
Care for Kauri Guide



The collaborative effort to address kauri dieback includes MAF Biosecurity New Zealand, Department of Conservation, Auckland Regional Council, Northland Regional Council, Environment Waikato, Environment Bay of Plenty and Māori

About this booklet

This booklet is for landowners, managers and occupiers with kauri on their land. It explains the ecology of kauri, common diseases and gives advice about care and propagation.

This booklet has three main sections:

- 1. Kauri ecology**
We describe the kauri family, how kauri grow and reproduce and diseases that affect these trees.
- 2. How to care for your kauri**
We give advice on how to reduce stress and care for your kauri.
- 3. How to grow kauri**
We describe how to gather seed, propagate and plant out kauri.

A glossary of terms used and list of further reading is also included.



Acknowledgements

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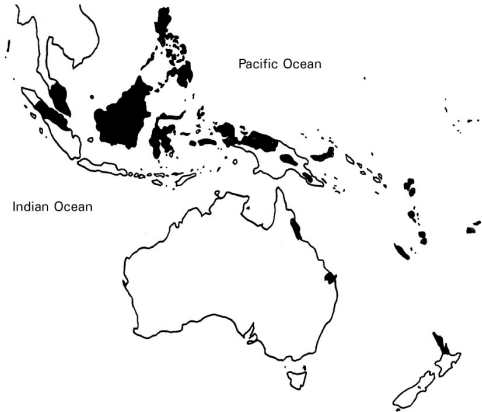
Kauri ecology

The kauri family

The New Zealand kauri (*Agathis australis*) belongs to one of the world's oldest family of conifers, the Araucariaceae family.

The Araucariaceae family includes three groups (or genera):

1. **Araucaria**, which has 19 species, including Norfolk pine and monkey puzzle.
2. **Wollemia**, with just one species the Wollemi pine from New South Wales, Australia
3. **Agathis**, with 21 tree species, found in forests from South-East Asia to the western Pacific. All the trees in the *Agathis* genus are generally known today as kauri.



Worldwide distribution of *Agathis* species.



Simulated comparison of Tane Mahuta (left) and Kairaru (right)

Kauri giants

The New Zealand kauri is the largest tree in the *Agathis* genus and the only *Agathis* species native to New Zealand.

Many of the great kauri giants were felled by early pioneers for their high quality timber. One of the largest kauri trees ever recorded was 'Kairaru of Tutamoe' with an estimated diameter of 6.4m and a height of 65m. Unfortunately, Kairaru was destroyed in a fire before 1900.

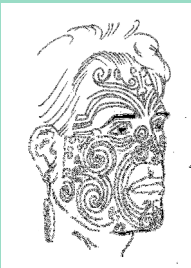
The largest kauri alive today is Tāne Mahuta with a diameter of 4.6m and height of 52m. It is estimated to be between 1200 and 2000 years old.

Part of New Zealand history

Cultural significance

Kauri is considered a taonga species by many Maori: valued as a connection to the spiritual beliefs and way of life of their ancestors.

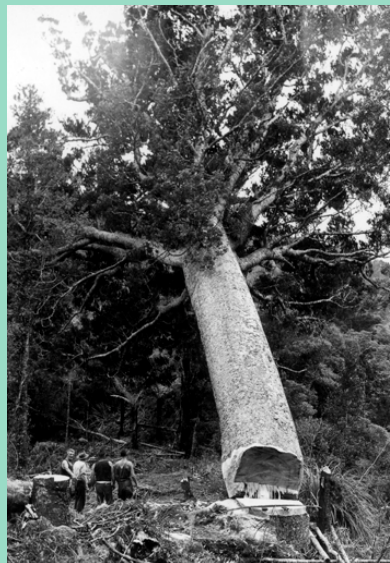
Kauri played an important role in many aspects of early Maori culture: integrated in creation mythology, rituals, war, art and everyday life. Some large trees were given names and revered as chiefs of the forest. On special occasions, the giant trunks of kauri were used to carve out large waka taua (sea/war canoes).



Kauri gum had many valuable functions. Gum was burned as an insecticide in kumara plots, wrapped in flax to make torches for night-fishing and used as a chewing gum (kāpia). Kauri resin was also burnt and mixed with fat to create the ink for moko (facial tattooing) of rangatira.

By the 1800s, early European pioneers had developed a thriving timber and gum industry based on kauri. Large areas of kauri were felled for their timber, which was valued for its strength and ability to withstand sea-water conditions (ideal for boat masts and hulls).

