native plants, and for lots of other species, therefore increasing biodiversity.

Although kānuka trees can form a distinctive type of forest, they are usually the first step towards mature native forest in the areas where they establish. Kānuka grows to form dense scrub and then, as the dominant stems grow and the others are suppressed and die, it can form a kānuka forest. A kānuka forest will generally diversify and ultimately be replaced in a natural succession by a mixed forest. Kānuka forests can survive even if the plants beneath the trees are heavily browsed by animals, but removing browsing animals from the understorey will allow a diverse forest to become established.

Biodiversity in kānuka shrubland and forests is influenced at several levels of the food chain: the communities of plants, soil life, insects and birds of kānuka-dominated ecosystems are very different from those found in pasture. Forest growing through mānuka or kānuka shrubland has been found to be richer than gorse-dominated shrubland, and the pathway towards native forest regeneration is different as a result.

The diversity of invertebrates in a particular environment is considered to be the most significant indication of biodiversity. Research done in the Gisborne district found that the diversity of the invertebrates in non-grazed 60-year-old kānuka forest can be as great as that found in primary forests. Extensive areas of kānuka support large numbers of forest birds, including threatened species such as whitehead/popokatea and fernbird.

Most native conifer and hardwood tree species establish naturally among pioneer vegetation, which provides initial protection from extremes in the climate and creates a suitable soil environment. Planting of a cover of hardy species in advance of establishing selected native tree species can mimic this process of natural succession. Many native trees favoured for timber production grow slowly in the early years, and the growth of some of them is improved when they are planted within shelter. Even for tōtara and kahikatea, which establish more successfully on open sites than other podocarp species, the use of a cover of hardy shrubs improves their survival and growth. In a study of 13 planted stands, ranging between 10 and 100 years old, it was found that less than one-third of the potential growth rate could be expected on poor sites with little shelter and poor care.

The use of quick-growing, generally hardy shrub species such as kānuka is a good method for providing shelter from frost and wind on exposed sites, as well as creating a canopy cover to control weeds. Kānuka is a forest pioneer species that can invade

A kānuka stand in development

Regenerating forest under kānuka

Kānuka becoming established in grassland

grassland naturally from seed sources already present in the environment, so it is very useful in this role. Kānuka might also help reforestation by providing fungi such as ectomycorrhizal inoculum that are essential for soil fertility, and by improving the conditions of the specific site where seeds and seedlings can develop.

When using kānuka in revegetation projects, it is essential to choose sites with sufficient soil fertility, moderate exposure to winds, and land use compatible with the establishment of the kānuka trees. It is also important to use the type of kānuka that grows in each region to ensure it is adapted to the local conditions. Ideally, locally sourced plants or seeds should be used. Finally, the success of revegetation with kānuka (as with any other plant) will require a level of care before, during and after establishment. The site must be prepared – e.g. by removing patches of pasture approximately one metre in diameter where each plant will be planted – to limit competition for water, nutrients and light. For land areas that lack existing seed sources that might spread naturally, kānuka can be established by planting, and possibly by seeding – a potentially lower-cost option. In pastoral situations, seedlings of native species are usually exposed to intense competition from resident pasture, so quick establishment is very important. This gives species like kānuka that germinate quickly and have fast early growth a real advantage.

Seed quality is a key factor in the success of the plantation, and ensuring the necessary level of genotypical variability (plants with different characteristics) will increase the chance of survival of the plantation. Also, in some soils it will be important to provide the plant with the proper soil life by adding soil from a nearby kānuka stand. After seeding or planting, competition from pasture or other undesired vegetation should be reduced on a periodic basis. Some fertiliser can be welcomed by the plants; and, most importantly, plants should be protected from being trampled by cattle.

Kānuka and Erosion Control

Erosion problems in New Zealand have been exacerbated by extensive deforestation. Despite the threat of erosion being well known, farmers as recently as the 1980s were being offered subsidies, through Land Development Encouragement Loans, to convert 'unproductive', steep, erosion-prone hill country under scrub and forest cover to pastoral farming. Within a few decades of land clearing, serious erosion problems became evident, particularly in the soft rock hill country of both the North and South Islands, and in hard rock greywacke terrains. In these landscapes, all the main types of erosion occur to different extents:

Sheet erosion

Streambank erosion

Gully erosion

Mass-movement erosion

SHEET EROSION

This is the uniform removal of soil in thin layers by the forces of raindrops and overland flow. It can be a very significant erosive process because it can cover large areas of sloping land and go unnoticed for quite some time.

GULLY EROSION

The removal of soil along drainage lines by surface-water runoff, forming gullies. Once started, gullies will continue to grow by headward (uphill) erosion or by slumping of the side walls unless steps are taken to stabilise the disturbance. This is a very visible type of erosion, although it is localised compared to sheet erosion, which can act on a vast area and go unnoticed.

STREAMBANK EROSION

This refers to the removal of soil and other material, such as rock and vegetation, from the streambank.

MASS-MOVEMENT EROSION

This is the movement of large amounts of soil downslope. This type of erosion includes shallow and deep landslides, slumps and earthflows.

Most of these erosion types have been recorded by geographers and geologists as common and widespread in the soils of Tairāwhiti for more than 50 years.

Surveys carried out over the past few decades in the East Coast reveal that shallow landslides affect the greatest proportion of hill-country terrain, and earthflow, slumps and gully erosion are far less extensive and frequent. Most of the work carried out on the relationship between kānuka and erosion in the East Coast seems to have been done on landslide erosion, with little to no information about the effect of kānuka on sheet erosion. The relative impact of sheet erosion and its contribution to the sediment budget in pastoral hill-country areas (at farm, catchment, regional or national scale) is poorly known, and it is likely to have a large impact on overall erosion.

The research carried out in the past 40 years on erosion in the East Coast clearly shows that high-density kānuka scrub/forest is very effective at holding the land in severe rainstorms, and at maintaining slope stability on steep hill slopes which tend to be prone to soil-slips when in pasture. The level of protection against erosion provided by semi-mature or mature kānuka stands has been found to be due to the density of the trees' root mass, and their structure and strength.

The Bioactivity of Kānuka

Bioactivity, Bioavailability and Bioaccessibility

WRITTEN BY
IRENE LOPEZ-UBIRIA *and*
ALVARO VIDIELLA-SALABERRY

Bioactivity is the specific effect of a substance upon a living organism, tissue or cell. It includes the way the substance is absorbed, how it is transported or carried to the target, the way it interacts with biomolecules, and the physiological response it produces. Some substances are capable of effects that result in health benefits: for example, they are antioxidant or anti-inflammatory.

To produce the effect on a living organism, bioactive substances must be bioavailable. This refers to the extent to which the bioactive substance is available at the action site, and it is really important because not all of the amounts of a bioactive compound are used effectively by the organism. Another related concept is bioaccessibility, which is the extent to which the bioactive substance is released from the matrix that contains it, therefore becoming bioavailable. Quite often bioactivity measurements are done in vitro (in a laboratory, outside a living organism) with purified bioactive substances. This means that bioaccessibility and bioavailability studies need to be carried out to understand whether the substance is capable of producing a physiological response that will result in health benefits.

Kānuka oil being tested in the Victoria University of Wellington laboratory

Kānuka Bioactivity

Historical records show that kānuka had a diverse range of medicinal uses. Both Māori and early Pākehā settlers used the plant to treat conditions such as urinary infections, coughs, colds, back pain, skin conditions, inflamed breasts, burns and scalds, and gum disease. It was also used to reduce fever.

Since 2000 there has been growing interest in the therapeutic potential of kānuka essential oil. Most of the existing literature relates to mānuka oil rather than kānuka oil, but there are several studies exploring the chemical composition and antimicrobial activity of kānuka oil with a view to understanding its possible uses in medicine.

Kānuka oil is increasingly used in aromatherapy, an alternative medicine practice in which essential oils and other aromatic compounds are used to improve the emotional state, cognitive function or physical health of patients. There are no toxicity studies showing the oil is safe, and what doses can be used without negative effects, and in general the literature on the efficacy of aromatherapies for treating medical conditions is very limited. People clearing kānuka scrub and some people using kānuka oil in aromatherapy have reported dermatitis (irritated skin), but the particular allergens that cause this reaction have not been identified. Anecdotal information gathered informally from aromatherapy students and practitioners in New Zealand suggests that mānuka and kānuka oils have been used extensively and there is no reason to be concerned about negative effects. One aromatherapist reported that when a pregnant woman used kānuka in a bath her skin reacted, but she had used the oil extensively without any problems before she became pregnant.

Given the enormous potential of kānuka oil, a great deal more scientific research and evidence is needed about its medical applications. It is necessary to confirm its safety and prove its efficacy for clinical use, as well as to conduct long-term tests of its toxicity. It is also necessary to understand any possible interactions when kānuka oil is used in combined therapy with other medicines.

The oil can have pain-relief properties and could help in reducing swelling and accompanying inflammation. It could also be effective against microbes causing infections.

The Medicinal Value of Kānuka Oil

According to the scientific literature, the major component of kānuka oil is α-pinene, an organic compound found in many plants. It can be obtained from eucalyptus, rosemary, citrus and sage, as well as a variety of coniferous trees like the European and North American pine trees. Research suggests that αα-pinene may have anti-inflammatory properties and potential anti-cancer benefits, but the existing studies have serious limitations and need to be carefully interpreted.

Kānuka oil from the North and South Islands of New Zealand has *p*-cymene present, which suggests that the oil can have pain-relief properties and could help in reducing swelling and accompanying inflammation. It could also be effective against microbes causing infections, as well as improve this effect in other substances. Other possible uses include as a treatment for chronic inflammatory conditions such as polymyalgia rheumatica, fibromyalgia and rheumatoid arthritis. There are several scientific reports that attribute antimicrobial efficacy to kānuka oil, but clinical evidence of its efficacy in treating bacterial, fungal or viral infections is limited. Essential oils from different kānuka types have demonstrated antiviral activity against Herpes and Polio viruses. Kānuka oil has been suggested as a way to treat muscle spasms, as well as decreasing the force of spontaneous contractions. The latter action suggests people should be cautious in using kānuka oil during childbirth, as intervening in contractions could put the baby and mother at risk.

As the use of broad-spectrum antibiotics increases, some micro-organisms are showing an alarming resistance to almost all commercially available antimicrobial drugs. Kānuka oil has been reported as having potent activity against several fungi and bacteria that cause hospital-acquired diseases and that are resistant to most medicines used to control them. These studies make kānuka oil a strong candidate for use in treating infections and immune-related diseases.

Kānuka Oil as a Pesticide

Natural pesticides based on essential oils are a potential alternative for protecting crops. Essential oils produced by steam distillation of plant material (notably in the families Myrtaceae and Lamiaceae) have traditionally been used to protect stored grain and legumes, and to repel flying insects at home. One of the most attractive aspects of using essential oils as crop protectants (and in other contexts for pest management) is the fact that they are not toxic for animals. Kānuka oil could be an alternative to chemical insecticides, as it has been reported to work as an insecticide and as an insect repellent. It has also been found to reduce insect feeding on plants (potentially reducing the damage caused to crops, for example) and to prevent insects from laying eggs on protected materials. According to some studies, kānuka oil and mānuka oil are both toxic when they come into contact with *Drosophila suzukii*, an insect that causes substantial damage to blueberry, cherry and raspberry crops.

Chemical Composition Variability Between Kānuka Oil Samples

One of the main constraints for the use of kānuka oil in medicine is the high degree of variability in the chemical composition of different essential oils. This is unsurprising, given that the taxonomy of kānuka was not clarified until 2014. In some of the studies it is extremely difficult if not impossible to determine accurately the *Kunzea* species source of the essential oil; and when the origin of the sample is not New Zealand, it is unclear if the kānuka essential oil comes from one of the species recognised in New Zealand or from other species. Moreover, the analysis of kānuka essential oils from different sources, even in New Zealand, reveals differences in their chemical composition. The extent to which these differences are due to the genotype of the tree or to the effect of the environment in the genotype is unclear.