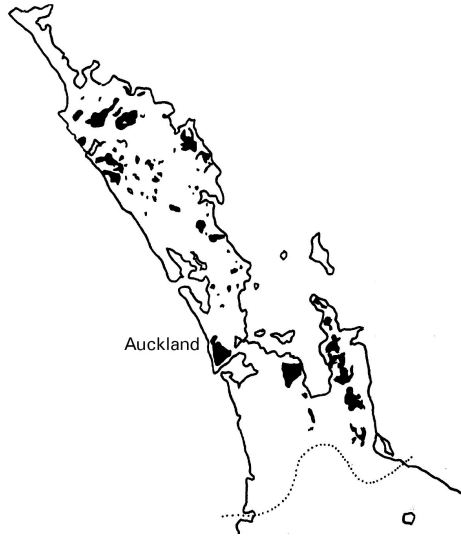
Kauri gum was used in varnishes, paint, linoleum and to create ornaments. Gum was largely collected from the ground, however some was gathered by deliberately injuring or 'bleeding' trees.



Kauri forest

The present distribution of kauri is restricted to warm northern regions above the latitude of 38°S (north of Kawhia-Hamilton-Tauranga).

The site, soil and temperature determine the type of forest that naturally contains kauri. There is no 'typical kauri forest': kauri can exist as solitary trees in broad leaf dominant bush or as dense stands.



Current distribution of kauri in New Zealand

Kauri growth requires high light levels but can tolerate low soil nutrient levels. Consequently, kauri seedlings are often suppressed under dense canopies of faster growing species in fertile soils. As a result kauri are often restricted to less fertile soils on ridges or establish *en masse* after a large disturbance such as a fire.



Young ricker stand of kauri

In a forest environment, mature kauri emerge above the canopy of other native trees. The lower forest can contain a variety of tree species including totara, tanekaha, taraire, tawa, miro and rewarewa alongside juvenile kauri.

At the shrub level a range of plant species can be found including tree ferns, nikau palms, lancewood, hangehange and mingimingi. Kauri grass is commonly found covering the ground below kauri.

A range of orchids and epiphytic plants are also often found perching amongst the branches of mature trees.

Reproduction

The reproductive organs of kauri are cones, which are formed every year, starting on trees from 20-40 years of age.

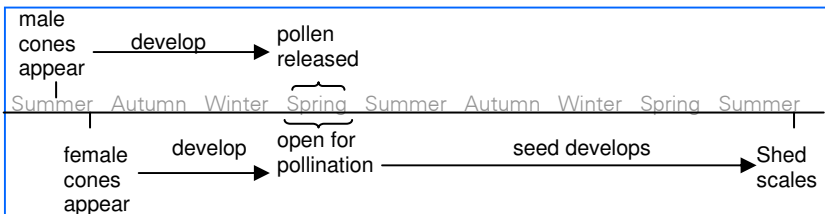
Kauri are 'monoecious': each tree has both the ball-shaped female and rod-shaped male cones.

Male cones release pollen which is carried by the wind to fertilise the female cones. Seeds then develop over a two year period within female cones with one seed attached to each scale.



Rod shaped male cones and ball shaped female cones

Up to 100 seeds can be released from mature cones, though on average only half of these will be viable.



Kauri seeds rely solely on the wind for dispersal and have a small wing which enables them to catch even light winds. A gentle breeze can carry seeds 100-150m from the parent tree however distances of up to 1.5km have been recorded.

Kauri seed loses viability over a few months time and is easily damaged by cold and wet. To germinate, a viable seed needs conditions generally not found under the parent tree: light, moisture, warmth and easily accessible soil nutrients. If the seed reaches suitable conditions, germination takes place within 10-20 days.

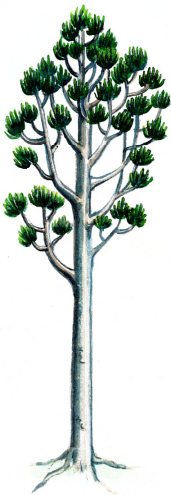
“How old is my kauri?”

It is not always easy to age kauri trees. The growth rate, final height and life span of a kauri depends on the growing conditions. Growth is suppressed in areas with compacted and poor soils, competition from other plants and lack of overhead light.

However, in all conditions kauri trees have three main stages of growth.



1. Kauri seedlings emerge as two-leaved cotyledons and develop into **bushy seedlings**. The colour of these young trees can be green or a red-bronze depending on the amount of rhodoxanthin (red) pigment present in the leaves. Both red and green seedlings are equally healthy and in fact, red seedlings turn green as they mature into the typical cone-shaped saplings.



2. In its 'teenage years' kauri growth is focussed upwards toward the canopy of the forest. Like humans, kauri develop into gangly teenagers with long slender bodies/ trunks. During this stage (usually 30-50+ years) kauri are self-pruning. They begin to drop the lower shaded branches in a process known as “abscission” which leaves the trunk without knots or scars.

These **pole-stage trees** or “**rickers**” become free of branches on the lower trunk with narrow conical crowns. As a ricker grows through the forest canopy (> 50 years) it begins to grow outwards, expanding the narrow trunk and crown. Kauri also begin cone and seed production at this stage.



3. Mature kauri trees (100+ years) emerge above the forest canopy with large straight trunks (free of branches up to 12-25m), supporting flattened/spreading crowns with large permanent branches that will not normally be dropped.

On average, kauri grow to heights of 30-40m and can live for more than 1000 years with trunk diameters of several metres. In suitable conditions, kauri aged 400-800 years old will have diameters of 1-2m (sometimes up to 3 – 5 m).

Small shoots off the main trunk can be found on some mature kauri. These ‘epicormic’ shoots can appear when the trunk is suddenly exposed to increased light levels and/or in stressful situations. These shoots may be a means to gain more energy from the sun to cope with stress.



Epicormic shoot (above) and double leader trunk (below)

Kauri typically have one main trunk, however if the growing tip is damaged at any stage (by frost, wind or physical damage), two or more “leader shoots” (trunks) can develop.

Kauri generally have a spurt of new growth once a year in spring, however a second ‘flush’ of growth can occur in warm and wet autumns. In young trees this new growth is obvious by the appearance of shoots with a blue-ish tinge. In older trees this can be seen as bright green foliage.



In crowded sites kauri will naturally thin themselves with the weaker trees dying off and the strongest trees surviving.

Bark

Juvenile kauri have a typically “pimply” bark with a reddish to grey colouring. In mature trees this develops into thick scales which frequently flake off and leave the trunk with a pattern of hammer-like markings.



Juvenile kauri bark (left) and mature bark (right)

Shedding bark is a natural trait which prevents vines adhering to and smothering kauri. In some cases trees may shed large amounts of bark at a time and appear unusually smooth. This is thought to be associated with a sudden spurt of growth.

Gum

A small amount of bleeding (“gummosis”) is natural for kauri trees. Kauri naturally produce gum as a defence response in events of stress. Strong winds, drought, insect attack and disease can all cause gum to ooze through the bark of kauri.

Kauri gum also acts as a natural band-aid to seal physical injuries and prevent infection by insects, fungi and bacteria.



Kauri with more than one leader shoot (two or more main trunks) often bleed gum from the joint in response to injury caused by wind stress.

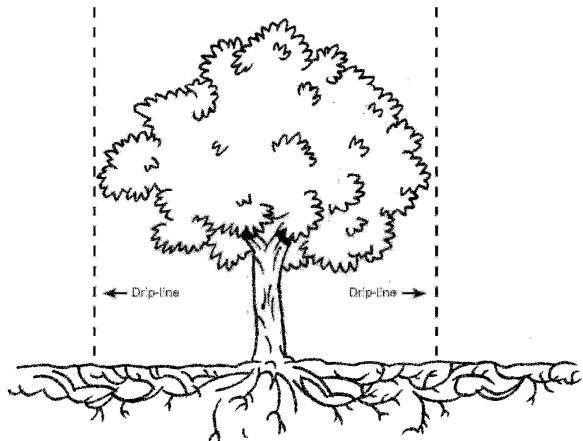
In the late 19th century many kauri were deliberately injured to increase gum production for collection and export. Bleeding of kauri was banned in state forests from 1905 after it was shown that it caused damage to the trees and a decline in health. There are still trees alive today that show scars from injuries caused by early gum collectors.

Roots

Kauri seedlings have a fine lateral root system associated with one main '**tap root**'. This can be up to three times longer than the height of the seedling in some cases. Tap roots continue to develop in young trees, reaching up to 2m deep.