Different studies show that the chemical composition of kānuka oil depends on the genotype of the tree. One study found that kānuka oil produced over an extensive area near East Cape had a lower α-pinene level (55.5%) than two kānuka oils from a more restricted area in Coromandel (67.8%). According to the authors, the composition of the oil probably represented a mean within considerable genotypic variation across the production

The Explorer in action

Kānuka oil: the final product

The Explorer in action

Loading the Explorer for extraction

area. Substantial differences in the chemical composition of the essential oil of kānuka were found even between single plants derived from seed collected near East Cape. These results have been confirmed by research undertaken by Hikurangi Bioactive Limited Partnership which revealed high chemical variability between kānuka essential oil samples obtained from trees belonging to different land blocks, as well as between the trees belonging to the same block.

It is known that factors like herbivore activity, temperature, reproductive stage, the age of leaves and the growing conditions can lead to quantitative and qualitative differences in the essential oils produced by plants. It has been observed that kānuka essential oil can vary according to the growing environment, season and the age of the tree. The proportion of its different components varies with the age of the tree, and the levels of some of them reach the highest values in the spring and summer when the foliage is growing. The extent and continuing nature of these sorts of variations have practical consequences for commercial kānuka oil production, as it is vital to standardise this for the development of the medicinal use.

To obtain a detailed understanding of the dynamics of oil composition in kānuka, repeat observations need to be made between and within seasons to ensure that plant selection for breeding programmes is based on true genotypic expression rather than seasonal fluctuations. Standardisation of plant tissues or parts taken in samples (position, physiological state, maturity, and so on), and replication within and between populations at any given sampling time, can improve the reliability of the data and conclusions, but data from a single sampling time cannot indicate how oil compositions may change over time at the plant or population level. Although it may be possible to begin identification of elite plants, with assessment of some plant and foliage characters in the second growth season, reliable confirmation of those identifications and an adequate analysis of the dynamics of oil composition in mature plants may take some four or five growth seasons.

However, it must be considered that the variation between sites and between individual plants is a commercially valuable resource for the selection and establishment of improved clonal lines with specific composition and functional properties.

Kānuka Bioactivity Compared to Mānuka Bioactivity

Until now, kānuka oil has been worth much less than mānuka oil, mainly due to the results of some studies that suggest kānuka oil has lower antimicrobial activity than mānuka oil. The antimicrobial activity of mānuka is believed to be caused by the presence and proportion of the β-triketones, a chemical compound that has not been found in the same proportion in kānuka oil samples. However, there is confusion on this point: the chemical analysis of kānuka oil used in different studies shows substantially different proportions of chemical compounds, and in some cases the proportion of β-triketones in kānuka oil is very similar to that of mānuka oil. Another contributing factor in the commercial value of kānuka oil is that the major component, α-pinene, can be easily obtained from other sources.

The Explorer in action

Searching for the differences in bioactivity between chemotypes can lead to the discovery of oils with much-desired and valuable health benefits. This opens a new promising era in the search for valuable kānuka extracts.

Conclusion

The research completed by Hikurangi Bioactives Limited Partnership has revealed an enormous variability in the composition (chemotype) of the essential oils produced from different kānuka plants from Tairāwhiti. These differences were found between trees from different blocks and between trees from the same block. The content of compounds found in all plants, such as α-pinene, was highly variable, ranging from less than 1% in some plants to more than 40% in others. Another example is *p*-cymene, which is a skin irritant and could be responsible for certain types of bioactivity: this compound was found in only half of the samples, with a few samples presenting more than 5% content.

The large variability of chemotypes that seems to be found between trees could reflect an even larger difference between chemotypes of kānuka plants from different species and different regions of New Zealand. This could explain the differences and contradictions reported in the literature to date on the bioactivity of kānuka, since each article defines 'kānuka' essential oil without much information about its origin.

Such large variability between kānuka oil samples could potentially correspond to differences in the bioactivity of the oils. Searching for the differences in bioactivity between chemotypes can lead to the discovery of oils with much-desired and valuable health benefits. This opens a new promising era in the search for valuable kānuka extracts.

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Kānuka and Māori in the Waiapū Valley

WRITTEN BY
BELLA PAENGA

From a distance I'd say I am 95% sure, but up close on sight and on touch, when I feel the leaf, the flower, the bark, I can confidently tell the difference between kānuka and mānuka. Ten years ago, all I knew was that mānuka and kānuka were two different trees; what the difference was, or which one of them we had growing across our whenua, I had no idea or interest in knowing. That would soon change.

As a landowner who was raised away from our land and returned as an adult to the Waiapū, I'm still learning more about myself and the taonga that has been passed down to us. On the passing of our dad we set up a whānau trust, deciding then that the only way forward was for us to combine our father's estate, our land interests, our plans to lease and develop the family farm, and our collective strengths, into our whānau trust, Toikairakau Trust. In July 2014 Toikairakau Trust took on the lease of our family farm, Tikitiki A13, with a vision to 'establish a place of connection, restoration and healing for the descendents of Ruihana Tii Kuia and her wider community.'

> We are involved with the 'kānuka project' to develop understanding around sustainable land use options, employment, collaboration with neighbouring whenua and whānau. We aim to strengthen these relationships to contribute to the overall wellbeing of our whānau and this whenua so we are able to live on the land, live for the land and live by the land.

WIREMU PAENGA,
TRUSTEE (TIKITIKI A13, KAIWAKA MARAE)

> Being involved in this research is an opportunity for the marae to support and encourage sustainable land use options for our whānau. We are looking to the future survival of the marae and whānau and whenua.

WIREMU PAENGA,
TRUSTEE (TIKITIKI A13, KAIWAKA MARAE)

Photographs of our lands in the early 1900s, prior to the birth of my grandfather, show when the trees were felled and burnt, the land cleared for grass. Today, these same areas have terrible erosion and invasive plant growth. These non-natives are an ongoing problem. Over the past couple of years I've been employed by Hikurangi Bioactives Limited Partnership to smooth the way between scientists studying kānuka and the landowners who have kānuka on their blocks, to support the research being carried out, and to ensure landowners are involved and informed. It is a journey that has enhanced my own personal relationship with this taonga rākau, te kānuka.

The following quotes are kōrero that have come from landowners involved in the research, landowner interviews, and wānanga and discussions that have helped me to understand their connections with, and changing views of, kānuka.

> It was all just scrub as we grew up, it was a nuisance to farmers and landowners because it restricted good grass growth and it was grass that cows and stock need. Just like today, rates need to be paid, that is one thing landowners can be sure of.

CHRIS HAENGA SNR,
LANDOWNER

> We had a few farms that would get us to come around and clear scrub from their land at different times of the year. Scrub cutting was a regular holiday mahi while we were at school, and led to casual mahi following school.

FARM LABOURER,
PREVIOUSLY SCRUB CUTTER

Bella Paenga and whānau

One part there we had a firewood business selling the scrub we were being paid to clear, top money for mānuka or kānuka firewood, me and some of the bros. We could work, clear that scrub, but running business wasn't something we were good at.

DAVE MONIKA,
LANDOWNER,PREVIOUSLY SCRUB CUTTER (AHIATEATUA A12)

A confusing history surrounds kānuka. It is a history of cutting and clearing, errors in classification, and a severe case of mistaken identity. Yet kānuka continues to thrive on our 48-hectare block and across the Waiapū. It seems that we have come full circle and science is discovering its unique story, understanding its huge variety and important role in biodiversity. It truly is a taonga rākau. I'm amazed at the ability of kānuka to keep the gouging river banks at bay, to hold our eroding lands with its roots, and to soften our soils for the giants to follow.

It's all mānuka here. Kānuka is a word from up north. To us, we called it mānuka, and by the time I finished primary school, to those my age and younger, we would call it all scrub. Just like the gorse and blackberry, no good on farm lands, and across the coast it was cleared for pasture development.

WAIAPŪ LANDOWNER

The interest from Māori landowners, not just across Tairāwhiti but across the country, confirms that many land blocks and owners see the value of kānuka for protecting land and waterways, as well as its extractive value and opportunities that may exist in the natural health and pharmaceutical industries. Many landowners and decision-makers are looking to future land-use options, and wanting a sustainable, healthy alternative to the existing industries and negative impacts on our taonga.

Since joining the research, there's an increased interest and awareness of the value that kānuka has. It would be great if there are opportunities to commercialise products from kānuka to generate incomes for whānau. Getting them out on their whenua will revitalise their connection a tinana, a wairua hoki.

ELIZ NGARIMU,
LANDOWNER

At the end of the day I have got rates to pay, I'm looking at the financial opportunities that exist for my land, for the future. But, hey, I'm looking at our rivers, at the damage that's been done and that keeps happening to our land, because I do care. I'm busy, I work full time, raise a family and I am active in our busy community. I don't have the time to research options, so I'm keen to be involved in research that creates options for my land and yours.

NATANA TAARE,
LANDOWNER (TIKITIKI B18 & TIKITIKI B16A1)

Erosion on Tikitiki A13

Although our land is currently grazed by an owner in the block, the desire is to see sustainable land use, and development of high-value products such as opportunities in the bioactives industry is the aim. That is why we are involved in the kānuka research and keen to participate in any research that will give us options for the future sustainable use of Ngawhakatutu whenua and whānau.

PANAPA EHAU,
LANDOWNER (NGAWHAKATUTU A142B)

Working on this research and learning about the relationship between the kānuka and our whānau here in the Waiapū, something that strikes me is that many people my age and older know that kānuka and mānuka have different whakapapa; they may even know that the trees they had been calling mānuka since childhood are also known as kānuka. What might at first seem like mistaken identity or ignorance is more likely evidence that we're using the wrong names. The pakeke that the scientist Peter de Lange spoke to were certain that mānuka was the right name for what we now call kānuka; and that what we call mānuka was known in the old days as kahikatoa.

Whatever names are used, it's encouraging when memories are triggered and some of the uses of kānuka/mānuka are shared. People remembered drinking the tea made from kānuka/mānuka leaves to help with a sore puku, or to relieve stress and settle after a busy day in the bush. Or sweeping out the old kāuta using kānuka/mānuka brush, leaving the room smelling fresh and clean. Some recalled being encouraged to chew new shoots of kānuka/mānuka for toothache or as a breath cleanser. Many spoke of lotions made up by a nanny or an uncle but were unsure of the ingredients. While most of the discussions I had reflected that kānuka isn't well known, there is still traditional knowledge about its use out in the community.

As a young man, my job was to pull out any trees that went down up the back in the bush and pull them out for firewood at the Pā. I don't recall anyone using that name kānuka, all of this is mānuka [pointing out the rākau on the surrounding land]. They just wanted to keep it clear for grass. The mānuka is hard, it wasn't one of the trees I would regularly pull out. More the tawa, occasionally an old kuere might go down. Some call that pūriri, but kuere is Ngāti Porou.

WI WAITOA,
LANDOWNER, PĀKEKE

I grew up out the back of Ūawa. My father had beehives and we knew that the mānuka flowered first and the kānuka after that. In those days it was what we knew – honey was our butter, our sugar. We didn't have much in those days, all the cooking was done on a wood stove, or open fire. We would use the kānuka to start the fires, the long chunky strips of bark followed by smaller kānuka branches or logs, but it would be the mānuka for the long nights to keep the house warm. Just like the leaf, the wood is extremely hard. It was used to make tools and weapons.

WAIAPŪ PĀKEKE

Keith Stevenson and Cheryl Kure

Today kānuka is being used in many different ways. Of course, it is still a highly valued firewood, still used to smoke fish. I regularly see mānuka chips for smokers being sold in petrol stations and the wood chips are usually white, so now I assume that the case of mistaken identity continues. (I am quietly pleased that I'm able to recognise this taonga rākau, that as much as we have tried to get rid of it, it continues to exist and thrive.) Kānuka honey and oil are real opportunities for many landowners. Although the market is not big now, it is on the rise as companies such as HoneyLab in the Bay of Plenty push forward with clinical testing and product development.

Many herbalists, healers, rongoā practitioners use kānuka essential oil for the relief of swelling or muscular pain or sprains, strains and work or sports injuries. It helps clear inflammation, and is used as a skin tonic and for relaxation. The science tells us that, just like us, there is a lot of variation in the kānuka growing on each land block, but generally across the Tairāwhiti the same range of diversity is found. As a pioneer and nursery species, kānuka contribute to an amazing biodiversity.

My son is nine now but I have been using kānuka essential oil around or on him since he was nine months old. It helps to settle him down.

CAROL HENARE,
HOME EXECUTIVE

My dad uses the hydrosol on his dogs. Great to keep the ticks and fleas away and gives them an amazing shine to their coats. They don't mind it so much.

MIHI KUPENGA

Mum's been adding the kānuka in her balms for a while now. Really good on those summer nights by the BBQ, helps keep the mozzies at bay and settle the itch. Nice too on the irritated sunburn. Smells good too.

RANGATAHI

A good mānuka stick, not too thick, makes a good walking aid. Solid, it isn't going to break. Our clothesline back up the homestead, supported by a long straight mānuka pole with a forked end, or was that a kānuka pole? Still a familiar sight. Uncle would use it for his smoker, he'd dig a short tunnel into the side of a bank and then dig another down to meet it from above. He had a small corrugated tank he'd stick over the hole with chicken netting secure inside for the fish to rest on. He uses the fresh green leaf and freshly chopped branches of mānuka to smoke his fish. He has been doing it like this for years. The flavours and smells, great memories.

AUNTY JEN STEWART,
LANDOWNER, HOMEMAKER (ŪAWA)

Like most if not all the landowners involved in the research about kānuka, and all those whānau who have contributed their ideas and their dreams, we are looking at options for our whenua that will ensure that our waterways, springs and rivers are protected. We are looking for high-value sustainable products. The land has had a lot taken out and in many places very little given back. So much of our lands need fencing and replanting. We are looking for employment opportunities that will reconnect whānau with their whenua, their marae. Most of all we are looking to get back in balance with our land and ourselves.

I see opportunity out of all this, an extraction factory being set up and jobs. An exciting idea for all of us.

DAVE MONIKA,
LANDOWNER, KĀNUKA HARVESTER (AHIATEATUA A12)

Dave Monika and Keita Rangi with the Explorer

Propagating and Growing Kānuka

WRITTEN BY
IRENE LOPEZ-UBIRIA *and*
ALVARO VIDIELLA-SALABERRY

Because kānuka grows easily in different regions of the country, oil production is currently based on harvesting wild stands of trees. Should a kānuka industry develop and demand for kānuka oil increase, it will be important to establish sustainable managed areas of trees for harvest. Dedicated plantations will allow producers to focus on improved lines of kānuka with superior chemistry, improved foliage production, and greater resistance to pests and diseases. Although regrowth is rapid after harvesting, the risk of damaging a wild resource that plays an important role as a pioneer and nursery species in the growth of native forest cannot be ignored.

Plant Propagation: Sexual and Asexual Reproduction

Plant propagation is the process of creating new plants. There are basically two types of propagation: sexual and asexual. Sexual reproduction comes from the union of the pollen and egg, involving the floral parts of a plant. The new plant is the result of the gene combination of the original (parent) plants, and it has a unique genetic makeup (genotype) that will give it unique characteristics; it will be different from its parents. The more similar the genotypes of the parent plants, the more similar the genotype of the resulting plant will be. In plants, sexual reproduction is generally carried out by the production of seeds. Asexual propagation involves taking the vegetative part of one parent plant – e.g. the stems, roots or leaves – and causing it to regenerate into a new plant. The resulting new plant is genetically identical to its parent.

Both types of propagation are common in nature, although reproduction through seeds is more frequent. When propagating plants for commercial purposes, the most suitable propagation method depends on several factors. For example, sexual reproduction through seeds may be cheaper and quicker than other methods; in certain species, it is the only viable method for propagation. Transmission of certain diseases from parents to their offspring is generally more difficult through seeds, and this can be a considerable advantage when using imported plant material. Sexual reproduction is also the main method used to obtain new plant varieties in breeding programmes. Asexual propagation has advantages, too. It can be easier and faster in some species where seed production is not the main natural propagation mechanism. It may also be the only way to propagate some varieties and obtain identical plants. It is also important for species with a juvenile phase; when the starting material is obtained from a mature individual, it bypasses the juvenile characteristics.

Kānuka Propagation

In nature, kānuka propagates mainly by seeds, through sexual propagation. Artificially, kānuka plants can be propagated from seeds and seedlings gathered from wild populations, and asexually from cuttings. To propagate through cuttings, semi-hardwood material sampled from the field can be used, although propagation though cuttings is more difficult than through seeds and seedlings.

Kānuka trees produce thousands of tiny, light seeds which are dispersed by the wind. Seeds are shed in the late autumn to early winter following flowering. Germination occurs in the cooler, wetter months of the year, with rapid growth of a taproot into moist, lower layers in the soil profile: a two-centimetre seedling can have taproots that are 10 centimetres long. One of the conditions necessary for the germination of these seeds is light. Mortality rates of newly germinated seedlings in the following summer can be high. Isolated plants soon develop extensive lateral root systems, ultimately extending for horizontal distances of 10 metres or more.

Because it is the easiest method, most kānuka plants produced in commercial nurseries are propagated from seeds. Most (if not all) of these plants are used in land restoration work. But when there is a need to reproduce an individual plant that is genetically identical to the parent plant, asexual reproduction is the only option. The main asexual reproduction method for kānuka is through cuttings. Cuttings involve rooting a severed piece of the parent plant, normally a semi-hardwood piece of stem. The difficulty of this propagation method for kānuka lies in the rooting process. It is necessary to use rooting hormones to enhance root formation, and fungicides to prevent the fungal infections that flourish in the humid environment needed for root formation.

Kānuka cuttings should be obtained with a sharp, clean blade, which will aid the healing of the exposed areas. The basal cut is done just below a node. The basal end of the cutting is generally impregnated with rooting hormone and fungicide. Then the basal part of the cutting is inserted into a rooting medium that allows oxygen flow around the roots and holds enough water to provide a humid environment. Perlite, vermiculite, coir and peat (or a mixture) are common substrates used for rooting. It is extremely important to have adequate irrigation systems so the cuttings do not dry out, and to provide a humid environment by reducing the evaporation of moisture from the leaves of the cuttings. Although the plant uses the nutrient reserves contained in the stem for root regeneration, the cuttings must receive enough light to carry out the photosynthesis activity necessary for the development of new roots, shoots and leaves.

The Importance of Inoculating Young Plants

The root systems of all native forest tree and shrub species are infected by fungi that form symbioses with the host plant, and play an essential role in the nutrition and water uptake of the host. These types of symbioses are called mycorrhizal symbioses, and the fungi are mycorrhizal fungi. Many of New Zealand's native woody flora form mycorrhizal symbioses exclusively with one of two types of mycorrhizal fungi: arbuscular mycorrhizal fungi (AMF) or ectomycorrhizal fungi (EMF), which differ according to the type of connection they make with the roots of the plant. Kānuka and mānuka are unusual among New Zealand's flora in that they are colonised by both AMF and EMF. Successful restoration of native vegetation may require restoration of components of the microbial community, and kānuka could play an important role by providing AMF and EMF.

The establishment of kānuka in grassland communities could also be constrained by a lack of appropriate mycorrhizal fungi. Grassland communities are dominated by species infected by AMF, and it is possible that some of these fungi will also infect kānuka. It is also possible, however, that the trees' growth and competitiveness may be improved by introducing AMF from kānuka communities, as has been shown for other species. This would also be the case for EMF, which are unlikely to be already present in grassland communities.

It has been observed that the biomass of kānuka growing in grassland soil improves substantially by inoculation with unsterilised soil from a kānuka stand. No response was obtained from inoculation with sterilised soil, so it was concluded that the improvement was due to mycorrhizal or microbial activity, rather than nutrients contained in the inoculating soil. No development of EMF was observed on kānuka roots, so enhancement due to EMF infection was ruled out. The observed biomass response could have been due to the infection of kānuka roots by more functionally appropriate AMF than those present in the grassland soil. Soil life, including beneficial bacteria that enhance plant growth and other microscopic organisms that have a role in soil fertility, may also contribute to the enhanced growth of kānuka inoculated with soil from kānuka stands. These beneficial bacteria may improve plant growth by suppression of plant pathogens, production of plant hormones or improving formation of AMF, whereas microscopic organisms may improve plant growth by accelerating plant nutrient release.

Further research is needed to identify the causative agent(s) of the response by kānuka to soil inoculation and to determine how these may be influenced by environmental factors. This information is necessary to develop practical inoculation techniques that will help kānuka become established.

Kānuka Growth Rates

According to The Mānuka and Kānuka Planting Guide (https://www.gdc.govt.nz/land-publications-and-resources/) published in 2017, seedlings 30 to 40 centimetres tall, planted at 1.5- to three-metre spacing in fertile and sheltered sites, can have initial growth rates of 60 to 70 centimetres per year. By Year 4 or 5, plant canopy spread will typically have a diameter of about two metres. In terms of branch extension, kānuka grows rapidly in warm temperate conditions (approximately 0.5 metres per year), but growth records vary considerably and are scarce.

Kānuka Harvest

Most if not all kānuka oil is currently produced from wild kānuka stands. Kānuka harvesting is undertaken by trimming plant foliage by hand. In general, periodic trimming does not affect the vigour of the plants. The trimmed bush will regrow and can be harvested again in three to five years. Juvenile bushes can be trimmed by mechanical cutters, and mānuka wild stands are harvested mechanically using specialised equipment by a number of New Zealand mānuka oil producers.

In the long term, developing plantations with selected genotypes and using mechanical harvesting would be a more cost-effective and efficient system of production. This is done in Australia, with *Melaleuca alternifolia* (tree tree) planted in rows and harvested mechanically with dedicated machinery.

The best harvest period for kānuka is yet to be established, and will depend on the variability of oil yield and oil composition. Commercial distillers generally trim during the spring and summer season when the highest quantity of oil is present in the foliage. Harvesting usually ceases in late summer and is not undertaken over winter. Trimming occurs annually or every two years, depending on plant growth rates.

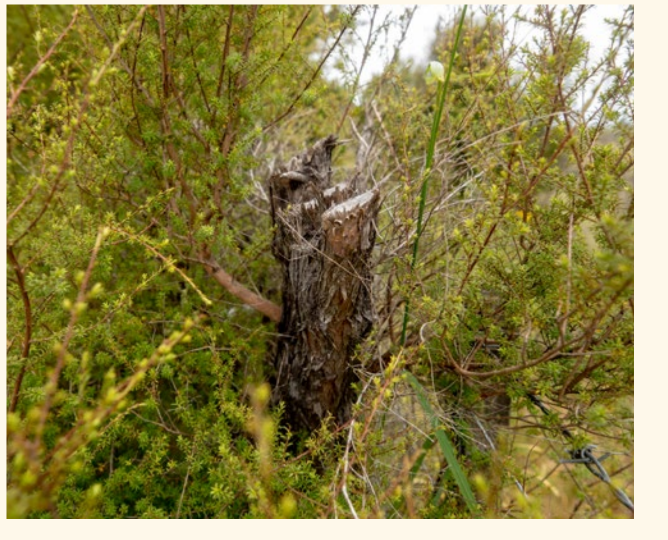
In general, kānuka leaf extracts offer higher oil yield than twigs, but their chemical composition is similar. The highest yields are obtained in spring/summer and the lowest in autumn/winter.