The root system develops to incorporate three different kinds of roots in mature kauri trees. Large **lateral roots** spread out from the base of the trunk with deep '**peg**' roots running off these (up to 5m deep) to anchor the tree to the ground. A network of fine '**feeder**' or **surface roots** run up from the laterals into the thick layer of litter in the forest to absorb nutrients.

Kauri are able to grow in dry areas with low nutrient levels through the help of mycorrhizal fungi. These fungi, attached to the roots of kauri trees, significantly increase the ability to absorb water and nutrients



The rootzone of mature trees extends out at least as far as the canopy is wide.

In dense areas, the root zones of neighbouring kauri may overlap – in these situations the lateral roots of neighbouring trees can fuse. This trait can result in the re-sprouting of kauri from stumps once cut down.

Soil nutrients are largely absorbed by the delicate surface roots of kauri – if the health of the surface roots is compromised through damage/disturbance (for example trampling or digging) the health of the whole tree can decline.

“Is my kauri sick?”

Bleeding small amounts of gum and shedding bark is natural for kauri trees. However, there are some signs of disease that you should look out for:

- **Gum at the base of the trunk and loss of foliage** may indicate *Phytophthora taxon Agathis* (PTA), aka kauri dieback. This is a soil borne disease which infects kauri through the roots.

PTA is associated with a collar rot causing bleeding lesions at the base of the trunk, yellowing foliage, severe defoliation and tree death. PTA is highly pathogenic to kauri and it can infect and kill kauri of all ages from seedlings to large trees.

This disease is specific to kauri in New Zealand. No other native or introduced trees are known to be affected.

There is currently no known control method for PTA. Preventing the spread to healthy trees is the only management tool for landowners. Make sure shoes, tyres and equipment are clean of dirt before and after visiting kauri forest.



Thinning foliage (top)



Globs of gum (middle image), develop into large bleeding lesions (below)



- **A slow decline in health, occasionally with small scattered bleeds up the trunk** can be caused by simple root damage and/or *Phytophthora cinnamomi*. This introduced soil pathogen is now found throughout New Zealand. This disease affects many plant species, particularly plants that are weak or stressed. In kauri trees, *P. cinnamomi* infection causes damage to the feeder roots of kauri and may cause a spotty pattern of bleeding up the trunk, reduced leaf size, a slow decline in canopy health and in some cases death of stressed trees.

- **Yellowing, wilting and death of seedlings** is caused by damping off. This root rot disease is caused by a range of microbes common in poorly drained soils. Strict hygiene in nursery situations is essential to avoid this disease.
- **Rotting in the centre of the trunk** is caused by core rot disease. This often affects large mature kauri trees, rotting the heart wood, leaving the giants hollow inside and causing a slow decline in health. Core rot is caused by several different species of native wood-rotting fungi. Physical damage to younger kauri can also allow core rot fungi to enter and infect the inner tissue.
- **Cone disease**: Warm wet summers can give rise to the infection of cones by the *Pestalotiopsis funerea* fungus. This reduces seed viability and can cause cones to drop prematurely.
- **Leaf disease**: Kauri leaves are affected by the fungus *Vizella tunicata* which causes small black spots on top of leaves. Damage is normally superficial and will not cause a major decline in health of the tree. Leaves may also be affected by *Trichopelthea asiatica*, a sooty mould which can live on secretions from insects. This mould covers the leaves in black soot but does not cause any physical damage.

Insect and animal pests

Both native and introduced animal species use kauri trees as a food source. At the seed stage, the ripening cones of kauri are often broken open and eaten by kaka in the forest. Ripe seed that falls to the forest floor may be eaten by the common weta, ground-feeding kakariki, the Australian rosella, mice and rats. This effectively reduces seedling regeneration.

Throughout their lives, the root systems of kauri trees are easily damaged by feral goats, pigs and stock. Such damage can lead directly to loss of health and/or the spread of disease. In order to maximise kauri health, effort should be made to control non-native pests.

Although kauri leaves are leathery and resilient to many pests, they can suffer feeding damage from weevils, caterpillars of kauri leaf rollers, the kauri leaf miner and the bronze beetle. Such insect damage is usually superficial and will not cause a decline in otherwise healthy kauri.



How to care for your kauri

Kauri trees are the big softies of the plant world. Although they can live for thousands of years in their natural environment they are sensitive to stress. The likelihood of disease and early death can be minimised by reducing any stressors and enhancing the health of kauri. With some care your kauri can live to a grand age and grow to great heights.