Further Reading

Davis, M., Dickie, I.A., Paul, T., Carswell, F. (2013). 'Is kānuka and mānuka establishment in grassland constrained by mycorrhizal abundance?' New Zealand Ecology Website, 14 May 2013. http://newzealandecology.org/nzje/3084.pdf


Kānuka cutting


Kānuka cultivation


Kānuka growing back after a harvest

A Guide to Harvesting Kānuka

WRITTEN BY
BELLA PAENGA

This is the simple process we have developed to harvest kānuka in a safe and sustainable manner. Our experience with harvesting suggests that spring and summer, in the early to mid-morning, are good times to harvest kānuka. The bioactivity is at its peak and the conditions help to control the growth of black sooty mould, which we have found causes trouble when extracting oil from the kānuka leaf.

Tips and Safety Suggestions

- Never work alone! Always work in pairs so you have help if something goes wrong.
- Let the landowner or farm manager know when harvesters are expecting to be on the block.
- Make sure that appropriate Personal Protective Equipment (PPE) is used and that all equipment is in good working condition.
- Depending on what the kānuka is being used for, you may need to prepare it differently.
- If a known amount of oil is required by a customer, it makes sense to harvest only enough kānuka brush to fill the order.
- Similarly, if harvesting for research purposes, knowing how much oil is needed will dictate how much kānuka brush should be harvested.
- When harvesting for smoking kai, the green leaf is important.
- Home crafters will be harvesting smaller amounts more frequently, and will most likely follow their own harvesting protocols.

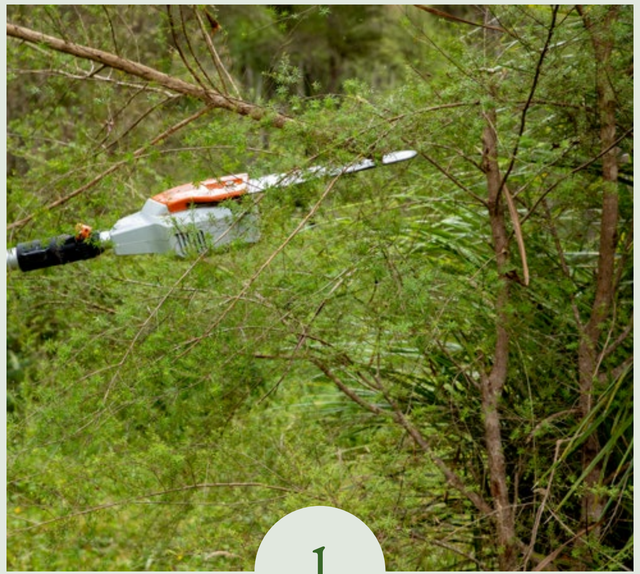
Harvesting Equipment

- Brush cutter
- Lopper
- Secateurs
- Large black garden sacks or wool fadge

Personal Protective Equipment

- High viz vest
- Safety glasses
- Covered boots
- First-aid kit

For Smaller, Younger Kānuka



1

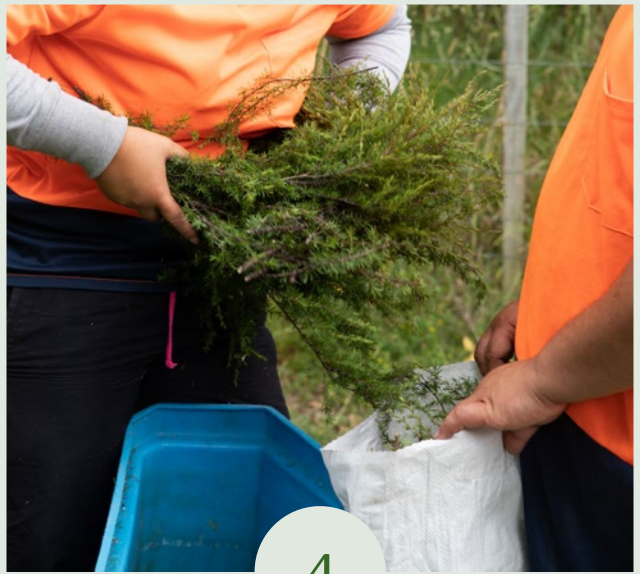
Using the brush cutter, cut the tree one metre at the trunk.

2

Use the secateurs or lopper to trim the branches to easy-to-handle sizes.

3

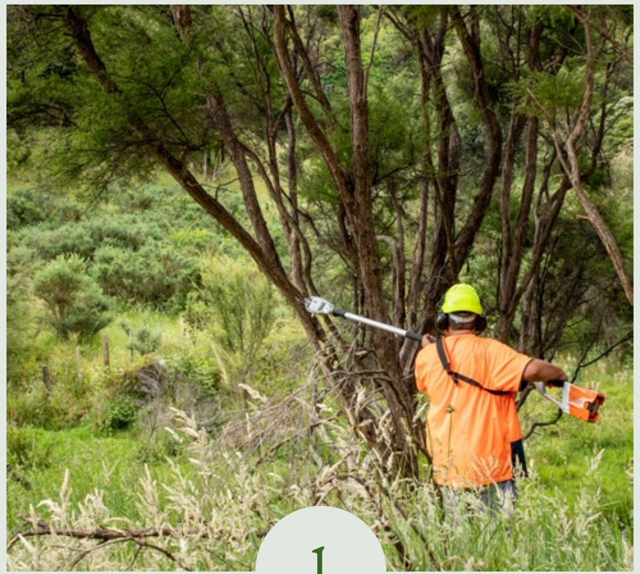
Cut branches down to 10 or 15 mm, or whatever size is appropriate depending on how the kānuka leaf will be used.



4

Bag the prepared branches.

For Larger, More Mature Kānuka



1

Look for branches with plentiful leaves that are clear of under-growing limbs.

2

Cut the branch back at the trunk using the brush cutter, and pull cut branch free of the tree.

3

Use the secateurs or lopper to trim the branches to easy-to-handle sizes.

4

Cut branches down to 10 or 15 mm, or whatever size is appropriate depending on how the kānuka leaf will be used.

Kānuka Distillation for Hydrosol and Essential Oil

WRITTEN BY
JILL MULVANEY

Even though both kānuka and mānuka yield only small amounts of essential oil by steam distillation using a still, the known effectiveness of the bioactives in each has been well documented and, in the case of mānuka, marketed worldwide. This makes them viable resources for commercial distillation.

Harvesting

Volatile organic compounds (VOCs) are found in all plants. Their primary purpose is to attract bees and other pollinators, deter insect pests and animals that might want to eat them, communicate with other plants, and protect them from the diseases carried by yeasts, microbes and fungi.

Plants themselves do not produce essential oils; they are the product of the distillation process. The VOCs are stored in tiny glands in the needle-like leaves of kānuka and mānuka. When the leaves are exposed to water vapour and heat, the VOCs are volatised – they turn into a gaseous state – and are carried through the still in the water vapour, which then turns into a liquid state when the vapour passes through the cooling condenser and becomes an essential oil.

Kānuka and other plants make VOCs at great cost to their overall energy. For this reason, it is important to observe the plants in different seasons, and to decide what will be the best time to harvest to get the largest amount of essential oil. Environmental conditions can trigger plants to produce more VOCs. For example, as flowers are forming, some plants use more energy to produce VOCs to attract pollinators, so it makes sense to harvest just before flowering.

Kānuka and manuka are different; their VOCs deter animals that otherwise might eat them, and protect the plants from bacteria. I have found I get a larger amount of essential oil from kānuka and mānuka between seasons and before flowering. In spring and autumn there is often a flush of new growth on the plants, and this can be a good time to harvest. Because the VOCs are in the leaves, harvesting in a way that gives a greater amount of leaf, and less branch and woody material, will lead to a better result in terms of the quantity of essential oil produced by the distilling process.

Once the plant material has been harvested, it can be useful to let it rest overnight. This releases some moisture, and can also trigger the material to make more VOCs as a means of healing and protecting itself.

Distilling

Distillation is the act of releasing and removing the VOCs using high-pressure steam or a mix of steam and boiling water. To begin distilling, plant material is packed into a basket, canister or column, which is then sealed to create atmospheric pressure. Water is added and then heated. Steam is created by either boiling the water in the tank or injecting steam and forcing it through the vessel containing the plant material. The heat of the steam ruptures the molecules in the plant material and carries the molecules of the VOCs through a cooling system into another container. When the steam passes through the cooling unit, it reverts back to water, and the essential oil is formed. The density of essential oil is lighter than water and so it rises to the surface, where it is easily separated using an oil separator, essencier or florentine flask. Water-soluble chemicals remain in the water that has passed through the still, creating extracts or hydrosols.

Hydrosols are the condensate water co-produced during the steam- or hydro-distillation of plant material. A distiller can be set up to specifically produce hydrosols with superior aroma and therapeutic benefits. Most hydrosols, however, are produced simply as a result of essential oil distillation.

It requires a lot of energy to run a still, so finding the most efficient ways to pack, heat and cool the still is very important. The more plant material in the still, the greater the yield will be. Using a chipper or shredder is a good way to reduce the size of the plant material and get more of it packed into the still. But the way the still is packed is also really important. The steam will look for the easiest way to escape, so if the plant material is not packed firmly to the edges of the basket or column, or has been loosely packed, the steam will not pass evenly through the plant material. As a result, it won't make optimum contact, and the yield will be less than it could have been with a good packing technique.

One way to tell if you have packed your still efficiently is to examine the plant material after the distillation has finished. The used plant material should come out as a bale, and when broken open it should be a uniform colour. Areas of colour are a sign that the steam has not passed through that area and has left a cold spot. If there are dark areas, it's a sign of a hot spot, where the steam has overcooked the area. This may have an effect on the aroma and composition of the essential oil.

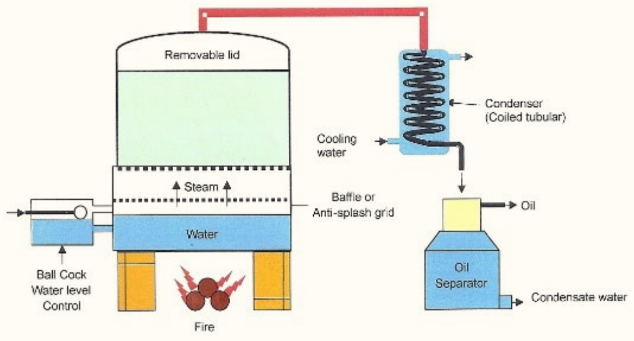
Distilling Guide

KĀNUKA

Species:	Kānuka	*Kunzea ericoides*	
Area:	Waiheke Island		
Month:	November		
Still:	Stainless Steel Explorer 40 L capacity		
	Actual EO	30.00	ml
	Weight plant material	5.00	kg
	Heat on	10.06	am
	First delivery	11.10	am
	Finish	1.30	pm
	Yield %	0.60	%

MĀNUKA

Species:	Mānuka	*Leptospermum scoparium*	
Area:	Waiheke Island		
Month:	March		
Still:	Stainless Steel Explorer 40 L capacity		
	Actual EO	24.00	ml
	Weight plant material	6.50	kg
	Heat on	10.06	am
	First delivery	11.10	am
	Finish	3.00	pm
	Yield %	0.37	%

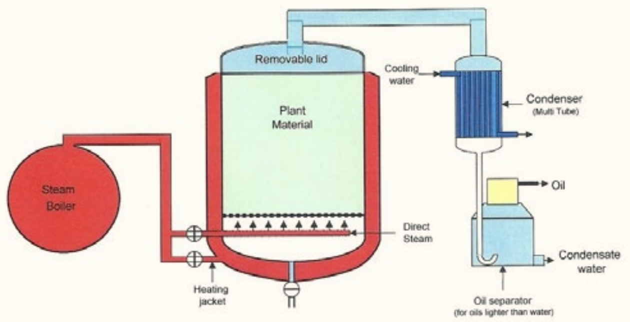


Water, Wet or Hydro Distillation

For this method of distillation, the plant material is submerged in water, which is then heated to boiling point. During this process there is direct contact between the boiling water and the plant material, and all parts of the plant material must be kept moving by the motion of the water. This method is used for plant material such as cinnamon bark that can't be easily be broken down by other methods using steam, and it is also used to make saturated hydrosols which capture the water-soluble constituents of the plant material.

Water and Steam Distillation

This method uses the same basic equipment as water distillation, but the plant material is set on a perforated grille above the water, rather than immersed in the water itself. This way of distilling is more energy efficient because the essential oil is produced at a much faster rate, and with higher yields, and there is less damage caused by heat.



Direct Steam Distillation

This method of distillation uses a different type of still from the other processes. There is no water in the tank with the plant material. Instead, steam is generated in a separate boiler chamber and then injected into the still, where it passes through the plant material that has been placed on a perforated grid above the steam inlet. A big advantage of direct steam distillation is that the amount of steam can be easily controlled, meaning that the plant material can be heated at lower temperatures of 90–100° Celsius, reducing the damage caused by heat. A big drawback to this process is the much higher cost of such equipment. Most commercial essential oils are produced this way.

Traditional Copper Alembics

Copper stills have been used for centuries to make spirits, aromatic waters and essential oils. Copper has an antiseptic and antibacterial action when a substance comes into contact with it, and is known to produce clean distillates due to an ion in the metal that removes sulphites that can cause off notes. Some plants react with copper, and copper sulphate is formed during the distillation process; this turns the essential oil a bright blue/green colour. Kānuka and mānuka both cause this reaction when distilled in a copper still. However, copper stills are suitable for other plants that are commonly found on New Zealand farms, and lifestyle and bush blocks with potential commercial value. These include pine, eucalyptus, cypress, fir, spruce and Douglas fir.

→ https://www.alembics.co.nz/products/copper-stills/

The Explorer

The Explorer is a good-quality still made from high-grade stainless steel, and designed as an efficient research and testing still. The drum can hold between 7 and 10 kilograms of plant material, and has a total volume of 54 litres. The weight of the empty still is 21 kilograms. It comes complete with a glass collector for the distillate, and pipettes for separating out the essential oil. Each Explorer has its own unique serial number and entitles the owner to a discount on plant analysis done by Phytochemia, a leading laboratory specialising in phytochemistry (the chemistry of plants) located in Quebec, Canada.

→ https://www.alembics.co.nz/products/stainless-steel-stills/

Commercial Setups

Once the commercial viability of a plant has been assessed, a larger still will be required, based on one of the methods described above. Marco Valussi of Gadoi (https://www.gadoi.it/en/) has a custom-built still to process the aromatic plants that grow wild in the mountainous regions of Verona, Italy. He is considered to be an artisan distiller and makes high-grade essential oils that are sold at premium prices. As well as wild harvesting pine, juniper and cypress, Gadoi cultivates crops suited to the region that produce quality essential oils. Business models such as this could provide extra income streams for landowners of large blocks and community cooperatives where there are large areas of invasive plants such as Douglas fir or wilding pine, or unfarmable areas covered with kānuka and mānuka.

Using Kānuka Oil at Home

WRITTEN BY
BELLA PAENGA

Infused Kānuka in a Carrier Oil

There are several ways to infuse oils, but my favourite relies on warmth and slow infusion over time. There are many suitable organic carrier oils that can be used, but fractionated coconut oil (MCT) and olive oil are popular and wise choices because they have long shelf lives, are easily available and are suitable for many applications.

DIRECTIONS

1. Place kānuka leaf in a clean jar. Leave at least 3-7 centimetres of open space above the kānuka leaf to cover with oil.
2. Fill the jar with your oil of choice, covering the kānuka by at least 3 centimetres or more; if the kānuka emerges above the surface, pour more oil into the jar to ensure the kānuka is fully covered.
3. Cover the jar securely with a lid and shake lightly.
4. Label the jar with the ingredients and the date of infusion.

Simply infusing kānuka leaf in a carrier oil transforms it into a versatile ingredient.

Slow Infusion

SLOW METHOD

1. Place the jar into a dark, warm safe place for 6–8 weeks.
2. Lightly shake the jar weekly.
3. At the end of 6–8 weeks, drain the oil through a sieve or mutton cloth.

If I'm infusing herbs and flowers, I'll soak them and place them in my hot-water cupboard for at least six weeks. After draining the oil off the plant material, I store the oil in the hot water cupboard.

Sun Infusion

MODERATE METHOD

1. Place the jar on a warm window sill in a safe place for 2–3weeks.
2. Lightly shake the jar at least once daily.
3. Drain the oil through a sieve or mutton cloth

Heat Infusion

SPEEDY METHOD

When I need kānuka oil in a hurry, this is the process I use.

1. Place kānuka into a crockpot or double boiler and cover with carrier oil.
2. Gently heat the mixture on a low heat for 4–5 hours.
3. Turn heat off and leave for 6 hours (or overnight).
4. Return to heat for a further 4 hours on low.
5. Drain the oil through a sieve or mutton cloth.
6. Add 1% Vitamin E oil to prolong the shelf life.
7. Label your oil with ingredients and date.
8. Store in the hot-water cupboard.

Kānuka Oil Soap

INGREDIENTS

- 930 grams kānuka-infused coconut oil
- 365 grams spring water
- 155 grams lye

DIRECTIONS

1. Heat and liquify the kānuka-infused coconut oil.
2. Remove from the heat.
3. Add the lye to the water, using gloves, goggles and a breathing mask for safety.
4. Once cooled to less than 65° Celsius, add the lye mixture to the kānuka-infused coconut oil.
5. Stick blend until thickened.
6. Pour into moulds and leave to harden and set, and then leave to cure for 6 weeks.

Kānuka Balm

INGREDIENTS

- 200 grams infused kānuka oil
- 35 grams beeswax
- 3 grams kānuka essential oil

DIRECTIONS

1. Heat the infused kānuka oil and the beeswax in a double boiler.
2. Once melted, remove from the heat.
3. Using a thermometer, heat mixture to 45° Celsius, and add kānuka essential oil (or any other essential oil as desired).
4. Pour into pottles, label with ingredients and date, and leave to set.

Kānuka Odour Eater

INGREDIENTS

- 1 cup baking soda
- 1/4 cup cornstarch powder
- 5 drops kānuka essential oil
- airtight jar

DIRECTIONS

1. Mix all the ingredients.
2. Store in the airtight jar.
3. Put 1 teaspoon in each shoe daily.

Kānuka Carpet and Furniture Deodoriser – Powder

INGREDIENTS

- 2 cups baking soda
- 1 cup cornstarch powder
- 2 tablespoons uncooked rice
- kānuka essential oil
- jar with lid
- hammer and nail

DIRECTIONS

1. Combine baking soda, cornstarch powder and rice into a large bowl.
2. Add 25 drops of kānuka essential oil.
3. Tip the mixture into a suitable jar.
4. Nail holes into the lid of the jar.
5. Secure lid and use as needed, sprinkling over carpets and soft furnishings. Leave for 1–2 hours, then vacuum.

Toilet Bombs with a Kānuka Kick

INGREDIENTS

- 1 cup baking powder
- cup citric acid
- 20 drops kānuka essential oil
- ¼ tsp dishwashing liquid

DIRECTIONS

1. Sift baking powder and citric acid into a container.
2. Slowly drizzle in dishwashing liquid and add the kānuka essential oil.
3. Mix well. The consistency you are looking for needs to bind together when squished in the hand but crumble when dropped into the container.
4. This makes 24 ice cube-sized toilet bombs with the added strength of kānuka
5. Store in an airtight container on your toilet, and use as needed.

Kānuka Carpet and Furniture Deodoriser – Spray

INGREDIENTS

- 200 mls distilled water
- 20 drops kānuka essential oil
- spritzer spray bottle

DIRECTIONS

1. Combine all the ingredients.
2. Pour into the bottle.
3. Spray on furniture, bedding, pet areas as needed.

Kānuka Bench Cleaner

INGREDIENTS

- 200 mls distilled water
- 20 drops kānuka essential oil
- ½ teaspoon dishwashing liquid
- spray bottle

DIRECTIONS

1. Mix all the ingredients.
2. Pour into a spray bottle and use as needed.

Making the Most of Kānuka Hydrosol

When plants are steam distilled to produce essential oils, some valuable compounds of the plant become dissolved in the distillation water. The condensed distillation water is known as hydrosol or aromatic water.

Due to its antifungal, anti-inflammatory and antibacterial properties, kānuka hydrosol has many uses, including for:

- cleaning and disinfecting surfaces; great for wiping down baby equipment
- spraying onto your linen/bedding to aid sleep
- a refreshing facial spritzer; great for a warm summer, a wound-up child, stressful moments, or when travelling abroad
- a fantastic natural skin toner
- helping soothe a variety of skin issues, including dry or itchy skin, eczema, acne and mild sunburn
- sanitising hands or feet
- disinfecting cuts and grazes
- freshening linen, towels, furniture, shoes or pet bedding
- deodorising your home to create a calm atmosphere
- adding to bath water for a therapeutic bath
- using as an eye wash for irritated eyes
- a dog wash and a flea/tick deterrent

Market Opportunities for Kānuka Derivatives

WRITTEN BY
NIKKI HARCOURT

There are a number of products that can be derived from kānuka trees. These include honey, tea, the dried leaves themselves, tinctures and essential oil. However, there is not a lot of robust information about the market opportunities for kānuka-derived products. I will review the current market situation, and identify future market potential and the strategies that will be required to grow these markets. The information I present here came from discussions with key industry players, and existing published data and analysis. The kānuka market is very much in its infancy, being primarily focused on the domestic New Zealand market and lacking a cohesive brand profile.

Kānuka Honey

Kānuka honey (NZD$9 per kg before costs) is worth much less than mānuka honey (NZD$18–95 per kg subject to UMF rating, before costs). Kānuka honey generates the same return to landowners/apiarists as bush blend honey, and I have not been able to identify any key buyers for kānuka honey at this time. This is probably because of the significant investment of time and effort put into creating and protecting the mānuka honey industry, and especially the emphasis on differentiating mānuka from kānuka honey. This has created the image of kānuka as a poor cousin, and it is possible that this impression has impacted on the market potential of other kānuka products. Given that there is scientific evidence that kānuka oil has antimicrobial and anti-inflammatory properties, and kānuka honey has immunostimulatory properties in vitro (i.e.supporting the activity of the immune system), and that topical medical-grade kānuka honey is an effective treatment for cold sores, the market potential should theoretically be similar to mānuka if the image problem can be overcome.