Kauri need

- healthy root zones
- nutrients
- water
- shelter
- sunlight
- room to grow

'Keep off the feet'

The surface feeder roots of kauri are delicate and easily damaged by compaction. For maximum tree health, the rootzone must be healthy and undisturbed. Where possible, keep away from the root zone. Avoid any disturbance to the soil in this area including digging, walking, mowing and building. Any existing compaction around trees should be removed where possible (for example re-route tracks away from kauri).

Ideally, tracks or buildings should be at least a few metres out from the 'drip zone' of kauri trees (keeping in mind this zone will increase with age/growth). In parks, boardwalks allow access to kauri forest while minimising disruption to the soil around the tree. Other track materials, such as reliably sourced bark chips or a bark-gravel mix can also provide a suitable environment for kauri roots and minimise compaction.



Kauri growing in paddocks with stock normally suffer root compaction and damage. Trees in agricultural situations benefit from being fenced off from stock to prevent trampling of roots. Fencing will also allow natural mulch to build up and soil health to improve.

Mulch

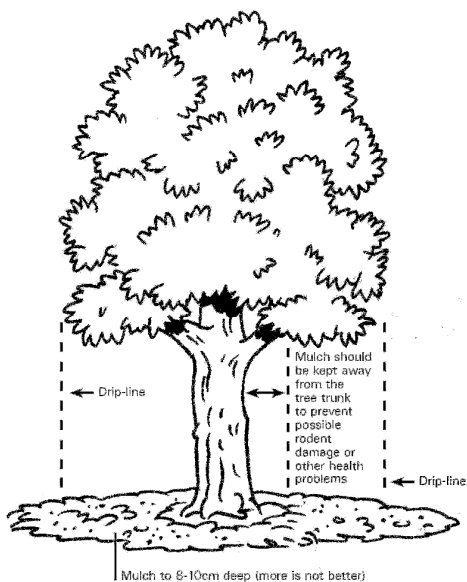
Kauri benefit from mulch around the root zone. Mulch holds moisture in the soil, insulates the soil and minimises weed growth, creating a good environment for the growth of feeder roots.

In natural forests, kauri provide their own mulch with large amounts of litter (up to 2m deep).

In urban and agricultural situations this natural litter is often removed or blown away. In some cases this can lead to exposed roots which are susceptible to damage and disease. Organic mulch such as fine bark chips and straw can be placed around the root zone to improve root health.



Forest litter provides a natural mulch



- Mulch should not be placed up against the base of the tree and must be relatively dry when applied.
- For established trees in urban situations a 10cm deep layer of fine bark chips (in a diameter up to 2m around mature trees) is ideal.
- Synthetic weed mats are not a good option around kauri – although they prevent weed growth, they do not decompose so prevent the feeder roots growing up into the rich organic layer.

NB: Mulch should not be added around kauri in wet areas as this can cause further waterlogging of the soil and may promote root diseases.

Soil nutrients

In natural conditions, kauri trees diminish soil nutrient levels and increase soil acidity. Kauri are tolerant of low levels of soil nutrients, but growth and health can be enhanced by ensuring nutrients are plentiful and competition is minimised. Established stressed trees can gain an instant boost from application of organic blood and bone (for example Nitrosol).

To further enhance tree growth/health for a sustained period, a few handfuls of slow release fertilizer (such as Planticote or Osmocote) can be placed around the tree before mulching and yearly after this. Fertiliser application is best done during warm wet periods in spring or autumn to ensure it soaks into the ground.

Kauri will grow best if they are not suppressed by dense competition. Kauri should be situated 5-10m from other large trees to reduce overcrowding.

Research has found that growth of kauri occurs best in soils with a pH between 4.8 and 6. Lime is not required unless the soil acidity is below pH 4.5. A simple soil acidity test kit can be bought from plant shops if there is concern that soil acidity may be affecting growth.



Water

Seedlings and young kauri trees (with developing root systems) are susceptible to drought. Mature trees, although well known for being more drought tolerant than many other native plants, will also suffer during long dry periods. To minimise drought stress, a solid water once a week is beneficial especially for young trees (as a rough guide, a few hours a week with a soaker hose over summer should be adequate).

NB. The water requirements of kauri will depend on the site and soil conditions. Care must be taken to prevent waterlogging, especially in areas with compacted or clay soils. Root diseases are more likely to infect trees in waterlogged soils and cause early death.

Provide some company...