The Bay of Plenty-based research company HoneyLab has created a line of natural medical products under the brand name Honevo, using pharmaceutical-grade kānuka honey. These products have been positioned as 'pharmanatural': evidence-based natural skincare solutions that are supported by published scientific research. HoneyLab has worked hard to promote the Honevo product line and brand in both the popular media and scientific publications.The Honevo formulation itself has patent pending status, meaning that companies wanting to use the Honevo formulation need to license the technology from HoneyLab. Cold-sore treatments are worth over USD$1 billion per year, and this is a very small segment of the growing natural medicine market forecast to be worth USD$210.81 billion by 2026.

HoneyLab has analysed the market (demand, current and emerging competitors, and channels to market) and identified a gap for a product that meets with consumers' preferences and demands both now and into the future. They have also tested the product on the market, and refined the packaging and messaging to ensure that it is specifically tailored to the target audience. For these reasons, the HoneyLab brand story stands out as a rare example of strategic planning within the kānuka market, where most of the honey products are low-value table honey or ingredients. While massive hype has been created for mānuka honey in the global market, and there is a perception that mānuka honey is a premium brand thanks to its special health-giving properties, kānuka honey has not benefited from brand development. The New Zealand Government's creation of a formal definition and strict export certification for mānuka honey reflects its value as an export commodity and the need to protect its unique profile against fraudulent behaviour that could erode brand reputation. Industry bodies have been formed to protect the mānuka honey industry and ensure that prices remain high through collective efforts and strategies, such as UMFHA, the rebranded Active Mānuka Honey Association that was formed in 1998 with the launch of the first activity rating for the antibacterial efficacy of mānuka honey captured as UMF. In contrast, there is no formal collective for kānuka honey producers. Mānuka producers have a financial incentive to ensure that their honey is of a mono-floral type (e.g. bees have foraged only on mānuka and there is no nectar sourced from other plant species in the honey), but there is no financial incentive to differentiate kānuka honey from bush honey, given that the price paid per kilogram is the same. To develop the kānuka honey market and create a premium brand, it is critical that honey producers work collectively to develop standards, certification, and marketing information and messaging.

The potential for kānuka honey to piggyback on existing global markets for mānuka honey seems obvious, as long as the unique selling proposition can be clearly stated to avoid any consumer confusion. Existing channels to market can also be utilised. This will certainly take a collective effort by all members of the supply chain, and the first step would be for the kānuka honey producers to form an industry body and undertake market research to understand how to position the brand so that it is distinct from mānuka. The size of the global honey market was reported to be USD$7,678 million per year in 2018 and it is expected to grow to USD$10,336 million per year by 2025. Although New Zealand honey export volumes constitute just 1.5% of the global honey market, our average export price is seven to nine times higher than most other exporting countries. This is proof that having a strong and unique value proposition that is clearly presented to and resonates with the target market works. As with mānuka honey, there are four potential product categories for kānuka honey: cosmetics; food and beverages; natural health products; and pharma. The focus of market development should be to raise the profile of kānuka honey and the products that use it, therefore increasing export demand and price.

Kānuka Oil

The market potential for kānuka oil is affected by the same challenges that face kānuka honey. Both are limited by the lack of brand development and the absence of a coordinated marketing strategy. There is evidence that kānuka oil may have therapeutic potential, yet its commercial potential is still not well understood because the industry is still in its infancy. The mānuka/kānuka oil industry is currently the subject of various government-funded projects (e.g. the Provincial Growth Fund), and these will contribute to a better understanding of the market potential.

While New Zealand produces and markets between four and five tonnes of mānuka oil per year, there is significantly less demand for kānuka oil. Mānuka and kānuka oil are marketed globally within the essential oil sector, which was reported to be worth USD$17 billion per year in 2017, and is forecast to grow to USD$27 billion per year in 2022. However, it is heavily dominated by a few varietals, with mānuka oil being a very small player. As a product category, all essential oils and cosmetics combined generated USD$176 million in export earnings for New Zealand in 2017. Perhaps the true potential for kānuka oil is to target the natural medicines category in the same way that HoneyLab has positioned the Honevo kānuka honey formulation. The increased demand from customers for evidence-based natural products is expected to be an ongoing trend.

The medium-scale commercial production of mānuka oil has been underway for around 20 years in New Zealand, in parallel with the development of the mānuka honey industry. The two biggest producers (responsible for 90% of annual production) are Tairāwhiti Pharmaceuticals on the East Cape, and New Zealand Mānuka Group in the eastern Bay of Plenty. Mānuka oil is currently positioned in the health/natural products for wellness market sector based on its triketone content – the chemicals that are responsible for its antimicrobial properties. In the last few years, plantations focused solely on mānuka oil production have begun to emerge, suggesting that the mānuka oil market is gaining momentum. It is likely that an industry body will form to consolidate efforts to lift its profile in the marketplace. Though it remains to be validated by market research, the strong aroma of mānuka oil may limit its use in some products, but its potential as a natural alternative to conventional antimicrobials is likely to resonate with consumers; the ability to link this product to the premium-brand image of mānuka honey should help to create trust in educated markets.

The true potential to generate higher returns from kānuka oil lies in creating successful value-added products. Referring back to HoneyLab's story, the product is the value-added Honevo line, and not the raw commodity of kānuka honey. My discussions with New Zealand companies selling kānuka oil domestically and exporting it overseas have identified that most of the oil is being sold in its raw (neat) form rather than being turned into a product. The price of kānuka oil (between NZD$500 and $800 per kg) varies greatly, as is the case for mānuka oil. The mānuka/kānuka oil blend marketed by NZ Coromandel Mountains Tea Tree Oil Company is mainly sold as a pure oil, with a limited value-added product in the form of soap. Others in the industry have told me that healing balms and other treatments containing kānuka oil that are exported to Europe generate significantly more revenue than sales of the oil itself.

Using kānuka leaves for tea and herbal preparations remains a cottage industry. There is only a limited number of companies buying kānuka foliage, and my conversations with some of these companies have revealed that they are not looking for new suppliers at this time.

Lessons From the Australian Tea Tree Industry

The story of how the Australian tea-tree oil market developed is interesting and relevant to the mānuka and kānuka oil markets, and offers some insights as to what could happen in New Zealand. It was on the back of validated health properties, mainly antimicrobial activity, that the volume of tea-tree oil (*Melaleuca alternifolia*) grew from 20 tonnes per year in the 1970s to 900 tonnes per year currently, generating AUD$35.32 million annually. There is an industry association (Australasian Tea Tree Industry Association Ltd) that sets standards for product accreditation to safeguard the industry as it matures. There has been strong support from the Rural Industries R&D Corporation (RIRDC) to build the science story as part of educating consumers and of brand development; at the same time the industry was optimising the production potential of the plants and the extraction technology used to create the oil.

Melaleuca, mānuka and kānuka are all members of the Myrtle/Myrtaceae family, and the fact that all three plants are known as 'tea tree' in different markets creates confusion for consumers. Owing to the huge profile of Australian tea-tree oil in the global market (e.g. the Thursday Plantation brand), it is likely that consumer perceptions about melaleuca oil have an impact on how consumers view mānuka and kānuka oils. Where side-effects have been reported in the use of melaleuca oil, such as skin dryness or contact dermatitis, this may have negative impacts on other oils from the Myrtaceae family, even though the chemical makeup of the oils is quite different. Like mānuka oil, Australian tea-tree oil is mainly prized because of its antimicrobial properties, and sharing scientific data about this with consumers, along with investment in products that have been clinically trialled to prove their effectiveness, is why the market for meleleuca oil continues to grow.

Where micro-organisms persist in the skin, they could be inhibited by beta triketones, naturally occurring organic chemical compounds that are found in members of the Myrtaceae, and specifically in mānuka oil. A number of studies report that triketones from mānuka oil have broad-spectrum antimicrobial activity, as well as activity against antibiotic-resistant bacteria. There is also some evidence that triketones may be beneficial for treating head lice and scabies.

Kānuka has distinct sensory properties, being sweeter in aroma and having a lighter feel than other oils. It also has a higher content of monoterpenes, which have shown potent anti-inflammatory activity; α-pinene in particular has been demonstrated to circumvent inflammatory skin conditions, probably by suppressing the chemicals produced by cells in the human body that drive the inflammatory response. While kānuka oil has more limited antimicrobial activity than the other Myrtaceae oils, and specifically less than mānuka oil, the anti-inflammatory activity is of particular interest from a commercial perspective because it is more suitable for anti-inflammatory applications.

Educating consumers about the different modes of action of the oil components, and creating a clear brand distinction between Australian tea-tree, mānuka and kānuka oils will play a critical role in growing the market share for each. Then again, some producers create blends of mānuka and kānuka oil to get the benefits from both chemical profiles, potentially delivering effective antimicrobial and anti-inflammatory activity to the application site. The most prominent company producing mānuka/kānuka oil blends is NZ Coromandel Mountains Tea Tree Oil Company, in business for 27 years and concentrating on the domestic market. It will be important to identify local variations in the chemical profile of kānuka oil, and these may eventually be harnessed to create regionally distinctive products, just as the high-triketone mānuka oils from the East Cape are differentiated from mānuka oils from other geographic regions.

While kānuka oil has more limited antimicrobial activity than mānuka oil, the anti-inflammatory activity is of particular interest from a commercial perspective.

Next Steps

Kānuka honey producers and product developers should look to form a collective to address the need for market research and brand development in parallel with research and development. This also applies to kānuka oil producers and value-add developers as well.

In a small fragmented market such as the kānuka oil market, individual companies will struggle to achieve these things on their own. The critical mass created by a collective, and especially the formation of an industry body, will enable this much-needed strategic development to occur. Generating data about the quality of the oils (e.g. analysis of the chemical profile using gas chromatography) or studying the efficacy of the oil against specific microbes, or its role in reducing inflammation, is expensive and time consuming, and much more achievable if producers collaborate. Having critical mass in the industry could help to create an accreditation test that is offered by an independently verified commercial lab to safeguard the industry and create consumer confidence in kānuka honey and oil products.

If an industry collective is formed, shared investment in infrastructure and shared fixed costs, along with the certification, market research and brand development, would help to grow the industry by addressing challenges such as ensuring there is a sufficient supply of high-quality foliage and suitable extraction facilities to supply oil to the market. The Provincial Growth Fund has given NZD$700,000 to the Ngāti Rangi mānuka and kānuka oil distillery in Northland to create a business ecosystem based on oil extraction from mānuka and kānuka, and it is likely that more oil distilleries will appear due to the political climate for investing in economic activity in the regions. Another potential opportunity is to be found in the impact of two government schemes, Te Uru Rākau (1 Billion Trees) and the Erosion Control Funding Programme, which could rapidly support the kānuka honey and oil industries as large areas of land, and especially marginal land, are planted with pioneering and nursery species like kānuka and mānuka.

Let's Make Things Easy and Transparent

Learning From the Mānuka Honey Industry

WRITTEN BY
KLAUDIA MacLEOD

Before mānuka honey became famous, before Peter Molan of Waikato University found that mānuka honey has unique antibacterial properties, it was considered an inferior honey, quite hard to sell and fetching half the price of clover honey. The discovery of the Unique Manuka Factor (UMF) that has since been identified as the chemical compound methylglyoxal, and which is responsible for the strong antibacterial action, has completely changed its image and started the mānuka honey industry.

International demand for high-UMF mānuka honey has increased dramatically over the past decade, and so have the prices that consumers are willing to pay for it. Claims of trickery and fraud soon began to circulate, alleging that some honey for sale was misleadingly labelled, some had been chemically enhanced and was only a clover blend with artificially added MGO, and so on. It is a known fact that worldwide sales of mānuka honey far exceed the amount produced each year. Consumers began to question the product and ask for guarantees that they were buying 'the real thing' – genuine mānuka honey with a guaranteed antibacterial strength. The Unique Mānuka Factor Honey Association (www.umf.org.nz) was founded to combat the problem and to ensure that companies selling mānuka honey adhered to strict standards.