Kauri don't like being alone or on the edge of bush – they like to have some company around them. Even in natural stands of bush, kauri trees on the edge will suffer from a loss of health and occasionally death from being exposed to the elements (the edge effect).

A range of native species commonly found growing in association with kauri can be planted to provide shelter for kauri growing in open areas. Suitable companion plants include manuka, a useful pioneer or nurse crop plant that rapidly provides shelter for young kauri while allowing access to light. Other suitable companion plants include akepiro (*Olearia furfuracea*), mapou (*Myrsine australis*), mingimingi (*Leucopogon fasciculatus*) and shining karamu (*Coprosma lucida*). Shade cloth can be used as a temporary wind break option.

Weed suppression to allow natural regeneration of companion plants is all that is needed to care for kauri establishing within existing bush areas.



Restored forest showing different spacings of large and small plants

....but don't crowd.

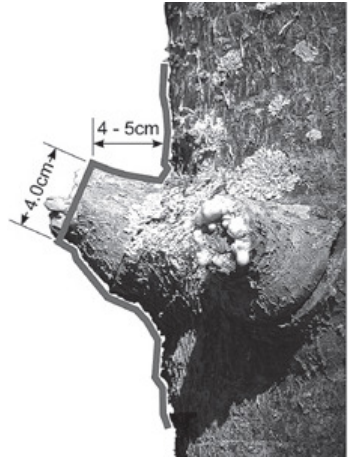
Care should be taken to minimise competition for sunlight and soil nutrients. If planting other large tree species (for example puriri, pohutukawa, kahikatea) nearby, ensure there is adequate space for future growth. Allow at least 3-10m between these species and kauri trees.

As a slow growing plant, young kauri can easily become suppressed by a dense canopy of fast growing plants. Access to overhead light is essential for growth of young trees.

Pruning

Kauri naturally drop their lower branches as they grow toward the forest canopy. However in open situations lower branches may be retained.

If a small branch dies on a kauri tree, or live branches need to be removed, a 4-5cm stub should be left on the tree. This measure encourages the tree to drop the stub naturally (it simulates the loss of energy, similar to that experienced if it became shaded in the forest) without leaving a scar or bleeding wound on the trunk. This method should only be used for branches less than 4cm in diameter, larger branches should be sawn off close to the trunk.



Wind stress can often cause cracking/damage at the joint of double leader shoots. Young trees with multiple leader shoots can be pruned back to one main trunk to avoid this.

Consult your local council for regulations regarding the pruning of kauri.

More tips/general care

- **Herbicides:** Take care when spraying around the root zone. Avoid using residual herbicides around kauri.
- **Weeds:** Weeds such as kikuyu grass can smother young trees and compete for nutrients. Mulch around the base will minimise weed growth, however removal of some weeds may be necessary.
- **Physical injuries:** The natural bleeding of gum over small injuries is sufficient to cover and heal small wounds. However, large physical injuries may need application of anti-fungal sealants to prevent entry of water and bacteria.

Be wary of large lateral kauri roots if mowing lawn within the root-zone. Mulch can prevent accidental mower damage.

Avoid securing wire or nails in the trunks of kauri. These activities cause damage over time.

How to grow kauri

Growing kauri from seed can be achieved at home with a little care and planning.

Gathering seed

Cones can be collected from healthy trees when scales first start to appear on the forest floor (February-March). This can be achieved by either carefully climbing up to the cones or by placing a raised plastic sheet below the canopy. Obtain permission before collecting seeds from public areas.



Cones placed in a dry room will naturally disintegrate within 5-10 days. Viable seed needs to be separated out. Only seeds that are swollen at the base are viable (you should be able to feel a bump when squeezing the seed between thumb and finger).

Germination

Seeds quickly lose viability over time so should be planted as soon as possible after collection. Two seeds can be placed (wing up) in pots or bags of soil (5cm² x 8cm deep) and covered with a 2-5mm layer of potting mix. This provides enough space for one year's worth of growth. If both seeds germinate, the weaker plant should be removed.



A warm environment (for example a glasshouse) and moist soil will enable seeds to germinate within 2-3 weeks. At around one month after germination, a two-leaved cotyledon should have emerged. Once this has reached ~5cm high, seedlings can be placed in a shade house or sheltered area outdoors to harden off.

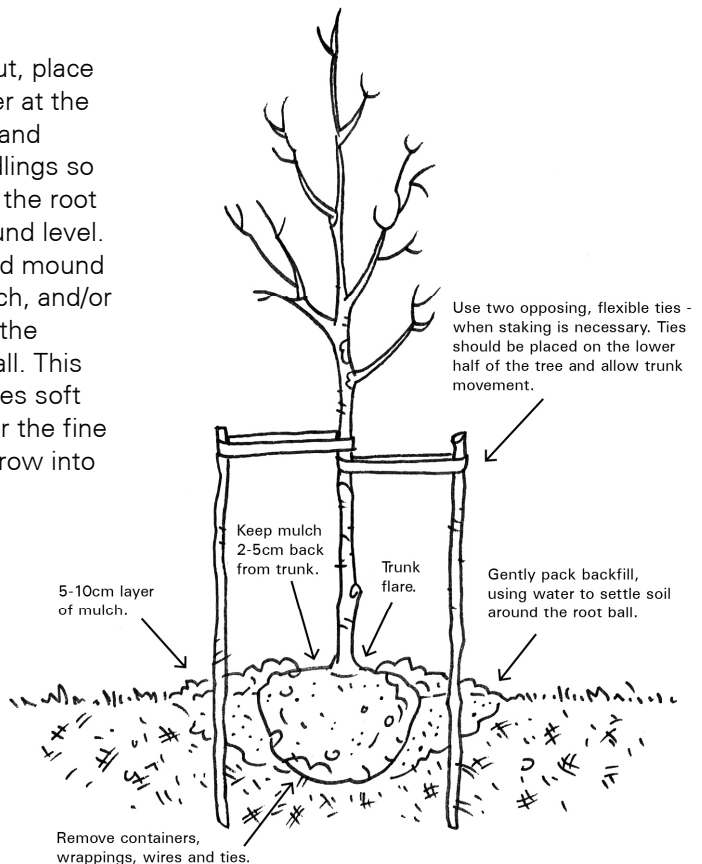
At one year, seedlings will be 15-30cm in height and should be re-potted into a final container (PB3 bags should be adequate) to allow growth of the developing root system. Care needs to be taken to prevent seedlings becoming root bound. Roots growing through holes in the bottom of the bag indicate a need for more room and need re-potting. From two years (~40 - 60cm) to four years old, seedlings can be successfully planted out (don't plant out seedlings less than 30cm in height).

Planting out and site preparation:

For optimal growth, seedlings should be planted out in autumn (late March - April) while the soil temperature is still warm.

Site selection is critical when planting kauri. Think carefully about how large a kauri tree can grow before planting one in an urban environment. It could become a nuisance on a small suburban section, planted too close to a building or beneath an overhead obstruction like a power cable. If kauri have died in the past due to PTA, then don't plant new kauri in or near the same area. Revegetation with other native plant species will reduce weed growth in these areas.

When planting out, place mulch or leaf litter at the base of the hole and position the seedlings so that 1/4 to 1/3 of the root ball is above ground level. Fill in the hole and mound up with soil, mulch, and/or leaf litter around the remaining root ball. This procedure provides soft fertile material for the fine feeder roots to grow into to.



N. B. Fertilizer should not be added into the hole before planting out as this can burn the roots.

Careful site selection and preparation is essential. The best results will be achieved by planting seedlings in **moderately fertile, free-draining soil in sheltered sites with adequate space to grow**

With some work, seedlings can also grow well in less suitable conditions. Pre-pitting is a useful step in preparation of all soil types, especially for compacted or clay soil. Pre-pitting involves digging a 30cm² pit one to three months before planting and placing the removed soil beside the hole to allow weathering. This process should develop a looser, lighter textured soil to place around the root ball. Mulch and well decomposed compost can be added to the soil at this stage.

In areas with very hard soils (which would prevent tap root development) or waterlogged soils (which can lead to root rot), kauri can be planted on hand-made mounds of soil/mulch (1 – 1.5m in diameter and 0.5-1m high). Planting in mounds allows the root system to develop before encountering the harsher soil conditions below.

Kauri grow best in sheltered areas. If planted in areas with wind gusts the root systems can be easily damaged. Wind damage can be minimised by securing young trees to stakes with cloth or pantyhose material (wire and rope ties can cause injury). Preferably, provide shelter on windy areas by planting kauri seedlings under established nurse crops (such as manuka and kanuka).