Finally, in late 2017, the New Zealand Government also came to the party and introduced new stringent regulations that aim to ensure that if the label states 'mānuka honey', then it really is mānuka honey. Strict lab testing is done for every batch of honey, and it is sorted into categories such as mono-floral or multi-floral mānuka honey. (Mono-floral means the honey is mostly made up of the nectar from a single flower, whereas multi-floral honey is a blend of nectar from different flowers.) Levels of UMF/MGO also need to be certified. These new regulations have certainly helped, but it has taken many years to get to this point and a lot of damage has been done to the reputation of the mānuka honey industry. Numerous companies now export mānuka honey, and most are members of the Unique Mānuka Factor Honey Association, but still it is very difficult for the consumer overseas to access all the information and be confident they are buying the right product. Only very recently one of the main women's magazines in Germany published a three-page article about mānuka honey, and included the extraordinary claim that 80% of the mānuka honey sold in Germany was not genuine.

In my view it is extremely important that the kānuka industry avoids similar problems. We must ensure that good industry standards can be defined from the beginning. This goes for kānuka honey and for kānuka essential oil.

Setting Standards

The kānuka industry needs an equally clear definition of mono-floral and multi-floral kānuka honey, as well as a grading system for its beneficial properties, such as levels of methylglyoxal, and antibacterial and anti-inflammatory action. For kānuka oil there needs to be a clear definition of the required chemical constituents to call a product pure essential oil of kānuka.

More research also should go into finding out which chemical constituents are responsible for the antibacterial, anti-viral, antifungal, antioxidant, and especially the strong anti-inflammatory action of kānuka oil. For example, what levels of which compounds are required to make a strongly acting oil? With more knowledge, a grading system could be developed accordingly.

I strongly believe our aim should be to produce top-quality therapeutic-grade kānuka oil. Therapeutic-grade essential oils are 100% natural, extracted from various parts of plants (in most cases by steam distillation), and are used for their special therapeutic characteristics and their scent. They are not mixed; nor are their compounds isolated and blended, as is often done for use in cosmetics. Therapeutic-grade essential oils should have a GCMS (gas chromatography mass spectrometry) analysis done for every batch produced to ensure all the constituents can be verified every time. We also need stringent quality-control procedures for all steps of production. These must ensure that there are no undesirable residues in kānuka oil, such as pesticides and herbicides, or contamination with phthalates through the use of wrong materials in seals or pipes. New Zealand wants to be selling top-quality oil to be successful in the international marketplace.

Marketing Is Key

As for general marketing, it would be a great opportunity to use the international hype around mānuka honey to also market kānuka. In Europe, customers are very open to alternative medicines, and the demand for natural cosmetics is strong. I have just returned from six weeks in Europe, and no one I talked to there had heard of kānuka. I was surprised that many people had not heard of mānuka honey either: it is still not a 'household' name. So some common marketing – jumping on to the mānuka honey bandwagon with kānuka honey, and promoting both mānuka and kānuka oil – should not be missed.

Australian tea tree (*Melaleuca alternifolia*) is already well known internationally, especially the brand Thursday Plantation. Australian tea-tree oil certainly had some negative publicity when it caused dry skin and skin irritation among some who used it, but I don't believe this puts kānuka at a disadvantage. Instead, we need to underline the differences: that kānuka oil is much more gentle on the skin, and that it has even more applications than tea tree, is also anti-inflammatory, and so on.

Ultimately, what the consumer is looking for is a product that is top quality, 100% natural and residue free. Being able to certify that the products are GMO free and not tested on animals is a key selling point, as is sustainable production and organic certification.

Some Thoughts About Kānuka and Intellectual Property

WRITTEN BY
TRACEY WHARE

The moment you start doing research about kānuka bioactives, or begin thinking about how to create a market for kānuka honey and oil, a whole lot of issues come up. Who owns native plants like kānuka? Is it the landowner on whose block it is growing? Is it Māori people more generally? And what do we mean by that? Whānau? Hapū? Iwi? Or does the ownership question even matter? Is it best to focus solely on the ownership of the newly acquired bioactive knowledge?

What about concepts like mātauranga Māori (Māori knowledge) and kaitiakitanga (Māori guardianship of land and resources in accordance with tikanga Māori, cultural practices)? Do they relate only to traditional or historical knowledge, or can they apply to newly created knowledge made by non-Māori? And ultimately, who should profit from newly created knowledge: Māori or those responsible for its discovery?

All of these questions raise legal issues around intellectual property, particularly in relation to the ownership of newly acquired intellectual property in kānuka, as well as how to share any profit from the commercialisation of such knowledge.

What is intellectual property?

Intellectual property law is an area of law that recognises and protects knowledge created by humans. Intellectual property law provides protection for this knowledge by using Western concepts of property rights. What this means in practice is that for a certain period of time, the creator or discoverer of such knowledge is able to maintain and control its use to the exclusion of all others. This is considered beneficial to society because it encourages innovative and creative thinking, and provides incentives for people to invest in the development and commercialisation of intellectual property. Once the time period has expired, the knowledge becomes publicly available for the benefit of society more widely.

> Intellectual property recognises and protects knowledge created by humans. It provides protection for this knowledge by using Western concepts of property rights.

Who Owns Kānuka?

THE VIEW OF STATE LAW

The ownership of kānuka is not easy to determine when it comes to state law, i.e. the statutes created by Parliament as well as the common law which is developed by judges. There is a lack of legal clarity about ownership of all native or taonga species, including kānuka. Part of the issue is that all native species are considered 'non-rival', meaning you cannot prevent others from enjoying it, and 'non-excludable', meaning it is difficult or impossible to exclude others from using it.

The general state law position is that no one owns kānuka as a species. There are some exceptions to this: for example, the state is likely to claim ownership of specimens located on land it claims to own. As no one owns kānuka as a species, it is the landowner who will control property rights in the kānuka growing on their land.

Who Owns Kānuka?

THE VIEW OF MĀORI LAW/TIKANGA MĀORI

Māori law or tikanga Māori takes a completely different starting point from state law in that it focuses on the relationship between people and the environment, and does not equate such relationships with Western concepts of exclusive ownership. For example, land and resources could traditionally be used by different Māori collectives at the same or different times for different purposes, such as gardening and gathering, meaning that Māori legal understandings of control and ownership exist but they stem from a different basis than Western understandings of ownership.

Unlike state law, Māori law has no centralised depository but is derived from oral traditions such as waiata (songs), pūrākau (stories), whakataukī/whakatauākī (proverbs, significant sayings), pēpeha (sayings of the ancestors) and kīwaha (colloquialisms), and can be found in written records such as Māori Land Court records, historical archives, books and family writings. Māori law can also be found in the practice of tikanga and the values that underpin tikanga: for example, manaakitanga, kaitiakitanga and whānaungatanga. Māori law is also specific to different places, meaning it can be understood and practised differently, as between Māori collectives.

Given that Māori understandings of land and resources are relational, Māori law does not provide a clear-cut answer on the issue of ownership. However, it does provide examples and principles by which tika or pono (both words can be translated as correct) solutions can be realised. In essence, Māori law is about finding a solution by looking to oral tradition, tikanga, and the advice of elders for inspiration and guidance. In relation to kānuka, the following questions should be considered when determining how Māori law might approach these issues:

- How was kānuka referred to in oral tradition and within tikanga practices?
- Historically, how did Māori negotiate with others, such as commercial entities?
- What values underpinned those negotiations and relationships?
- How were benefits shared amongst different groups?
- How were disputes settled?

In addition to Māori law or tikanga Māori, te Tiriti o Waitangi 1840 and He Whakaputanga o te Rangatiratanga o Nu Tireni 1835 (Declaration of Independence) both recognise and affirm tino rangatiratanga (Māori authority) in relation to land and taonga. As such, both documents uphold Māori forms of ownership of taonga species.

WAI 262

The Waitangi Tribunal has also considered intellectual property rights. The Waitangi Tribunal is a commission of inquiry established by Parliament with a mandate to investigate and make recommendations on claims brought by Māori relating to Crown breaches of te Tiriti o Waitangi and the Treaty of Waitangi.

In 2001, the Waitangi Tribunal released its report, *Ko Aotearoa Tenei*, which addresses intellectual property rights, including intellectual property rights in native species.

The Tribunal found that Māori knowledge of native species is a form of taonga over which Māori were guaranteed tino rangatiratanga, and that state law and government practice has not respected tino rangatiratanga over Māori knowledge. The Tribunal proposed that this breach be addressed by allowing Māori to exercise control over taonga in the form of kaitiakitanga.

To date, the Government has not formally responded to the Tribunal's report, though it is in the process of finalising a whole-of-government approach called Te Pae Tawhiti. Cabinet was expected to take a decision on government work programmes by the end of 2019. (https://www.tpk.govt.nz/en/a-matou-kaupapa/wai-262-te-pae-tawhiti).

Who Owns Kānuka?

THE VIEW OF INTERNATIONAL LAW

Unlike state law, international law provides clarity on the intellectual property rights of Indigenous peoples but also requires consideration of state sovereignty.

The UN Declaration on the Rights of Indigenous Peoples 2007 (the Declaration) is the most comprehensive international instrument to address Indigenous peoples' rights. New Zealand endorsed the Declaration in 2010. The Declaration provides for the ownership, use, development and control of lands, territories and resources in the hands of Indigenous peoples, as well as the intellectual property deriving from them. It also provides that states shall recognise and protect these rights. As such, the Declaration supports and affirms Māori ownership of intellectual property rights in taonga species.

Another international legal instrument that was drafted prior to the Declaration takes a different stance. It is premised on the basis that states have rights over natural resources within their borders. The Convention on Biodiversity 1992 (the CBD) is a legally binding international treaty that commits states to the triple objective of conserving biological diversity, using natural resources sustainably, and fairly and equitably sharing benefits deriving from the use of genetic resources. New Zealand has ratified the CBD.

In addition to the CBD, states have developed an international regime on access to biological material, and sharing benefits in return for allowing access. This is called the Nagoya Protocol 2010. The Nagoya Protocol addresses traditional knowledge associated with genetic resources, with provisions on access, benefit-sharing and compliance. It also addresses genetic resources where indigenous and local communities have the established right to grant access to them. States are to take measures to ensure these communities' prior informed consent, and fair and equitable benefit-sharing, keeping in mind community laws and procedures as well as customary use and exchange. The Nagoya Protocol also provides for joint ownership of intellectual property rights. New Zealand has neither signed nor ratified the Nagoya Protocol.

It could be argued that the CBD and the Nagoya Protocol provide for state ownership of natural resources, while the Declaration provides for Indigenous peoples' ownership. One way of reconciling these differences is to interpret the CBD and the Nagoya Protocol consistently with the Declaration, because in international law there is an expectation of maximum compliance with international declarations. This understanding also aligns with the fact that the Declaration contains the minimum standards for the survival, dignity and wellbeing of Indigenous peoples, meaning a lack of compliance with the Declaration is likely to lead to further injustices and rights violations.

Māori law does not provide a clear-cut answer on the issue of ownership. However, it does provide examples and principles by which tika or pono solutions can be realised. It is about finding a solution by looking to oral tradition, tikanga, and the advice of elders for inspiration and guidance.

Hikurangi Bioactives Limited Partnership: A Case Study

Hikurangi Bioactive Limited Partnership (HBLP), based in Te Tairāwhiti, is in the business of researching the bioactive properties of indigenous organisms. One of HBLP's projects is kānuka. It has contracted with 14 Māori landowners from the region to harvest kānuka from their land blocks in order to conduct bioactive research.

If the kānuka samples lead to the discovery of bioactive properties that are commercially viable, HBLP has committed to sharing the benefits with the participating Māori landowners. From a justice perspective they believe it is the right thing to do, and from a community development perspective they want to encourage locally driven economic development. HBLP wants to ground its relationship with Māori landowners not only in commercially sound principles, but also in substantive values such as the guarantees set out in te Tiriti o Waitangi, and legal obligations sourced in tikanga Māori and Indigenous peoples' rights.

Because of the nature of the kānuka project and the importance of addressing intellectual property legal matters, HBLP approached me, a legal academic at Auckland law school, to assist with researching intellectual property ideas, and to act as the lead facilitator and drafter of an intellectual property agreement.

The objective of the project was to draft and execute an intellectual property agreement that recognises who owns the intellectual property from the kānuka bioactive research, and sets out how any financial benefit from that bioactive research will be shared. These two issues were at the heart of this project, requiring much discussion, drafting of papers, countless further questions and multiple solutions, as well as consensus building.

HBLP is aware that standard commercial intellectual property agreements often provide for the ownership of bioactive research to be held by the commercial entity, with local communities playing a minimal or passive role in the commercialisation activities. Standard agreements may provide some benefits: for example, financial compensation, the provision of infrastructure or employment opportunities. HBLP did not consider this model was useful because it failed to address more substantive questions such as recognising the authority of Māori landowners, their relationship to kānuka, and the ongoing effects of colonisation and its severe impacts upon the ability of Māori to exercise tino rangatiratanga, including carrying out their own commercialisation activities, or how the rights of Māori landowners could be upheld and implemented within a commercial intellectual property agreement. HBLP wanted to do things differently; they wanted to ensure that Māori rights in kānuka and their status as tangata whenua were recognised and provided for in the intellectual property agreement in tangible ways. In summary, HBLP wanted to use this opportunity to fully provide for Māori rights in kānuka.

Once HBLP understood the limitations of state law, they realised that it could not accommodate or provide for all the issues that had been raised. They also recognised that Māori law or tikanga Māori as well as Indigenous peoples' rights could provide a more rights-based starting point which potentially could address the issues raised.

HBLP recognised the importance of conducting their work in accordance with tikanga Māori, meaning that both the process and the substantive outcome had to be tika or pono. In practice, this meant adopting Māori ways of working in order to reach an agreement. A tikanga Māori approach was understood as the most appropriate way of ensuring Māori landowners engaged in the process and supported its outcomes. For example, this meant that hui needed to be held in the community, and that key HBLP people had to attend all such hui.

In preparation for the community hui, HBLP held their own preparatory meetings to agree upon the best way forward. What eventuated was a series of three community hui, held over a period of four months, which I facilitated. The hui began with a brainstorming session to identify the issues and questions from the community. At subsequent hui, discussion papers were tabled to answer community questions, pose further questions and provide options for discussion. Consensus decision-making was adopted to ensure that the project moved at a pace that allowed everyone to come to terms with what was being considered and provided ample opportunities for discussion.

The final draft intellectual property agreement borrows from standard commercial intellectual property agreements but also contains a number of differences. For example, the agreement begins with a lengthy background section detailing the relationship of the parties and a timeline of the community hui.

It also annexes the discussion papers and summary documents from the community hui. Detailing the background ensures there is a complete record of the history of the project to explain how the agreement was arrived at.

The purpose, scope and objectives of the agreement also mirror the priorities of both parties as well as the values underpinning the agreement. For example, the agreement recognises the inherent authority of Māori landowners, their relationship as kaitiaki and the values that underpin the relationship, as well as the impacts of colonisation on Māori relationships to kānuka.

The agreement also records that the Māori landowners are the owners of the kānuka bioactive research, and that the licence to exclusively commercialise intellectual property is held by HBLP. It details how profit will be shared, as well as a process by which the landowners can buy back the licence. HBLP wanted to acknowledge that while they are currently in a position to carry out commercialisation activities, it might be possible for the Māori landowners themselves to engage in bioactive commercialisation in the future. The agreement establishes a governance group, one of the purposes of which is to provide training opportunities for the landowners to learn about commercialisation activities, and to become familiar with the products and opportunities created from the intellectual property, with the intention that they are able to play a leading role in buying back the licence.

Another significant difference is the law governing the agreement includes both state law and the laws of tikanga of Te Tairāwhiti. Should a dispute arise, the parties will work together to involve a mediator or other third party in the resolution of the dispute who has knowledge of the laws of the tikanga of Te Tairāwhiti.

Conclusion

What this project demonstrates is the ability of entrepreneurs to engage in commercial activities while also recognising and providing for Māori rights. Creative solutions can be found if those involved are open to different ways of thinking, and are committed to spending time and energy listening to the community and developing solutions that meet their needs. This project demonstrates that business can and should respond to more substantive issues of justice and equity when developing projects. In doing so, Māori rights are realised and a much richer and nuanced story evolves. This ultimately adds greater value not only to the relationships that are formed but also to the commercial products that are created.

Creative solutions can be found if those involved are open to different ways of thinking, and are committed to spending time and energy listening to the community and developing solutions that meet their needs.

Government Support for Māori Landowners (Projects and Kaupapa Will Be Assessed On Their Merits)

This spreadsheet provides examples of funding and support opportunities that may be useful for land development opportunities. Information has been taken from websites and application documents.

FUND	ADMINISTERED BY	PURPOSE	TYPES OF PROJECTS	USEFUL QUESTIONS	FURTHER INFORMATION
Māori Agribusiness: Pathway to Increased Productivity (MAPIP)	Ministry of Primary Industries Manatū Ahu Matua - Māori Agribusiness Directorate	Assisting Māori landowners to make the most of their land assets	e.g. best land-use assessments, science investigations, feasibility studies, etc.	Do we need more information and support to be able to make good land-use decisions and increase productivity?	www.mpi.govt.nz/funding-and-programmes/maori-in-the-primary-industries/maori-agribusiness/
1 Billion Trees – Partnerships	Ministry of Primary Industries Manatū Ahu Matua — Te Uru Rākau	Activities that support planting projects by promoting innovation, research and workforce initiatives	e.g. workforce development, coordination/extension of the support-planting projects, landscape-scale planting projects	Will the project result in increased advice and support for landowners through improved information, technical advice and/or extension? Will the project result in increased availability of labour to establish, plant and maintain trees and/or upskill a workforce? Will the project contribute to improved environmental outcomes on a greater scale? What co-funding/in-kind support is being contributed to the project?	www.teururakau.govt.nz/funding-and-programmes/forestry/planting-one-billion-trees/one-billion-tree-fund/#Partner
1 Billion Trees – Direct landowner grants	Ministry of Primary Industries Manatū Ahu Matua — Te Uru Rākau	Improve land productivity, tackle environmental issues, reduce effects of climate change, improve water quality, provide a source of carbon credits, create jobs and careers	e.g. planting projects (including land preparation, sourcing plants, planting costs) for indigenous mixed species (e.g. riparian planting), mānuka/kānuka, indigenous natural regeneration, exotics (e.g. pine, eucalypts)	How much land is available for planting? Do we own the land or have rights to plant it? Has a site assessment been done that shows which plants need to go where, and why? Is access to the carbon market important? Who will do ongoing maintenance, e.g. plant and past control, pruning (if necessary), infilling, and how will this be funded?	www.teururakau.govt.nz/funding-and-programmes/forestry/planting-one-billion-trees/one-billion-tree-fund/#landowne
Whenua Māori Fund	Te Puni Kōkiri Ministry of Māori Development	Assist owners and trustees of Māori freehold land to explore new ways to boost land productivity, diversify, or prepare for new opportunities	e.g. governance support and training, planning documents, business cases, research and viability studies that seek to improve land use and/or prepare owners for commercial ventures, etc.	Do we need support to establish or make our governance and management structures stronger? Do we need land-use capability studies, help in identifying land-use options or farm plans? Do we need a business case or support identifying investment opportunities?	www.tpk.govt.nz/docs/whenua/tpk-whenua-maori-fund-brochure-2016.pdf

Government Support for Māori Landowners (Projects and Kaupapa Will Be Assessed On Their Merits)

FUND	ADMINISTERED BY	PURPOSE	TYPES OF PROJECTS	USEFUL QUESTIONS	FURTHER INFORMATION
Provincial Growth Fund – General	Ministry of Business, Innovation & Employment Hīkina Whakatutuki – Provincial Development Unit	Provide loans and/or grants to enhance economic development opportunities, create sustainable jobs, increase social inclusion and participation, meet climate change targets	e.g. infrastructure (roads, broadband, etc.) that will lift productivity, grow jobs and connect communities, and provide economic development projects	What PGF tier (category) is the main focus of the project: Regional, Infrastructure of Sector based? How does the project increase local skills, reduce environmental impacts and improve the productivity of the sector? To what degree is the project investment ready, e.g. are feasibility studies/business-case complete, and governance and management structures in place?	**General**: www.growregions.govt.nz/about-us/the-provincial-growth-fund/ **Tier 1 Regional:** www.growregions.govt.nz/get-funding/projects-we-can-fund/regional/ **Tier 2 Sector based:** www.workandincome.govt.nz/employers/subsidies-training-and-other-help/skills-for-industry.html#null **Tier 3 Infrastructure:** https://www.growregions.govt.nz/get-funding/projects-we-can-fund/infrastructure-projects/
PGF – Te Ara Mahi allocation	Ministry of Business, Innovation & Employment Hīkina Whakatutuki – Provincial Development Unit	Provide loans or grants that 'power-up' enterprise and employment opportunities in the region	e.g. employment opportunities in primary industries, tourism/hospitality, civil construction	What opportunities do we have or want to provide for workers? How many people do we have ready to train? What support do they need during their training? What provider will we use? What qualifications will the trainees come out with and what is their pathway to sustainable employment?	
PGF – Whenua Māori allocation	Ministry of Business, Innovation & Employment Hīkina Whakatutuki – Provincial Development Unit	Provide loans and/or grants to progress investment-ready projects that develop land or provide on-farm improvements	e.g. projects that lift the productivity of Māori land	Is the project investment ready? Have feasibility studies been completed? Is there clear evidence of specialist commercial advice on best land use? Does the project have a strong governance structure and management plan in place?	www.growregions.govt.nz/about-us/the-provincial-growth-fund/
He Poutama Rangatahi: youth employment	Ministry of Business, Innovation & Employment Hīkina Whakatutuki – Provincial Development Unit	Support communities to develop pathways for rangatahi (aged 15-24) who are not currently in employment, education or training, and take them through to sustained employment underpinned by intensive pastoral care	e.g. skills development and on-the-job training towards longer-term employment	Do we have opportunities for unemployed and/or at-risk youth aged 15–24? What specialist services do we need to support these youth into employment? What is the term of the employment we can offer? Are the skills needed specific to a role, or could they be used across a wider employment market? Do we have a qualified trainer and/or supplier and pastoral-care services?	www.growregions.govt.nz/about-us/he-poutama-rangatahi/

Contributors

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Bella Paenga is a Tikitiki landowner and community coordinator for the 'Optimising Kānuka Production' project with Hikurangi Bioactives Limited Partnership, keeping the lines of communication open between the project team and the landowners and other stakeholders involved in the project. She was one of the original directors of Hikurangi Enterprises Limited.

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JILL MULVANEY

Jill Mulvaney is a distiller of aromatics and principal director of Alembics NZ. With over 25 years' experience, Jill now teaches and consults on all aspects of plant extraction, aroma and natural flavour, advancing ideas and products that can be utilised across a broad range of industries. In recent years, Jill has worked for numerous start-ups and established New Zealand and Australian brands, blending unique botanical prototypes for the food and beverage industry.

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KLAUDIA MACLEOD

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