Slow release fertilizer (such as Planticote or Osmocote) can be added during the spring after planting on all soils to ensure nutrients are available for maximum growth. For the first 5 – 10 years after planting, seedlings should be monitored regularly to ensure they are not smothered by weeds or suppressed by overhead canopy.

Like any native forest plant, individual kauri are part of a larger ecosystem. All members of the community are inter-connected and are affected by one another. Care for kauri should first be based on care for the entire ecosystem/community in which it lives. Eradication of weeds and pest animal species will increase the health of the Ecosystem, improving conditions for all plant species.

Glossary

araucariaceae	a family of conifer species.
bleeding	deliberately injuring the trunks of kauri to cause gum production.
branch abscission	ability of young kauri to drop branches without knots or scars developing.
collar rot	damage to the tissues around the base of the trunk.
conifer	cone-bearing plant.
cotyledon	the first leaf of the embryo of a seed plant.
damping off	root rot disease that can cause death of kauri seedlings.
drip zone	the area of ground below the canopy of an individual tree.
endemic	native or confined to a particular area.
epicormic shoots	small shoots that grow from the lower trunk in response to sudden increase in light levels or stress.
genera	plural of genus. A taxonomic category grouping closely related species.
germinate	begin to sprout or grow.
gummosis	gum production.
humus	decomposed organic material.
lianas	variety of climbing woody vines.
moko	facial tattoo.
monoecious	plant species that produce male and female reproductive organs on the same plant
mycorrhizal fungi	fungi that have a beneficial relationship in and on the roots of host plants.
nurse crop	plants that help establishment of kauri seedlings: manuka and kanuka provide shelter for seedlings while allowing access to overhead light.
pH	a measure of acidity or alkalinity, on a scale from 0 (very acidic) to 14 (very alkaline). Neutral pH = 7.
phytophthora	the phytophthora genus is a group of destructive plant pathogens. From Greek phyton, "plant" and phthora "destruction"; "the plant destroyer".
pre-pitting	weathering soil from planting hole prior to planting.
rangatira	maori chief or of noble birth.
rootzone	area where roots grow horizontally. At least the area of the drip zone.
rickers	the term "ricker" is a reference to either the sticks used to make hay-ricks; or as a corruption of 'Riga' the Baltic port that had been a primary source of timber for British ship spars prior to development of the kauri timber industry.

References and further reading

- Bergin, D & Stewart, G. 2004. Kauri: Ecology, Establishment, Growth and Management. New Zealand Forest Research Institute Limited.
- Dwersteg, D. Recreation of pristine kauri forest (*Agathis australis*) and present forest management in Northland, New Zealand.
- Ecroyd, C.E. 1982. Biological flora of New Zealand 8. *Agathis australis* (D. Don) Lindl.* (Araucariaceae) Kauri. New Zealand Journal of Botany, 1982, Vol. 20: 17-36.
- Halkett, J & Sale, E.V. 1986. The world of the Kauri. Reed Methuen Publishers, Auckland
- Lloyd, R.C. 1977. Planting Kauri: instructions and care. New Zealand Forest Service.
- Morrison, F.T & Lloyd, R.C. 1972. Artificial establishment of New Zealand Kauri at Waipoua. New Zealand Journal of Forestry, 17(2): 264–273
- Sando, C.T. 1936. *Notes on Agathis australis. Te Kura Ngahere*, 4(1): 16–21.
- Silvester, W. B. 2006. *Managing Access to Heritage Kauri Trees*. Unpub.
- Stewart, K. 2008 Kauri. Penguin Books Ltd, London.
- Orwin, J. 2004. Kauri: Witness to a nation's history. New Holland Publishers, Auckland.
- Waitakere City Council. 2005. *Native to the West - a guide for planting and restoring the nature of Waitakere City*.
- Department of Conservation. 2001. *Protecting and restoring our natural heritage: A practical guide*.

Websites

- Kauri Dieback www.kauridieback.co.nz
- Te Ara Encyclopaedia of New Zealand www.teara.govt.nz
- The Kauri Museum www.kauri-museum.com

Images

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The creation myth

In the beginning, out of nothingness Ranginui (the sky father) and Papatuanuku (the earth mother) were created.

Rangi and Papa clung together, trapping the children they had made in a land of darkness.

The strongest child Tane mahuta (the god of the forests and creator of the forest creatures) pushed his parents apart to bring light to the land and allow his children to flourish.

The Te Roroa iwi of Waipoua forest believe Tane's legs were the giant trunks of kauri.